

The Worldwide Corrosion Authority



Corrosion Glossary ▣ Glossary Entry

Corrosion Terminology - A's

abrasion resistance—the ability of a material to resist being worn away and to maintain its original appearance and structure when subjected to rubbing, scraping, or wear.

abrasive—a solid substance that, owing to its hardness, toughness, size, shape, consistency, or other properties, is suitable for grinding, cutting, roughening, polishing, or cleaning a surface by friction or high-velocity impact.

abrasive blast cleaning—cleaning and roughening of a surface produced by the high-velocity impact of an abrasive that is propelled by the discharge of pressurized fluid from a blast nozzle or by a mechanical device such as a centrifugal blasting wheel. [also referred to as **abrasive blasting**]

abrasive blasting—see **abrasive blast cleaning**.

accelerator—a chemical substance that increases the rate at which a chemical reaction (e.g., curing) would otherwise occur.

AC impedance—see **electro-chemical impedance**.

acrylic—type of resin polymerized from acrylic acid, methacrylic acid, esters of these acids, or acrylonitrile.

activator—a chemical substance that initiates a chemical reaction (e.g., curing). Heat and radiation may also serve as activators for some chemical reactions.

active—(1) a state of a metal surface that is corroding without significant influence of reaction product. (2) the negative direction of electro-potential.

active-passive cell—an electro-chemical cell in which the anode is a metal in the active state and the cathode is the same metal in the passive state.

adductcuring agent—a material that is formed by pre-reacting the curing agent with a portion of the resin component of the coating.

adhesion—the state in which two surfaces are held together by chemical interfacial forces, mechanical interlocking forces, or both.

aeration cell—see **differential aeration cell**.

aging—(1) the process of exposing materials to an environment for an interval of time. (2) change in metallurgical properties that generally occurs slowly at room temperature (natural aging) and more rapidly at higher temperature (artificial aging).

airdrying—process by which an applied wet coat converts to a dry coating film by evaporation of solvent or reaction with oxygen as a result of simple exposure to air without intentional addition of heat or a curing agent.

airless spraying—process of spraying coating liquids using hydraulic pressure, not air pressure, to atomize.

alkyd—type of resin formed by the reaction of polyhydric alcohols and polybasic acids, part of which is derived from saturated or unsaturated oils or fats.

alligatoring—pronounced wide cracking over the surface of a coating, which has the appearance of alligator hide.

alloy steel—an iron-based alloy containing carbon (usually less than 2.5 mass percent), manganese (usually greater than 0.25 mass percent) and specified minimum quantities of one or more alloying elements other than manganese, silicon, and copper, but does not contain 10.5 mass percent or greater chromium.

alternate immersion—exposure to environmental cycles, each involving immersion in a fluid for a period of time followed

by removal from that fluid for another period of time.

amphoteric metal—a metal that is susceptible to corrosion in both acidic and alkaline environments.

anaerobic— absence of air or free (molecular) oxygen.

anchor pattern—see **surface profile**.

anion—a negatively charged ion.

anneal—heat to and hold at a temperature appropriate for the specific material and then cool at a suitable rate, for such purposes as reducing hardness, improving machineability, or obtaining desired properties.

anode—the electrode of an electro-chemical cell at which oxidation occurs. (Electrons flow away from the anode in the external circuit. It is usually the electrode where corrosion occurs, and metal ions enter solution.)

anode cap—an electrical insulating material placed over the end of the anode at the lead wire connection.

anode corrosion efficiency—the ratio of the actual corrosion (mass loss) of an anode to the theoretical corrosion (mass loss) calculated from the quantity of electricity that has passed between the anode and cathode using Faraday's law.

anodic inhibitor—a corrosion inhibitor whose primary action is to reduce the rate of the anodic reaction, producing a positive shift in corrosion potential.

anodic polarization— (1) the change of electrode potential caused by an anodic current flowing across the electrode/electrolyte interface. (2) a forced noble (positive) shift in electro-potential. [See **polarization**.]

anodic protection—a technique to reduce the corrosion rate of a metal surface by polarizing that surface to a more oxidizing potential.

anodizing—an electro-chemical oxidation process that converts the surface of a metal (such as aluminum or titanium) to an oxide coating.

anolyte—the electrolyte adjacent to the anode of an electro-chemical cell.

antifouling—preventing fouling. [See **fouling**.]

atmospheric zone—the portion of a marine structure that extends upward from the splash zone and is exposed to sun, wind, water spray, and rain.

attenuation—electrical losses in a conductor caused by current flow in the conductor.

Auger electron spectroscopy—analytical technique in which the sample surface is irradiated with low-energy electrons and the energy spectrum of electrons emitted from the surface is measured.

austenite—the face-centered cubic crystalline phase of iron or iron-based alloys.

austenitic/ferritic stainless steel—see **duplex stainless steel**.

austenitizing—forming austenite by heating iron or iron-based alloys to a temperature in the transformation range (partial austenitizing) or above the transformation range (complete austenitizing).

Auxiliary electrode—see **counter electrode**.

Corrosion Terminology - B's

back fill—material placed in a hole to fill the space around the anodes, vent pipe, and buried components of a cathodic protection system.

Barcol hardness—a hardness value obtained by measuring the resistance of rubbers, plastics, or coatings to indentation by a steel impress or under spring load in accordance with Test Method D2583.

barrier coating— (1) a coating that has a high resistance to permeation of liquids and/or gases. (2) a coating that is applied over a previously coated surface to prevent damage to the underlying coating during subsequent handling.

beach marks—the characteristic markings on the fracture surfaces produced by fatigue crack propagation. [also known as *arrest marks*, *clam shell marks*, and *conchoidal marks*]

beta curve—a plot of dynamic (fluctuating) interference current or related proportional voltage (ordinate) versus the corresponding structure-to-electrolyte potentials at a selected location on the affected structure (abscissa).

binder—the nonvolatile portion of the vehicle of a formulated coating material.

bituminous coating—an asphalt or coal-tar compound used to provide a protective coating for a surface.

blast angle— (1) the angle of the blast nozzle with reference to the surface during abrasive blast cleaning. (2) the angle of the abrasive particles propelled from a centrifugal blasting wheel with reference to the surface being abrasive blast cleaned.

blister—a dome-shaped projection on the surface of a coating resulting from the local loss of adhesion and lifting of the film from an underlying coat or from the base substrate.

blooming—see **blushing**.

blow down—(1) the injection of air or water under high pressure through a tube to the anode area for the purpose of purging the annular space and possibly correcting high resistance caused by gas blockage. [cathodic protection use] (2) the process of discharging a significant portion of the aqueous solution in order to remove accumulated salts, deposits, and other impurities. [boiler or cooling water tower use]

blushing—whitening and loss of gloss of a coating, usually organic, caused by moisture. [also known as **blooming**]

bracelet anode—a galvanic anode with geometry suitable for direct attachment around the circumference of a pipeline. This may be a half-shell bracelet consisting of two semicircular sections or a segmented bracelet consisting of a large number of individual sections.

braze—(1) a bond produced as the result of heating an assembly to the brazing temperature greater than 450 °C [840 °F] and less than the solidus temperature of the base metal using a brazing filler metal distributed and retained between the closely fitted faying surfaces of the joint by capillary action. (2) the act of creating a braze.

breakdown potential—the least noble potential at which pitting or crevice corrosion, or both, will initiate and propagate in a specific environment.

Brinell hardness—hardness value, measured in accordance with ISO 6506-1 or Test Method E10, using a 1 to 10 mm diameter tungsten carbide ball and a force of approximately 9.807 to 29.420 N (1 to 3000 kgf).

brittle fracture—fracture that occurs with little or no plastic deformation of the material. [contrast with **ductile fracture**]

brush-off blast cleaned surface—an abrasive blast cleaned steel surface that is free of all visible contaminants and foreign matter but may have some tightly adherent mill scale, rust, or coating. [See NACE No. 4/SSPC-SP 7 for detailed

specification.]

burnish—process of smoothing surfaces using frictional contact between the material and some other hard pieces of hard material (e.g., hardened steel balls).

Corrosion Terminology - C's

calcareous coating—a layer consisting of calcium carbonate and other salts deposited on the surface. When the surface is cathodically polarized as in cathodic protection, this layer is the result of the increased pH adjacent to the protected surface.

calcareous deposit—see **calcareous coating**.

carbon steel—alloy of carbon and iron containing up to 2 mass percent carbon and up to 1.65 mass percent manganese and residual quantities of other elements, except those intentionally added in specific quantities for deoxidation (usually silicon and/or aluminum).

carburizing—the absorption and diffusion of carbon in iron or an iron-based alloy in contact with a suitable carbonaceous environment at elevated temperature.

case hardening—hardening a ferrous alloy so that the outer portion, or case, is made substantially harder than the inner portion, or core. Typical processes are carburizing, cyaniding, carbonitriding, nitriding, induction hardening, and flame hardening.

case in paint—water-thinned paint with vehicle derived from milk.

casting— (1) a component formed at or near its finished shape by the solidification of liquid material in a mold; (2) the creation of such a component.

catalyst—a chemical substance, usually present in small amounts relative to the reactants, that increases the rate at which a chemical reaction (e.g., curing) would otherwise occur, but is not consumed in the reaction.

cathode—the electrode of an electro-chemical cell at which reduction is the principal reaction. (Electrons flow toward the cathode in the external circuit.)

cathodic corrosion—corrosion of a metal when it is a cathode, usually caused by the reaction of an amphoteric metal with the alkaline products of electrolysis.

cathodic disbondment—the destruction of adhesion between a coating and the coated surface caused byproducts of a cathodic reaction.

cathodic inhibitor—a corrosion inhibitor whose primary action is to reduce the rate of the cathodic reaction, producing a negative shift in corrosion potential.

cathodic polarization— (1) the change of electrode potential caused by a cathodic current flowing across the electrode/electrolyte interface. (2) a forced active(negative) shift in electrode potential. [See **polarization**.]

cathodic protection—a technique to reduce the corrosion rate of a metal surface by making that surface the cathode of an electro-chemical cell.

catholyte—the electrolyte adjacent to the cathode of an electro-chemical cell.

cation—a positively charged ion.

caustic cracking—cracking of a metal or alloy under the combined action of tensile stress and corrosion in the presence of a strongly basic solution (e.g., sodium hydroxide, potassium hydroxide).

caustic embrittlement—an obsolete term referring to **caustic cracking**.

cavitation—the formation and rapid collapse of cavities or bubbles of vapor or gas within a liquid resulting from mechanical or hydrodynamic forces.

cavitation-corrosion—the conjoint action of cavitation and corrosion.

cavitation damage—the degradation of a solid body resulting from its exposure to cavitation. (This may include loss of material, surface deformation, or changes in properties or appearance.)

cavitation-erosion—the conjoint action of cavitation and erosion.

cell—see **electro-chemical cell**.

cementation—the introduction of one or more elements into the surface layer of a metal or alloy by diffusion at high temperature. (Examples of cementation include carburizing [introduction of carbon], nitriding [introduction of nitrogen], and chromizing [introduction of chromium].)

cementite—iron carbide (Fe_3C) when referred to as a microstructural constituent of steel.

chalking—the development of loose, removable powder (pigment) at the surface of an organic coating, usually caused by weathering.

checking—the development of slight breaks in a coating that do not penetrate to the underlying surface.

chemical conversion coating—an adherent, reaction-product layer on a metal surface formed in situ by reaction with a suitable chemical, used for protective, decorative, or functional purposes. (It is often used to provide greater corrosion resistance or prepare the surface prior to the application of an organic coating.)

chevron pattern—a V-shaped pattern on a fatigue or brittle-fracture surface. The pattern can also be one of straight radial lines on cylindrical specimens.

chipping— (1) removing coating and surface contaminants from a substrate in small pieces by cutting, striking, or applying mechanical force; (2) a failure mechanism in which small pieces or fragments of a material or coating are removed by mechanical damage, loss of adhesion, or both. [contrast with **peeling**]

chloride stress corrosion cracking—cracking of a metal under the combined action of tensile stress and corrosion in the presence of an electrolyte containing dissolved chlorides.

cleavage fracture—fracture that occurs along planes determined by the crystal structure of the material. (It is typically associated with a brittle fracture.)

coat—one layer of a coating system applied to a surface in a single continuous application to form a uniform film when dry.

coating— (1) a liquid, liquefiable, or mastic composition that, after application to a surface, is converted into a solid protective, decorative, or functional adherent film. (2) (in a more general sense) a thin layer of solid material on a surface that provides improved protective, decorative, or functional properties.

coating system—the complete number and types of coats applied to a substrate in a predetermined order. (When used in a broader sense, surface preparation, pretreatments, dry film thickness, and manner of application are included.)

cold cracking—cracking of a weld during or after cooling to ambient temperature, sometimes after a considerable time delay. (It usually occurs at temperatures less than 205 °C [400 °F] for metals, and less than the glass transition temperature for plastics.)

cold lap—a linear discontinuity with rounded edges at exposed surfaces that is caused by solidification of the meniscus of a partially cast metal or alloy (e.g., an anode used for cathodic protection) as a result of interrupted flow of the casting stream or the joining of two casting streams at too low a temperature.

cold shut—horizontal surface discontinuity caused by solidification of a portion of a meniscus during the progressive filling of a mold, which is later covered with more solidifying metal as the molten metal level rises. Cold shuts generally occur at corners remote from the point of pour.

cold working—deforming metal plastically under conditions of temperature and strain rate that induce strain hardening, usually, but not necessarily, performed at room temperature [contrast with **hot working**]

commercial blast cleaned surface—an abrasive blast cleaned steel surface that is free of all visible contaminants and foreign matter but may have some random staining on no more than 33 percent of the surface area. [See NACE No.3/SSPC-SP 6 for detailed specification.]

compressive strength—the maximum compressive stress a material is capable of withstanding without sustaining

permanent deformation.

concentration cell—an electro-chemical cell, the electromotive force of which is caused by a difference in concentration of some component in the electrolyte. (This difference leads to the formation of discrete cathodic and anodic regions.)

concentration polarization—that portion of polarization of an electro-chemical cell produced by concentration changes resulting from current flowing through the electrolyte.

conductive coating— (1) a coating that conducts electricity. (2) an electrically conductive, mastic-like material used as an impressed current anode on reinforced concrete surfaces.

conductive concrete—a highly conductive cement-based mixture containing coarse and fine coke and other material used as an impressed current anode on reinforced concrete surfaces.

conductivity— (1) a measure of the ability of a material to conduct an electric charge. (2) the current transferred across a material (e.g., coating) per unit area per unit potential gradient. (Conductivity is the reciprocal of resistivity.)

contact corrosion—see **galvanic corrosion**.

continuity bond—a connection, usually metallic, that provides electrical continuity between structures that can conduct electricity.

continuous anode—a single anode with no electrical discontinuities.

conversion coating—see **chemical conversion coating**.

copper sulfate test— (1) a test method in which a solution of copper sulfate, and possibly other ingredients, in water is swabbed onto the surface of certain metals to determine the presence of metals more active (anodic) than copper. (2) a spot test method in which a 5 to 10 percent solution of copper sulfate in water is swabbed onto a steel surface to determine whether mill scale is present. (The appearance of copper indicates that mill scale is not present.)

corrosion—the deterioration of a material, usually a metal, that results from a chemical or electro-chemical reaction with its environment.

corrosion-inhibitive pigment—a pigment that, when formulated into a liquid coating material, has the property of reducing corrosion of the metal substrate to which the coating is applied.

corrosion fatigue—the process wherein a metal fractures prematurely under conditions of simultaneous corrosion and repeated cyclic loading at lower stress levels or fewer cycles than would be required to cause fatigue of that metal in the absence of the corrosive environment.

corrosion fatigue strength—the maximum repeated stress that can be endured by a metal without fracture under definite conditions of corrosion and cyclic loading for a specific number of stress cycles and a specified period of time.

corrosion inhibitor—a chemical substance or combination of substances that, when present in the proper concentration and forms in the environment, reduces the corrosion rate.

corrosion potential— (represented by the symbol E_{corr}) the potential of a corroding surface in an electrolyte measured under open-circuit conditions relative to a reference electrode. [also known as **electro-chemical corrosion potential, free corrosion potential, open-circuit potential**]

corrosion rate—the time rate of change of corrosion. (It is typically expressed as mass loss per unit area per unit time, penetration per unit time, etc.)

corrosion resistance—ability of a material, usually a metal, to withstand corrosion in a given environment.

corrosiveness—the tendency of an environment to cause corrosion.

counter electrode—the electrode in an electro-chemical cell that is used to transfer current to or from a working electrode.

counter poise—a conductor or system of conductors arranged beneath a power line, located on, above, or most frequently, below the surface of the earth and connected to the footings of the towers or poles supporting the power line.

couple—see **galvanic couple**.

coupon—a portion of a material or sample, usually flat, but occasionally curved or cylindrical, from which one or more specimens can be taken for testing.

crack— (1) a partial split or break. (2) a split or break in a coating that penetrates to the substrate.

cracking—fracture of a material along a path that produces a linear discontinuity (without complete separation).

crater— (1) a metal surface anomaly consisting of a bowl-shaped cavity with the minimum dimension at the opening greater than the depth. [contrast with **pit**] (2) a small, rounded dish or bowl-like depression in a wet-applied coating. [contrast with **fish eye**]

crazing—a network of checks or cracks appearing on the surface of a coating.

creep—time-dependent strain occurring under stress.

creep strength—that stress which, when applied to a material at a specific temperature, will cause a specified amount of elongation in a specified time.

crevice corrosion—localized corrosion of a metal or alloy surface at, or immediately adjacent to, an area that is shielded from full exposure to the environment because of close proximity of the metal or alloy to the surface of another material or an adjacent surface of the same metal or alloy.

critical anodic current density—the maximum anodic current density observed in the active region for a metal or alloy electrode that exhibits active-passive behavior in an environment.

Critical humidity—the relative humidity above which the atmospheric corrosion rate of a specific metal or alloy increases sharply.

critical pitting potential— (represented by the symbol E_p or E_{pp}) the least noble potential at which pitting corrosion will initiate and propagate in a specific environment. [See **breakdown potential**.]

curing—chemical process of developing the intended properties of a coating or other material (e.g., resin) over a period of time.

curing agent—a chemical substance used for curing a coating or other material (e.g., resin).[also referred to as **hardener**]

curing time—the minimum period between application and the time at which the applied material attains its intended physical properties.

current— (1) a flow of electric charge. (2) the amount of electric charge flowing past a specified circuit point per unit time, measured in the direction of net transport of positive charges. (In a metallic conductor, this is the opposite direction of the electron flow.)

current density—the electric current flowing to or from a unit area of an electrode surface.

current efficiency—the ratio of the electro-chemical equivalent current density for a specific reaction to the total applied current density.

Corrosion Terminology - D's

DC decoupling device—a device used in electrical circuits that allows the flow of alternating current in both directions and stops or substantially reduces the flow of direct current.

deactivation—the process of prior removal of the active corrosive constituents, usually oxygen, from a corrosive liquid by controlled corrosion of expendable metal or by other chemical means, thereby making the liquid less corrosive.

dealloying—a corrosion process whereby one constituent of an alloy is preferentially removed, leaving an altered residual structure. [also known as **parting**, **selective dissolution**, or **selective leaching**]

decomposition potential—the potential of an electrode surface at which the electrolyte, or a component thereof, decomposes by electrolysis.

decomposition voltage—see **decomposition potential**.

deep ground bed—one or more anodes installed vertically at a nominal depth of 15 m (50 ft) or more below the earth's surface in a drilled hole for the purpose of supplying cathodic protection current.

delamination— (1) separation of layers in a material. (2) a separation between one or more coats from another coat within a coating system. [contrast with **disbondment**] (3) a separation of the concrete (usually in layers) from therein forcing steel at their interface, usually as a result of corrosion.

delayed cracking— (1) cracking in a metal occurring after plating or pickling, sometimes after a considerable time delay. (2) not a preferred term for **cold cracking**.

depolarization— (not a preferred term) the removal of factors resisting the current flow in an electro-chemical cell. [See **polarization**.]

deposit corrosion—localized corrosion under or around a deposit or collection of material on a metal surface. [also called **poultice corrosion**] [See also **crevice corrosion**.]

dezincification—dealloying that results in the selective removal of zinc from copper-zinc alloys.

dielectric coating—a coating that does not conduct electricity.

dielectric shield—an electrically nonconductive material, such as a coating, sheet or pipe, that is placed between an anode and an adjacent cathode, usually on the cathode, to improve current distribution in a cathodic protection system.

differential aeration cell—a concentration cell caused by differences in oxygen concentration along the surface of a metal in an electrolyte [See **concentration cell**]

diffusion-limited current density—the current density that corresponds to the maximum transfer rate that a particular species can sustain because of the limitation of diffusion [often referred to as **limiting current density**]

disbondment—the loss of adhesion between a coating and the substrate.

discontinuity—(1) an interruption in the normal physical structure or configuration of a coating such as cracks, laps, seams, inclusions, porosity, or holidays. (A discontinuity does not necessarily affect the usefulness of the coating.) (2) a condition in which the electrical path through a structure is interrupted by a device that acts as a dielectric or insulating fitting.

dissimilar metals—different metals that could form an anode-cathode relationship in an electrolyte when connected by an electron-conducting (usually metallic) path.

double layer—the interface between an electrode or a suspended particle and an electrolyte created by charge-charge interaction leading to an alignment of oppositely charged ions at the surface of the electrode or particle. The simplest model

is represented by a parallel plate condenser.

doubler plate—an additional plate or thickness of metal used to provide extra strength or thickness to a structure locally (e.g., at the point of anode attachment to an offshore structure).

drainage—conduction of electric current from an underground or submerged metallic structure by means of a metallic conductor.

driving potential—difference in potential between the anode and the steel structure.

dry film thickness—the thickness of a dried film, coating, or membrane.

dry spray—a rough, powdery noncoherent film produced when atomized coating particles partially dry before reaching the surface.

dry to handle—stage of drying or curing of an applied coating at which time the coated object can be carefully handled without damage.

dry to recoat—stage of drying or curing of an applied coating at which time a subsequent coat can be applied satisfactorily.

dry to touch—stage of drying or curing of an applied coating at which time it no longer adheres to a finger that is lightly touched or rubbed across the surface and does not show a fingerprint at the point of contact.

drying—the process in which a liquid film is converted to a solid film by evaporation of volatile components.

drying oil—an oil capable of conversion from a liquid to a solid by slow reaction with oxygen in the air.

drying time—minimum time required for an applied coating to reach the desired stage of drying or curing.

ductile cast iron—cast iron that has been treated while molten with an element (usually magnesium or cerium) that spheroidizes the graphite. [also called **nodular cast iron**].

ductile fracture—fracture that occurs with appreciable plastic deformation of the material. [contrast with **brittle fracture**]

ductility—the ability of a material to withstand plastic deformation prior to fracture. (It is usually measured by the permanent elongation or reduction in the cross-sectional area of a fractured tensile test specimen.)

duplex stainless steel—stainless steel whose microstructure at room temperature consists primarily of a mixture of austenite and ferrite. [also called **austenitic/ferritic stainless steel**].

Corrosion Terminology - E's

elastic deformation—changes of dimensions of a material upon the application of a stress within the elastic range. Following the release of an elastic stress, the material returns to its original dimensions without any permanent deformation.

elasticity—the property of a material that allows it to recover its original dimensions following deformation by a stress below its elastic limit.

elastic limit—the maximum stress to which a material may be subjected without retention of any permanent deformation after the stress is removed.

electrical interference—any electrical disturbance on a metallic structure in contact with an electrolyte caused by stray current(s).

electrical isolation—the condition of being electrically separated from other metallic structures or the environment.

electro-chemical admittance—the reciprocal of the electro-chemical impedance, D_I/DE .

electro-chemical cell— (1) an electro-chemical reaction involving two half reactions, one of which involves oxidation of the reactant(product) and the other of which involves reduction of the product (reactant).(The equilibrium potential of the electro-chemical cell can be calculated from the change in free energy for the overall electro-chemical reaction. The equilibrium potential of the electro-chemical cell can be measured by separating the oxidation and reduction half reactions into individual compartments and measuring the voltage that develops between them under conditions that virtually no charge passes between them.) [thermodynamic use] (2) an electro-chemical system consisting of an anode and a cathode in metallic contact and immersed in an electrolyte. (The anode and cathode may be different metals or dissimilar areas on the same metal surface.) [common use]

electro-chemical corrosion potential—see **corrosion potential**.

electro-chemical equivalent—the mass of an element or group of elements oxidized or reduced at 100 percent efficiency by the passage of a unit quantity of charge such as a Faraday (96,485 coulombs), ampere-hour, or coulomb.

electro-chemical impedance—the frequency dependent, complex valued proportionality factor, D_I/DE , between the applied potential (or current) and the response current (or potential) in an electro-chemical cell. This factor becomes the impedance when the perturbation and response are related linearly (the factor value is independent of the perturbation magnitude) and the response is caused only by the perturbation. The value may be related to the corrosion rate when the measurement is made at the corrosion potential.

electro-chemical noise—fluctuations of potential or current, or both, originating from uncontrolled variations in a corrosion process.

electro-chemical potential—the partial derivative of the total electro-chemical free energy of the system with respect to the number of moles of the constituent in a solution when all other factors are constant. (Analogous to the chemical potential of the constituent except that it includes the electrical as well as the chemical contributions to the free energy.)

electrode—a material that conducts electrons, is used to establish contact with an electrolyte, and through which current is transferred to or from an electrolyte.

electrode potential—the potential of an electrode in an electrolyte as measured against a reference electrode.

electro-kinetic potential—a potential difference in a solution caused by residual, unbalanced charge distribution in the adjoining solution, producing a double layer. (The electro-kinetic potential is different from the electrode potential in that it occurs exclusively in the solution phase. This potential represents the reversible work necessary to bring a unit charge from infinity in the solution up to the interface in question but not through the interface.) [also known as **zeta potential**]

electrolysis—production of chemical changes of the electrolyte by the current flowing through an electro-chemical cell.

electrolyte—a chemical substance containing ions that migrate in an electric field.

electrolytic corrosion—not a proper term, but sometimes incorrectly used to refer to **galvanic corrosion**, **stray-current corrosion**, or any form of electro-chemical corrosion.

electrolytic cleaning—a process for removing soil, scale, or corrosion products from a metal surface by subjecting the metal as an electrode to an electric current in an electrolytic bath.

electromotive force series—a list of elements arranged according to their standard electrode potentials, the sign being positive for elements whose potentials are more noble than hydrogen such as gold and negative for those more active than hydrogen such as zinc. [not to be confused with **galvanic series**]

electro-osmosis—the migration of water through a semipermeable membrane as a result of a potential difference caused by the flow of electric charge through the membrane.

ellipsometry—an optical technique wherein plane-polarized light is focused on a surface and the reflected beam is analyzed to determine the phase shift of the components of the light to provide information on the properties of films that may be present on the surface.

embrittlement—reduction of ductility, or toughness, or both, of a material (usually a metal or alloy).

EMF series—see **electromotive force series**.

enamel— (1) a paint that dries to a hard, glossy surface. (2) a coating that is characterized by an ability to form a smooth, durable film.

end effect—the more rapid loss of anode material at the end of an anode, compared with other surfaces of the anode, resulting from higher current density.

endurance limit—the maximum stress that a material can withstand for an infinitely large number of fatigue cycles.

environment—the surroundings or conditions (physical, chemical, mechanical) in which a material exists.

environmental cracking—cracking of a material wherein an interaction with its environment is a causative factor in conjunction with tensile stress, often resulting in brittle fracture of an otherwise ductile material. [also known as **environmentally assisted cracking**] Discussion—Environmental cracking is a general term that includes the terms listed below. The definitions of these terms are listed elsewhere in this document: **caustic cracking**, **chloride stress corrosion cracking**, **stress corrosion cracking**, **sulfide stress cracking**. Discussion—The following terms have been used in the past in connection with environmental cracking but are now obsolete and should not be used: **caustic embrittlement**, *delayed cracking*, *liquid metal embrittlement*, **season cracking**, *static fatigue*, *sulfide corrosion cracking*, *sulfide stress corrosion cracking*.

environmentally assisted cracking—see **environmental cracking**.

epoxy—type of resin formed by the reaction of aliphatic or aromatic polyols (such as bisphenol) with epichlorohydrin and characterized by the presence of reactive oxirane end groups.

equilibrium potential—the potential of an electrode in an electrolyte at which the forward rate of a given reaction is exactly equal to the reverse rate. (The equilibrium potential can only be defined with respect to a specific electro-chemical reaction.) [also known as **reversible potential**]

erosion—the progressive loss of material from a solid surface resulting from mechanical interaction between that surface and a fluid, a multi-component fluid, or solid particles carried with the fluid.

erosion-corrosion—a conjoint action involving erosion and corrosion in the presence of a moving corrosive fluid or a material moving through the fluid, leading to accelerated loss of material.

exchange current density—the rate of charge transfer per unit area when an electrode reaches dynamic equilibrium (at its reversible potential) in a solution; that is, the rate of anodic charge transfer (oxidation) is exactly equal to the rate of cathodic charge transfer (reduction).

exfoliation corrosion—subsurface corrosion that proceeds laterally from the sites of initiation along planes parallel to the surface

forming corrosion products that force metal away from the body of the material, giving rise to a layered appearance resembling the pages of a book.

external circuit—the wires, connectors, measuring devices, current sources, etc., that are used to bring about or measure the desired electrical conditions within an electro-chemical cell. It is this portion of the cell through which electrons travel.

Corrosion Terminology - F's

fatigue—the process of progressive localized permanent structural change occurring in a material subjected to fluctuating stresses less than the ultimate tensile strength of the material that may culminate in cracks or complete fracture after a sufficient number of fluctuations.

fatigue strength—the maximum stress that can be sustained for a specified number of cycles without fracture.

fault current—a current that flows from one conductor to ground or to another conductor as a result of an abnormal connection (including an arc) between the two. A fault current flowing to ground may be called a ground fault current.

feather edging—see **feathering**.

feathering—reducing the thickness of the edges of an undamaged coating film, such as adjacent to a damaged coating or rusted area, by abrasion or sanding to produce a smoothly tapered transitional area prior to re-coating.

ferrite—the body-centered cubic crystalline phase of iron or iron-based alloys.

ferritic stainless steel—stainless steel whose microstructure at room temperature consists predominantly of ferrite.

ferritic steel—a steel whose microstructure at room temperature consists predominantly of ferrite.

fiberglass-reinforced plastic—a resin-rich coating or lining into which layers of fiberglass reinforcement have been incorporated to produce mechanical and physical properties superior to the base resin itself.

filiform corrosion—corrosion that occurs under some coatings in the form of randomly distributed thread like filaments.

film—a thin, not necessarily visible layer of material.

finish coat—see **topcoat**.

fisheye—a small dimple or crater with a visible defect or contaminant in the central area resembling a fisheye that forms in a wet-applied coating. [see **crater**]

forced drainage—drainage applied to underground or submerged metallic structures by means of an applied electromotive force or sacrificial anode.

foreign structure—any metallic structure that is not intended as a part of a system under cathodic protection.

fouling—an accumulation of deposits. (This includes accumulation and growth of marine organisms on a submerged surface and the accumulation of deposits on heat exchanger tubing.)

fractography—descriptive treatment of fracture, especially in metals, with specific reference to photographs of the fracture surface.

fracture mechanics—a quantitative analysis for evaluating structural reliability in terms of applied stress, crack length, and specimen geometry.

free corrosion potential—see **corrosion potential**.

free machining—the machining characteristics of an alloy to which an ingredient has been introduced to give small broken chips, lower power consumption, better surface finish, and longer tool life.

fretting corrosion—deterioration at the interface between contacting surfaces as the result of corrosion and slight oscillatory slip between the two surfaces.

furan—type of resin formed by the polymerization or polycondensation of furfuryl, furfuryl alcohol, or other compounds containing a furan ring.

Corrosion Terminology - G's

galvanic anode—a metal that provides sacrificial protection to another metal that is more noble when electrically coupled in an electrolyte. This type of anode is the electron source in one type of cathodic protection.

galvanic corrosion—accelerated corrosion of a metal because of an electrical contact with a more noble metal or nonmetallic conductor in a corrosive electrolyte.

galvanic couple—a pair of dissimilar conductors, commonly metals, in electrical contact in an electrolyte.

galvanic current—the electric current flowing between metals or conductive nonmetals in a galvanic couple.

galvanic series—a list of metals and alloys arranged according to their corrosion potentials in a given environment.

galvanized coating—(1) a coating of zinc on steel that contains an interfacial interdiffusion layer of zinc and iron, forming a metallurgical bond at the steel surface; (2) [not preferred] a coating of metallic zinc applied by hot-dipping, mechanical means, electroplating or other means.

galvanizing—(1) applying a coating of zinc. (2) see **galvanized coating**.

galvanodynamic—refers to a technique wherein current, continuously varied at a selected rate, is applied to an electrode in an electrolyte.

galvano staircase—refers to a galvano step technique for polarizing an electrode in a series of constant current steps wherein the time duration and current increments or decrements are equal for each step.

galvanostatic—refers to a technique wherein an electrode is maintained at a constant current in an electrolyte.

galvano step—refers to a technique wherein an electrode is polarized in a series of current increments or decrements.

general corrosion—corrosion that is distributed more-or-less uniformly over the surface of a material.

grain—an individual crystal in a solid metal or alloy in which the atoms are arranged in an orderly pattern.

grain boundary—an interface separating two grains.

grain dropping—the dislodgement and loss of a grain or grains (crystals) from a metal surface as a result of inter granular corrosion.

graphitic corrosion—deterioration of cast iron wherein the metallic constituents are selectively leached or converted to corrosion products, leaving the graphitic particles intact. [should not be used as a term to describe **graphitization**]

graphitization—the formation of graphite in iron or steel, usually from decomposition of iron carbide at elevated temperatures. [should not be used as a term to describe **graphitic corrosion**]

graycast iron—cast iron that displays a gray fracture surface as a result of the presence of flake graphite.

grit—small particles of hard material (e.g., iron, steel, or mineral) with irregular shapes that are commonly used as an abrasive in abrasive blast cleaning.

gritblasting—abrasive blast cleaning using grit as the abrasive.

ground bed—one or more anodes installed below the earth's surface for the purpose of supplying cathodic protection current.

Corrosion Terminology - H's

half-cell— (1) the single oxidation or reduction half reactions in the complete electro-chemical cell. (The potential of a half-cell can only be calculated from the thermodynamic properties of its components.) [thermodynamic use] (2) commonly used in the field to refer to a **reference electrode**, but this is not a preferred use.

half-cell potential—the potential in a given electrolyte of one electrode of a pair relative to a standard state or a reference state. (Potentials can only be measured and expressed as the difference between the half-cell potentials of a pair of electrodes.)

hand tool cleaning—removal of loose rust, loose mill scale, and loose coating by hand chipping, scraping, sanding, and wire brushing. [See SSPC-SP 2.]

hardener—see **curing agent**.

hardness— (1) resistance of a material to plastic deformation, usually by indentation. (2) the concentration of inorganic polyvalent cations (generally calcium and magnesium) in water.

heat-affected zone—that portion of the base metal that is not melted during brazing, cutting, or welding, but whose microstructure and properties are altered by the heat of these processes.

heat treatment—heating and cooling a solid metal or alloy in such a way as to obtain desired properties. Heating for the sole purpose of hot working is not considered heat treatment.

high-pressure water cleaning—water cleaning performed at pressures from 34 to 70 MPa (5,000 to 10,000 psig).

high-pressure water jetting—water jetting performed at pressures from 70 to 210 MPa (10,000 to 30,000 psig).

high-temperature hydrogen attack—a loss of strength and ductility of steel by high-temperature reaction of absorbed hydrogen with carbides in the steel, resulting in decarburization and internal fissuring.

holiday—a discontinuity in a protective coating that exposes unprotected surface to the environment.

holiday detection—testing of a coating system for holidays using an instrument that applies a voltage between the external surface of the coating and a conductive substrate.

hot corrosion—an accelerated corrosion of metal surfaces that results from the combined effect of oxidation and reactions with sulfur compounds and other contaminants, such as chlorides, to form a molten salt on a metal surface that fluxes, destroys, or disrupts the normal protective oxide.

hot-dip galvanizing—applying a coating of zinc by immersion in a bath of molten zinc.

hot working—deforming metal plastically under conditions of temperature and strain rate that recrystallization takes place simultaneously with the deformation, thus avoiding any strain hardening. [contrast with **cold working**]

hydrogen blistering—the formation of subsurface planar cavities, called hydrogen blisters, in a metal resulting from excessive internal hydrogen pressure. Growth of near-surface blisters in low-strength metals usually results in surface bulges.

hydrogen embrittlement—embrittlement caused by the presence of hydrogen within a metal or alloy.

hydrogen-induced cracking—stepwise internal cracks that connect adjacent hydrogen blisters on different planes in the metal, or to the metal surface. [also known as **stepwise cracking**]

hydrogen over voltage—over voltage associated with the liberation of hydrogen gas.

hydrogen stress cracking—cracking of a metal or alloy under the combined action of tensile stress and the presence of hydrogen in the metal or alloy.

Corrosion Terminology - I's

immunity—a state of resistance to corrosion of a metal in which the metal itself is more thermodynamically stable than its possible corrosion products. (In practical situations, immunity is assumed when the equilibrium concentration of corrosion products is negligible [typically less than 10^{-6} mol/L].)

impact resistance—ability of a material to resist damage from impact.

impingement corrosion—a form of erosion-corrosion generally associated with the local impingement of a high-velocity, flowing fluid against a solid surface.

impressed current—an electric current supplied by a device employing a power source that is external to the electrode system. (An example is direct current for cathodic protection.)

impressed current anode—an electrode, suitable for use as an anode when connected to a source of impressed current. (It is often composed of a substantially inert material that conducts by oxidation of the electrolyte and, for this reason, is not corroded appreciably.)

impulse dielectric test—a method of applying voltage to an insulated wire through the use of electric pulses (usually 170 to 250 pulses per second) to determine the integrity of the wire's insulation.

inclusion—a nonmetallic phase such as an oxide, sulfide, or silicate particle in a metal.

Inorganic zinc-rich coating—coating containing a metallic zinc pigment (typically 75 mass percent zinc or more in the dry film) in an inorganic vehicle.

instant-off potential—the polarized half-cell potential of an electrode taken immediately after the cathodic protection current is stopped, which closely approximates the potential without IR drop (i.e., the polarized potential) when the current was on.

intentiostatic—see **galvanostatic**.

intercrystalline corrosion—see **intergranular corrosion**.

interdendritic corrosion—corrosion of cast metals that progresses preferentially along paths between dendrites.

interference bond—an intentional metallic connection, between metallic systems in contact with a common electrolyte, designed to control electrical current interchange between the systems.

interference bond—an intentional metallic connection, between metallic systems in contact with a common electrolyte, designed to control electrical current interchange between the systems.

interference current—see **stray current**.

intergranular stress corrosion cracking—stress corrosion cracking in which the cracking occurs along grain boundaries.

internal oxidation—the formation of isolated particles of oxidation products beneath the metal surface.

intumescence—the swelling or bubbling of a coating usually caused by heating. (The term is commonly used in aerospace and fire-protection applications.)

ion—an electrically charged atom or group of atoms.

IR drop—the voltage across a resistance when current is applied in accordance with Ohm's law.

iron rot—deterioration of wood in contact with iron-based alloys.

Isocorrosion curve—a line drawn linking all points on a graph that have equal corrosion rates.

Isocorrosion diagram—a graph on which the axes represent environmental parameters (e.g., concentration, temperature, pressure, velocity) and on which one or more iso corrosion curves are drawn.

Corrosion Terminology - K's ▼

knife-line attack—intergranular corrosion of an alloy along an arrow band adjoining or in contact with a weld.

Corrosion Terminology - L's

lamellar corrosion—see **exfoliation corrosion**.

Langelier Saturation Index—a number calculated from total dissolved solids, calcium concentration, total alkalinity, pH, and solution temperature that shows the tendency of a water solution to precipitate or dissolve calcium carbonate, wherein an index less than -0.3 indicates that the water tends to be corrosive, while an index greater than $+0.3$ indicates scale forming potential. [also called *Langelier Index* or *Saturation Index*]

latex paint—a paint containing a stable aqueous dispersion of synthetic resin, produced by emulsion polymerization, as the principal constituent of the binder. (Modifying resins may also be present.)

leveling— (1) the process whereby a wet-applied coating flows out after application to minimize any surface irregularities produced by the process of application. (2) smoothing of a surface by electro-chemical means to reduce surface roughness. (3) flattening of sheet or plate.

lifting—softening and raising or wrinkling of a previous coat by the application of a subsequent coat.

limiting current density—see **diffusion-limited current density**.

line current—the direct current flowing in a pipeline.

lining—a coating or layer of sheet material adhered to or in intimate contact with the interior surface of a container used to protect the container against corrosion by its contents and/or to protect the contents of the container from contamination by the container material.

liquid metal cracking—environmental cracking caused by contact with a liquid metal.

local corrosion cell—an electro-chemical cell created on a metal surface because of a difference in potential between adjacent areas on that surface.

localized corrosion—corrosion at discrete sites (e.g., pitting or crevice corrosion).

long-line current—current flowing through the earth between an anodic and a cathodic area that returns along an underground metallic structure. (Usually used only where the areas are separated by considerable distance and where the current flow results from concentration-cell action.)

low-alloy steel—alloy steel with a total alloying element content of less than approximately 5 mass percent.

low-carbon steel—steel having less than 0.30 mass percent carbon and no intentional alloying additions.

low-pressure water cleaning—water cleaning performed at pressures less than 34 MPa (5,000 psig). [also called *power washing* or *pressure washing*]

Luggin capillary—see **Luggin-Haber probe**.

Luggin-Haber probe—device used in measuring the potential of an electrode with a significant current density imposed on its surface. (The probe minimizes the IR drop that would otherwise be included in the measurement and without significantly disturbing the current distribution on that electrode.) [also called **Luggin capillary** or **Luggin probe**]

Luggin probe—see **Luggin-Haber probe**.

Corrosion Terminology - M's

macro cell corrosion—corrosion of a metal embedded in porous media (e.g., concrete or soil) caused by concentration or galvanic cells that exist on a scale at least as large as the smallest major dimension of the corroding item (e.g., the diameter of a bar or pipe).

malleable cast iron—white cast iron that is thermally treated to convert most or all of the cementite to graphite (temper carbon).

martensite—a hard, body-centered cubic phase of iron supersaturated with carbon, usually produced by rapid cooling.

martensitic steel—steel in which a microstructure of martensite can be attained by quenching at a cooling rate fast enough to avoid the formation of other micro structures.

mastic—(1) aromatic resin of the mastic tree, commonly used in lacquers and varnishes. (2) a material of relatively viscous, paste-like consistency that can be poured when heated but often requires mechanical manipulation (e.g., using a trowel) to apply, which dries or cures to form a thick protective coating. (Mastics usually contain fillers, such as powdered lime or graded mineral aggregate, to produce the desired consistency.)

metal dusting—accelerated deterioration of a metal or alloy exposed to a carbonaceous or nitrogenous gas at elevated temperatures that forms a dust-like corrosion product.

metallizing—the coating of a surface with a thin metal layer by thermal spraying, hot dipping, or vacuum deposition.

microbiologically influenced corrosion—corrosion affected by the presence or activity, or both, of microorganisms.

mill scale—the oxide layer formed during hot fabrication or heat treatment of metals.

mist coat—a thin tack coat, applied as a mist of spray, used to improve adhesion of a new coat to an existing partially cured coat or to displace air in a porous substrate.

mixed potential—a potential resulting from two or more electro-chemical reactions occurring simultaneously on one metal surface.

modulus of elasticity—a measure of the stiffness or rigidity of a material. It is actually the ratio of stress to strain in the elastic region of a material if determined by a tension or compression test. [also called *Young's Modulus* or *coefficient of elasticity*]

mud zone—that portion of a structure that is located below the interface of a water body with its respective sea-, lake-, or riverbed and is covered by mostly solid material.

Corrosion Terminology - N's

natural drainage—current drainage from an underground or submerged metallic structure to a more negative (more anodic) structure, such as the negative bus of a trolley substation.

near-white metal blast cleaned surface—an abrasive blast cleaned steel surface that is free of all visible contaminants and foreign matter but may have some random staining on no more than 5 percent of the surface area. [See NACE No. 2/SSPC-SP10 for detailed specification.]

negative return—a point of connection between the cathodic protection negative cable and the protected structure.

Nernst equation—an equation that expresses the potential of an electro-chemical reaction in terms of the activities of its products and reactants.

Nernst layer—the diffusion layer at the surface of an electrode in which the concentration of a chemical species is assumed to vary linearly from the value in the bulk solution to the value at the electrode surface.

nitriding—the absorption and diffusion of nitrogen in metallic materials (most commonly ferrous alloys). (Typical processes for intentional nitriding include, but are not limited to, liquid nitriding, gas nitriding, and ion or plasma nitriding.)

noble—the positive (increasingly oxidizing) direction of electrode potential.

noble metal—a metal with a standard electrode potential more positive than that of hydrogen.

noble potential—a potential more positive than the standard hydrogen potential.

nodular cast iron—see **ductile cast iron**.

normalizing—heating a ferrous alloy to a suitable temperature above the transformation range (austenitizing), holding at temperature for a suitable time, and then cooling in still air to a temperature substantially below the transformation range.

Corrosion Terminology - O's

occluded cell—an electro-chemical cell created at a localized site on a metal surface that has been partially obstructed from the bulk environment.

opacity—the degree of obstruction to the transmission of visible light or to which a material obscures a substrate.

open-circuit potential—see **corrosion potential**.

orange peel— (1) the dimpled appearance of a dried coating resembling the surface of a navel orange. (2) The rough appearance of a metal surface resulting from large grain size and deformation.

organic zinc-rich coating—coating containing a metallic zinc pigment (typically 75 mass percent zinc or more in the dry film) in an organic vehicle.

over voltage—the difference in potential of an electrode between its equilibrium and steady-state values when current is applied.

oxidation— (1) loss of electrons by a constituent of a chemical reaction. (2) corrosion of a material that is exposed to an oxidizing gas at elevated temperatures.

oxidation-reduction potential—the potential of a reversible oxidation-reduction reaction in a given electrolyte reported on the standard hydrogen electrode scale. [also called **redox potential**]

oxygen concentration cell—see **differential aeration cell**.

Corrosion Terminology - P's

paint—a pigmented liquid or resin applied to a substrate as a thin layer that is converted to a solid film after application. (It is commonly used for decoration or protection.)

paint system—see **coating system**.

parting—see **dealloying**.

parting limit—the minimum concentration of a more noble component in an alloy above which dealloying does not occur in a specific environment.

passivation—the process in metal corrosion by which metals become passive. [See **passive**.]

passivation potential—see **primary passive potential**.

passivator—a corrosion inhibitor that reduces the corrosion rate of a metal by changing reactions at the metal surface to cause the formation of a protective corrosion product, resulting in a positive shift in corrosion potential.

passive— (1) the state of a metal surface characterized by low corrosion rates in a potential region that is strongly oxidizing for the metal. (2) the positive direction of electrode potential.

passivity—the state of being passive.

patina— (1) the corrosion product film, usually green, that forms on the surface of copper and copper alloys exposed to the atmosphere. (2) a corrosion product film on the weathered surface of any metal.

peeling—detachment or partial detachment of a coating from the substrate or undercoat in sheets or strips. [contrast with **chipping**]

pH—the negative logarithm of the hydrogen ion activity written as:

$$\text{pH} = -\log_{10}(a_{\text{H}^+}) = \log_{10}\left(\frac{1}{a_{\text{H}^+}}\right)$$

a_{H^+} = hydrogen ion activity = the molar concentration of hydrogen ions multiplied by the mean ion- activity coefficient.

phosphating—treatment of steel or other metals with an aqueous phosphate, phosphoric acid solution, or both to form an adherent phosphate surface layer that can serve as a good base for subsequent coating application. [also known as **phosphatizing**]

phosphatizing—See **phosphating**.

pickling— (1) treating a metal or alloy in a chemical bath to remove scale and oxides (e.g., rust) from the surface. (2) complete removal of rust and mill scale by acid pickling, duplex pickling, or electrolytic pickling. [See SSPC-SP8.]

pickling solution—a chemical bath, usually an acid solution, used for pickling.

pigment—a solid substance, generally in fine powder form, that is insoluble in the vehicle of a formulated coating material. It is used to impart color or other specific physical or chemical properties to the coating.

pinhole—a minute hole through a coat or coats that exposes an underlying coat or the substrate.

pipe-to-electrolyte potential—see **structure-to-electrolyte potential**.

pipe-to-soil potential—see **structure-to-electrolyte potential**.

pit—a surface cavity with depth equal to or greater than the minimum dimension at the opening. [contrast with **crater**]

pitting—localized corrosion of a metal surface that is confined to a small area and takes the form of cavities called pits.

pitting factor—the ratio of the depth of the deepest pit resulting from corrosion divided by the average penetration as calculated from mass loss.

pitting resistance equivalent number—A number calculated using a weighted formula typically based on the chromium (Cr), molybdenum (Mo), nitrogen (N), and sometimes tungsten (W) content of an alloy, developed to rank the pitting and crevice corrosion resistance of stainless steels and some nickel-based alloys. (Larger numbers indicate increased resistance to pitting and crevice corrosion in seawater and other halide-containing aqueous environments.) (For example, NACE MR0175/ISO 15156 uses $PREN = Cr + 3.3 \{Mo + 0.5W\} + 16N$, where each element symbol represents the mass percent of that element in the alloy.)

plastic deformation—permanent deformation caused by stressing beyond the elastic limit.

plasticity—the ability of a material to deform permanently (non-elastically) without fracturing.

polarization—the change from the corrosion potential as a result of current flow across the electrode/electrolyte interface.

polarization admittance—the reciprocal of polarization resistance.

polarization cell—a DC decoupling device consisting of two or more pairs of inert metallic plates immersed in an aqueous electrolyte. The electrical characteristics of the polarization cell are high resistance to DC potentials and low AC impedance.

polarization curve—a plot of current density versus electrode potential for a specific electrode/electrolyte combination.

polarization decay—the change in electrode potential with time resulting from the interruption of applied current.

polarization resistance—the slope (dE/di) at the corrosion potential of a potential (E) – current density (i) curve. (It is inversely proportional to the corrosion current density when the polarization resistance technique is applicable.)

polarized potential— (1) (general use) the potential across the electrode/electrolyte interface that is the sum of the corrosion potential and the applied polarization. (2) (cathodic protection use) the potential across the structure/electrolyte interface that is the sum of the corrosion potential and the cathodic polarization.

polyester—type of resin formed by the condensation of poly basic and mono basic acids with polyhydric alcohols.

polyurethane—a polymer formed by reaction of an isocyanate with a polyol (hydroxyl-containing material). (When used as

a coating binder, it generally produces a tough, durable, glossy protective coating with good chemical and ultraviolet light resistance.)

post weld heat treatment—heating and cooling a weldment in such a way as to obtain desired properties.

potential-pH diagram—a graphical method of representing the regions of thermodynamic stability of species for metal/electrolyte systems. [also known as **Pourbaix diagram**]

potentio dynamic—refers to a technique wherein the potential of an electrode with respect to a reference electrode is varied at a selected rate by application of a current through the electrolyte.

potentio kinetic—see **potentio dynamic** .

potentio staircase—refers to a potentio step technique for polarizing an electrode in a series of constant potential steps wherein the time duration and potential increments or decrements are equal for each step.

potentio stat—an instrument for automatically maintaining an electrode in an electrolyte at a constant potential or controlled potentials with respect to a suitable reference electrode.

potentio static—refers to a technique for maintaining a constant electrode potential.

potentio step—refers to a technique wherein an electrode is polarized in a series of potential increments or decrements.

pot life—the maximum elapsed time during which a coating can be effectively applied after all components of the coating have been thoroughly mixed.

poultice corrosion—see **deposit corrosion**.

Pourbaix diagram—see **potential-pH diagram**.

power tool cleaning—removal of loose rust, loose mill scale, and loose coating by power tool chipping, descaling, sanding, wire brushing, and grinding. [SeeSSPC-SP 3.]

precipitation hardening—hardening caused by the precipitation of a constituent from a supersaturated solid solution.

primary passive potential—the potential corresponding to the maximum active current density (critical anodic current density) of an electrode that exhibits active-passive corrosion behavior.

prime coat—see **primer**.

primer—a coating material intended to be applied as the first coat on an uncoated surface. The coating is specifically formulated to adhere to and protect the surface as well as to produce a suitable surface for subsequent coats. [also referred to as **prime coat**]

profilometer—an instrument for measuring and recording the topographical profile of a surface.

protection potential— the most noble potential at which pitting or crevice corrosion, or both, will not propagate in a specific environment.

protective coating—a coating applied to a surface to protect the substrate from corrosion.

Corrosion Terminology - Q's

quenched and tempered— quench hardened and then tempered.

Corrosion Terminology - R's

redox potential—see **oxidation-reduction potential**.

Reduction gain of electrons by a constituent of a chemical reaction.

reference electrode—an electrode having a stable and reproducible potential, which is used in the measurement of other electrode potentials.

reference half-cell—see **reference electrode**.

reinforcement— (1) glass cloth, chopped fibers, or mat used to provide additional tensile and flexural strength and other properties to a coating or lining. (2) bars or fibers added to concrete to enhance its mechanical properties.

relative humidity—the ratio, expressed as a percentage, of the amount of water vapor present in a given volume of air at a given temperature to the amount required to saturate the air at that temperature.

remote earth—a location on the earth far enough from the affected structure that the soil potential gradients associated with currents entering the earth from the affected structure are insignificant.

residual stress—stress present in a component free of external forces or thermal gradients.

resin—a clear to translucent, solid or semisolid, viscous organic substance, often of relatively high molecular mass, which exhibits a tendency to flow when subjected to stress and usually has a softening or melting range. (Natural resins originate from secretions of certain plants and insects. Synthetic resins are physically similar polymerized synthetic materials, either thermoplastic or thermosetting, which are used to form plastics. Resins are commonly used as the binder in various paints, coatings, adhesives, and synthetic plastics.)

resistivity—the electrical resistance between opposite faces of a unit cube of material.

rest potential—corrosion potential after time transients have subsided.

reversible potential—see **equilibrium potential**.

rimmed steel—an incompletely deoxidized steel. [also called **rimming steel**]

rimming steel—see **rimmed steel**.

riser— (1) that section of pipeline extending from the ocean floor up to an offshore structure. (2) the vertical tube in a steam generator convection bank that circulates water and steam upward. (3) a large-diameter pipe or duct in a fluidized catalytic cracking unit into which the hydrocarbon feed is injected to mix with a stream of hot catalyst and steam and through which the resulting reaction mixture flows upward.

Rockwell C hardness—hardness value, measured in accordance with ISO 6508-1 or Test Methods E18, obtained using a diamond cone indenter and a force of approximately 1.471 N (150 kgf).

rouge—a reddish-brown fine powder consisting primarily of iron oxide particles.

run—See **sag**.

rust—corrosion product consisting of various iron oxides and hydrated iron oxides. (This term properly applies only to iron and ferrous alloys.)

rust bloom—discoloration indicating the beginning of rusting.

Corrosion Terminology - S's

sacking—scrubbing a mixture of a cement mortar over the concrete surface using a cement sack, gunnysack, or sponge rubber float.

sacrificial anode—see **galvanic anode**.

sacrificial pigment—a pigment that provides cathodic protection to the substrate by galvanic action [contrast with **corrosion-inhibitive pigment**].

sacrificial protection—reduction of corrosion of a metal in an electrolyte by electrically connecting the metal to a galvanic anode (a form of cathodic protection).

sag—nonuniform downward flow of a wet-applied coating under the force of gravity that results in an uneven coating having a thick lower edge.

sample—portion of material taken from a larger quantity in a manner intended to be representative of the whole, typically used for test purposes.

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.

scanning electron microscope—an electron optical device that scans a beam of electrons across a surface and collects the resulting electrons or photons to form an image whose contrast is determined by topography, elemental composition, or other properties.

season cracking—(an obsolete term) a form of environmental cracking of brass in the atmosphere.

selective dissolution—see **dealloying** .

selective leaching—see **dealloying**.

sensitization—a metallurgical state caused by certain heating, cooling, or cold working conditions that results in precipitation of constituents (e.g., carbides in a stainless steel) at grain boundaries, thereby causing an alloy to be susceptible to intergranular corrosion or intergranular stress corrosion cracking in a specific environment in which the alloy would normally exhibit corrosion resistance.

sensitizing heat treatment—a heat treatment that produces sensitization.

shallow ground bed—one or more anodes installed either vertically or horizontally at a nominal depth of less than 15 m (50 ft) for the purpose of supplying cathodic protection current.

shelf life—the maximum length of time packaged materials (e.g., coating materials) can be stored, at specified conditions, and remain in usable condition.

shielding— (1) protecting; protective cover against mechanical damage. (2) preventing or diverting cathodic protection current from its natural path.

shop coat—one or more coats applied in a shop or plant prior to shipment to the site of erection or fabrication.

shot blasting—abrasive blast cleaning using metallic (usually steel) shot as the abrasive.

shot peening—inducing compressive stresses in the surface layer of a material by bombarding it with a selected medium (usually steel shot) under controlled conditions.

sigma phase—an extremely brittle Fe-Cr phase that can form at elevated temperatures in Fe-Cr, Fe-Cr-Ni and Ni-Cr-Fe alloys.

slip—a deformation process involving shear motion of a specific set of crystallographic planes.

slow strain rate technique—an experimental technique for evaluating susceptibility to environmental 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 environmental cracking.

slushing compound—oil or grease coatings used to provide temporary protection against atmospheric corrosion.

solid solution—single crystalline phase containing two or more elements.

solution heat treatment—heating a metal to a suitable temperature and holding at that temperature long enough for one or more constituents to enter into solid solution, then cooling rapidly enough to retain the constituents in solution.

solvent cleaning—removal of oil, grease, dirt, soil, salts, and contaminants using organic solvents or other cleaners such as vapor, alkali, emulsion, or steam. [See SSPC-SP 1.]

spalling—the spontaneous chipping, fragmentation, or separation of a surface or surface coating.

spark test—a high-voltage electrical test in which a spark is used to detect a discontinuity in a coating.

specular gloss—reflection of light, as from a mirror, as opposed to diffuse reflection in all directions.

splash zone—the portion of a marine structure that is intermittently wetted by waves, wind-blown water spray, and tidal action. (Surfaces that are wetted only during major storms are not included.)

specimen—prepared portion of a sample or coupon upon which a test is intended to be performed. [also known as **test specimen**.]

spreading rate—the average area covered by a unit volume of coating material at a specified dry film thickness. (Spreading rate is usually specified as square meters per liter or square feet per gallon.)

stainless steel—steel containing 10.5 mass percent or more chromium, possibly with other elements added to secure special properties.

standard electrode potential—the reversible potential for an electrode process when all products and reactants are at unit activity reported on the standard hydrogen electrode scale.

standard jetting water—water of sufficient purity and quality that does not impose additional contaminants on the surface being cleaned and does not contain sediments or other impurities that are destructive to the proper functioning of water jetting equipment.

steel—a material that has more iron, by mass percent, than any other element and contains carbon generally less than 2.1 mass percent.

steel shot—small particles of steel with spherical shape that are commonly used as an abrasive in abrasive blast cleaning or as a selected medium for shot peening.

step potential—the potential difference between two points on the earth's surface separated by a distance of one human step, which is defined as one meter, determined in the direction of maximum potential gradient.

stepwise cracking—see **hydrogen-induced cracking**.

stray current—current flowing through paths other than the intended circuit.

stray-current corrosion—corrosion resulting from stray current.

stress corrosion cracking—cracking of a material produced by the combined action of corrosion and sustained tensile stress (residual or applied). [See **environmental cracking**.]

stress relieving (thermal)—heating a metal to a suitable temperature, holding at that temperature long enough to

reduce residual stresses, and then cooling slowly enough to minimize the development of new residual stresses.

structure-to-electrolyte potential—the potential difference between the surface of a buried or submerged metallic structure and the electrolyte that is measured with reference to an electrode in contact with the electrolyte.

structure-to-soil potential—see **structure-to-electrolyte potential**.

structure-to-structure potential—the potential difference between metallic structures, or sections of the same structure, in a common electrolyte.

submerged zone—the surface area of a marine structure that is always covered with water and extends downward from the splash zone and includes that portion of the structure below the mud line.

subsurface corrosion—see **internal oxidation**.

sulfidation—the reaction of a metal or alloy with a sulfur-containing species to produce a sulfur compound that forms on or beneath the surface of the metal or alloy.

sulfide stress cracking—cracking of a metal under the combined action of tensile stress and corrosion in the presence of water and hydrogen sulfide (a form of hydrogen stress cracking).

Surface potential gradient—change in the potential on the surface of the ground with respect to distance.

Surface profile—their regular peak and valley profile on a bare surface that can result from operations such as abrasive blast cleaning or power tool cleaning. [also called **anchor pattern**]

sweep blast cleaned surface—See **brush-off blast cleaned surface**.

Corrosion Terminology - T's

tackcoat—a thin wet coat applied to the surface that is allowed to dry just until it is tacky before application of a thicker wet coat. (Use of a tack coat allows application of thicker coats without sags or runs.)

Tafel plot—a plot of the relationship between the change in potential (E) and the logarithm of the current density (log i) of an electrode when it is polarized in the anodic or cathodic direction, or both, from its open-circuit potential.

Tafel slope—the slope of the nonvertical, nonhorizontal straight-line portion of the E log i curve on a Tafel plot.

Tape adhesion test—a test in which an adhesive tape is applied to a cured coating, generally after making cuts through the coating to the substrate, and rapidly removed to evaluate the adhesive bond of the coating to the substrate.

tarnish—surface discoloration of a metal resulting from formation of a film of corrosion product.

tempering—heat treatment by heating to a temperature below the lower critical temperature for the purpose of decreasing the hardness and increasing the toughness of hardened steel, hardened cast iron, and sometimes normalized steel.

Test specimen—see **specimen**.

Thermal spraying—a high-temperature process by which finely divided metallic or nonmetallic materials are deposited in a molten or semi molten condition to form a coating on a surface when cooled.

Thermogalvanic corrosion—corrosion resulting from an electrochemical cell caused by a thermal gradient.

thermoplastic—a polymeric material (typically a resin) capable of being (a) repeatedly softened by heat and hardened by cooling or (b) [not a preferred term but used for coatings] dissolved by solvent and reformed upon solvent evaporation. [contrast with **thermoset**]

thermoplastic coating—a coating with a thermoplastic binder.

thermoset—a polymeric material (typically a resin) that undergoes a chemical cross-linking reaction (by mechanisms involving heat, oxidation, catalysis, light [often ultraviolet], electron beam, or chemical additive) leading to a relatively infusible state. [contrast with **thermoplastic**]

thermoset coating—a coating with a thermoset binder.

throwing power—the relationship between the current density at a point on a surface and its distance from the counter electrode. The greater the ratio of the surface resistivity shown by the electrode reaction to the volume resistivity of the electrolyte, the better is the throwing power of the process.

tidal zone—that portion of a marine structure that is intermittently wetted by tidal action.

top coat—the final coat of a coating system. [also referred to as **finish coat**]

touch potential—the potential difference between a metallic structure and a point on the earth's surface separated by a distance equal to the normal maximum horizontal reach of a human (approximately 1.0 m [3.3 ft]).

toughness—the ability of a material to absorb energy and deform plastically before fracturing.

transpassive region—the region of an anodic polarization curve, more positive than the passive potential range, in which there is a significant increase in current density (increased metal oxidation) as the potential becomes more positive.

tubercle—a mound of corrosion product and deposit capping a region of localized metal loss.

tuberculation—the formation of localized corrosion products scattered over the surface in the form of knob-like mounds called tubercles.

Corrosion Terminology - U's

ultimate tensile strength—the maximum stress that a material can sustain without failing from tensile overload.

ultrahigh-pressure water jetting—water jetting performed at pressures above 210 MPa (30,000 psig).

under film corrosion—see **filiform corrosion**.

uniform corrosion—corrosion that proceeds at exactly the same rate over the surface of a material. (This is the assumption when calculating corrosion rate or corrosion loss from mass loss or electro-chemical measurements. This term should not be used instead of **general corrosion** to describe an observed surface distribution of corrosion).

upset—a hot deformation process to cause a thickening of metal by compressive forces.

urethane—not a preferred term, but commonly used to refer to **polyurethane**.

Corrosion Terminology - V's ▼

vehicle—the liquid portion of a formulated coating material.

Vickers hardness—hardness value, measured in accordance with ISO 6507-1 or Test Method E92, obtained using a diamond pyramid indenter and one of a variety of possible applied loads.

void— (1) a holiday, hole, or skip in a coating. (2) a hole in a casting or weld deposit usually resulting from shrinkage during cooling.

Corrosion Terminology - W's

wash primer—a thin, inhibiting, or passivating primer, usually formulated with chromate or phosphate pigment in a synthetic resin (e.g., polyvinyl butyral) binder.

water cleaning—use of pressurized water discharged from a nozzle to remove unwanted matter from a surface.

water jetting—use of standard jetting water discharged from a nozzle at pressures of 70 MPa (10,000psig) or greater to prepare a surface for coating or inspection.

weight coating—an external coating applied to a pipeline to counteract buoyancy.

weld—join two or more pieces of material by applying heat and/or pressure with or without filler material, to produce a union through localized fusion of the substrates and solidification across the interfaces.

weld decay— (not a preferred term) inter granular corrosion, usually of stainless steels or certain nickel alloys, that occurs as the result of sensitization in the heat-affected zone during the welding operation.

weldment— (1) an assembly of components joined by welding. (2) [for metals] the weld metal, the heat-affected zone, and the adjacent parent metal.

weld metal—that portion of a weldment that has been molten during welding.

wet film gauge—device for measuring wet film thickness of a coating.

Wet film thickness—the thickness of a coating measured immediately after application before any appreciable solvent has evaporated or drying has taken place.

wet sponge test—a low-voltage electrical test suitable for detecting holidays in thin-film coatings.

white cast iron—cast iron that displays a white fracture surface.

white metal blast cleaned surface—an abrasive blast cleaned steel surface that is free of all visible contaminants, foreign matter, and staining. [See NACE No.1/SSPC-SP 5 for detailed specification.]

white rust—the white powdery corrosion product that can form on zinc, zinc-coated, or aluminum-based alloy surfaces. [See **rust**.]

working electrode—the test or specimen electrode in an electro-chemical cell.

wrinkling—formation of a surface appearance in a coating resembling the skin of a dried prune, usually caused by application shortcomings.

wrought—describes a metal in the solid condition formed to a desired shape by working (e.g., rolling, extruding, forging), usually at an elevated temperature.

Corrosion Terminology - X,Y,Z's

yield point—the stress on a material at which the first significant permanent or plastic deformation occurs without an increase in stress. In some materials, particularly annealed low-carbon steels, there is a well-defined yield point from the straight line defining the modulus of elasticity.

yield strength—the stress at which a material exhibits a specified deviation from the proportionality of stress to strain. The deviation is expressed in terms of strain by either the offset method (usually at a strain of 0.2 percent) or the total-extension-under-load method (usually at a strain of 0.5 percent).

zeta potential—see **electrokinetic potential**.