1 Glossary

NACE/ASTM STANDARD TERMINOLOGY RELATING TO CORROSION

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 electrochemical impedance.

acrylic—type of resin polymerized from acrylic acid, meth-acrylic 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 electrode potential.

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

adduct curing 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).

air drying—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 machinability, or obtaining desired properties.

anode—the electrode of an electrochemical 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 electrode 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 electrochemical 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 electrochemical 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.

backfill—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 impressor 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.

barrier pigment—a pigment that impedes permeation through an organic coating solely by its physical presence. [contrast with corrosion-inhibitive pigment and sacrificial pigment]

beach marks—the characteristic markings on the fracture surfaces produced by fatigue crack propagation. [Also known as *arrest marks*, *clamshell 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.

blowdown—*(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 solu-

tion 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 3,000 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).

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.

casein paint—water-thinned paint with vehicle derived from milk.

cast iron—a generic term for a large family of cast ferrous alloys in which the carbon content exceeds the solubility of carbon in austenite at the eutectic temperature, or about 2 mass percent. Most cast irons also contain silicon, and may contain other alloying elements and impurities.

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 electrochemical 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 by products 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 electrochemical cell.

catholyte—the electrolyte adjacent to the cathode of an electrochemical 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 electrochemical 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 brittlefracture 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 electrochemical 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 electrochemical 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 electrochemical reaction with its environment.

corrosion-inhibitive pigment—a pigment that has the property of minimizing corrosion of the metal substrate to which the coating is applied by directly reducing the anodic or cathodic reactions, or both. [contrast with sacrificial pigment and barrier pigment]

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 condi-

tions 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 electrochemical 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 electrochemical cell that is used to transfer current to or from a working electrode.

counterpoise—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 electrochemical equivalent current density for a specific reaction to the total applied current density.

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 groundbed—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 the reinforcing 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 electrochemical 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, non-coherent 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.]

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.

electrochemical admittance—the reciprocal of the electrochemical impedance, $\Delta I/\Delta E$.

electrochemical cell—*(1)* an electrochemical 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 electrochemical cell can be calculated from the change in free energy for the overall electrochemical reaction. The equilibrium potential of the electrochemical 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 electrochemical 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]

electrochemical corrosion potential—see corrosion potential.

electrochemical 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.

electrochemical impedance—the frequency dependent, complex valued proportionality factor, $\Delta I/\Delta E$, between the applied potential (or current) and the response current (or potential) in an electrochemical 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.

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

electrochemical potential—the partial derivative of the total electrochemical 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.

electrokinetic potential—a potential difference in a solution caused by residual, unbalanced charge distribution in the adjoining solution, producing a double layer. (The electrokinetic 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 electrochemical 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, straycurrent corrosion, or any form of electrochemical 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, corrosion fatigue, hydrogen embrittlement, hydrogen-induced cracking (stepwise cracking), hydrogen stress cracking, liquid metal 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 de-

fined with respect to a specific electrochemical 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 multicomponent 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 electrochemical cell. It is this portion of the cell through which electrons travel.

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 recoating.

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 threadlike filaments.

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

finish coat—see topcoat.

fish eye—a small dimple or crater with a visible defect or contaminant in the central area resembling a fish eye 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.

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)* a galvanized coating. *(2)* process of applying a galvanized coating.

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

galvanostaircase—refers to a galvanostep 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.

galvanostep—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 intergranular 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]

gray cast 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.

grit blasting—abrasive blast cleaning using grit as the abrasive.

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

half cell—*(1)* the single oxidation or reduction half reactions in the complete electrochemical 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 waterjetting—waterjetting 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 overvoltage—overvoltage 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.

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 current—see stray current.

intergranular corrosion—preferential corrosion at or adjacent to the grain boundaries of a metal or alloy.

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 isocorrosion curves are drawn.

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

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 electrochemical 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 electrochemical 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—a 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.

macrocell 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 microstructures.

mastic—*(1)* aromatic resin of the mastic tree, commonly used in lacquers and varnishes. *(2)* a material of relatively viscous, pastelike 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 electrochemical 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.

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-SP 10 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 electrochemical 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.

occluded cell—an electrochemical 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.

overvoltage—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.

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 atmo-

sphere. (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:

$$pH = -\log_{10} (a_{H}^{+}) \quad (1)$$

where: 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-SP 8.]

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 (nonelastically) 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 polybasic and monobasic 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.)

postweld 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]

potentiodynamic—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.

potentiokinetic—see potentiodynamic.

potentiostaircase—refers to a potentiostep 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.

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

potentiostatic—refers to a technique for maintaining a constant electrode potential.

potentiostep—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. [See SSPC-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.

quenched and tempered—quench hardened and then tempered.

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.

sacking—scrubbing a mixture of a cement mortar over the concrete surface using a cement sack, gunny sack, 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 and barrier 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 groundbed—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 waterjetting 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—the irregular 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.

tack coat—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 semimolten 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.

topcoat—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.

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

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

underfilm 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 electrochemical 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.

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.

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.

waterjetting—use of standard jetting water discharged from a nozzle at pressures of 70 MPa (10,000 psig) 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) intergranular 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 electrochemical 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.

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.

Source: NACE/ASTM Standard G193-12d, "Standard Terminology and Acronyms Relating to Corrosion" (ASTM International, West Conshohocken, PA, USA: ASTM International, 2012).

NACE/ASTM STANDARD ACRONYMS RELATING TO CORROSION

aboveground storage tank—AST
acoustic emission—AE
acrylonitrile butadiene styrene [polymer]—ABS
all volatile treatment [boiler treatment]—AVT
alternating current—AC
American Wire Gauge—AWG
atomic absorption [spectroscopy]—AA
Auger electron spectroscopy—AES
biological oxygen demand—BOD
Birmingham Wire Gauge—BWG
body-centered cubic—bcc
boiler feedwater—BFW
boiling point—bp
boiling water reactor—BWR
Brinell hardness—HB
carbon steel—CS
cathodic protection—CP
chemical oxygen demand—COD
chlorinated polyvinyl chloride—CPVC
cold-rolled—CR
constant extension rate test—CERT
conversion electron Mossbauer spectroscopy—CEMS
cooling water—CW
cooling water tower—CWT
copper/copper sulfate ($Cu/CuSO_4$) electrode—CSE
corrosion-resistant alloy—CRA
critical crevice-corrosion temperature—CCT
critical pitting temperature—CPT
current density—CD
deionized [water]—DI
differential thermal analysis—DTA
direct current—DC
direct imaging mass analyzer—DIMA
discounted cash flow—DCF
dissolved oxygen—DO
double-cantilever-beam—DCB
dry film thickness—DFT
ductile iron—DI

eddy current test/testing—ECT
electric resistance weld/welded—ERW
electrical resistance—ER
electrochemical current noise—ECN
electrochemical impedance spectroscopy—EIS
electrochemical noise [technique]—EN
electrochemical potential noise—EPN
electrochemical potentiokinetic reactivation—EPR
electromagnetic test/testing—ET
electromotive force—EMF
electron energy loss spectroscopy—EELS
electron probe microanalysis—EPMA
electron spectroscopy for chemical analysis—ESCA
energy dispersive spectroscopy—EDS
energy dispersive x-ray analysis—EDXA
ethylenediaminetetraacetic acid—EDTA
ethylene propylene diene elastomer—EPDM
face-centered cubic—fcc
fast Fourier transform—FFT
fiberglass-reinforced plastic—FRP
fiber-reinforced plastic—FRP
flue gas desulfurization—FGD
fluid catalytic cracking unit—FCCU
fluidized bed combustion—FBC
fluorinated ethylene propylene [copolymer]—FEP
fluorocarbon elastomer—FKM
flux-cored arc weld/welding—FCAW
Fourier transform infrared—FTIR
freezing point—fp
frequency response analyzer—FRA
furnace-cooled—FC
fusion-bonded epoxy [coating]—FBE
gas metal arc weld/welding—GMAW
gas tungsten arc weld/welding—GTAW
glass/fiberglass-reinforced epoxy—GRE
glass/fiberglass-reinforced plastic—GRP
heat-affected zone—HAZ
heat exchanger—HX
heat treatment/heat-treated—HT
high frequency—HF
high-level liquid waste [nuclear]—HLLW
high-pressure water cleaning—HPWC

high-pressure waterjetting—HPWJ
high-strength low-alloy [steel]—HSLA
high-temperature hydrogen attack—HTHA
high-voltage alternating current—HVAC
high-voltage direct current—HVDC
hot-rolled—HR
hydrogen embrittlement—HE
hydrogen-induced cracking—HIC
hydrogen ion activity [negative logarithm of]—pH
hydrogen stress cracking—HSC
impressed current—IC
impressed current cathodic protection—ICCP
infrared—IR
inorganic zinc-rich [coating]—IOZ
inside diameter—ID
intergranular attack—IGA
intergranular corrosion—IGC
intergranular stress corrosion cracking—IGSCC
ion microprobe mass analyzer—IMMA
ion scattering spectroscopy—ISS
Knoop hardness—HK
Langelier Saturation Index—LSI
light water reactor—LWR
linear polarization resistance—LPR
linear variable differential transformer—LVDT
liquid metal cracking—LMC
liquid penetrant test/testing—PT
low-pressure water cleaning—LPWC
magnetic particle test/testing—MT
maximum allowable working pressure—MAWP
melting point—mp
microbiologically influenced corrosion—MIC
multiple crevice assembly—MCA
net present value—NPV
nominal pipe size—NPS
nondestructive examination—NDE
nondestructive test/testing—NDT
normal hydrogen electrode—NHE
normalized and tempered—N&T
nuclear magnetic resonance—NMR
ocean thermal-energy conversion—OTEC
oil-country tubular goods—OCTG

oil-quenched—OQ
organic zinc-rich [coating]—OZ
outside diameter—OD
perfluoroalkoxy [polymer]—PFA
perfluorocarbon elastomer—FFKM
pitting resistance equivalent number—PREN
polybutylene—PB
polycarbonate—PC
polyetheretherketone—PEEK
polyethylene—PE
polypropylene—PP
polytetrafluoroethylene—PTFE
polythionic acid—PTA
polyurethane—PUR
polyvinyl acetate—PVAC
polyvinyl chloride—PVC
polyvinylidene chloride—PVDC
polyvinylidene fluoride—PVDF
postweld heat treatment/heat-treated—PWHT
potential of zero charge—PZC
power factor—PF
precipitation hardening/hardenable—PH
pressurized water reactor—PWR
quality assurance—QA
quality control—QC
quenched and tempered—Q&T
radio frequency—RF
radiographic test/testing—RT
reinforced thermoset plastic—RTP relative humidity—RH
Rockwell B hardness—HRB
Rockwell C hardness—HRC
room temperature—RT
root mean square—rms
Ryzner Stability Index—RSI
saturated calomel electrode—SCE
scanning Auger microscopy—SAM
scanning electron microscopy—SEM
scanning reference electrode technique—SRET
scanning transmission electron microscopy—STEM
secondary ion mass spectroscopy—SIMS
shielded metal arc weld/welding—SMAW
slow strain rate—SSR

slow strain rate test/technique—SSRT
solution anneal/solution-annealed—SA
spark-sources mass spectroscopy—SSMS
specific gravity—SG
specified minimum yield strength—SMYS
stainless steel—SS
standard hydrogen electrode—SHE
standard temperature and pressure—STP
Standard Wire Gauge [British]—SWG
stress corrosion cracking—SCC
stress-oriented hydrogen-induced cracking—SOHIC
stress relief/stress-relieved—SR
styrene-butadiene rubber—SBR
submerged arc weld/welding—SAW
sulfate-reducing bacteria—SRB
sulfide stress cracking—SSC
Systeme Internationale d'Unites [metric]—SI
tensile strength/stress—TS
thermogravimetric analysis—TGA
time-temperature-sensitization [diagram]—TTS
time-temperature-transformation [diagram]—TTT
time to failure—TTF
total acid number—TAN
total dissolved solids—TDS
total hardness—TH
transgranular stress corrosion cracking—TGSCC
transmission electron microscopy—TEM
trisodiumphosphate—TSP
tungsten inert gas [weld/welding]—TIG
ultimate tensile strength/stress—UTS
ultrahigh frequency—UHF
ultrahigh pressure—UHP
ultrahigh-pressure waterjetting—UHPWJ
ultrasonic test/testing—UT
ultraviolet—UV
ultraviolet spectroscopy—UVS
underground residential distribution—URD
underground storage tank—UST
vapor phase inhibitor—VPI
Vickers hardness—HV
volatile corrosion inhibitor—VCI
volatile organic compound—VOC

water cleaning—WC
water-cooled reactor—WCR
waterjetting—WJ
water-quenched—WQ
wavelength dispersive spectrometry—WDS
wedge opening load—WOL
wet fluorescent magnetic particle test/testing—WFMT
x-ray diffraction—XRD
x-ray fluorescence—XRF
x-ray photoelectron spectroscopy—XPS
yield strength/stress—YS
zero-resistance ammeter—ZRA

AA—atomic absorption [spectroscopy]
ABS—acrylonitrile butadiene styrene [polymer]
AC—alternating current
AE—acoustic emission
AES—Auger electron spectroscopy
AST—aboveground storage tank
AVT—all volatile treatment [boiler treatment]
AWG—American Wire Gauge
bcc—body-centered cubic
BFW—boiler feedwater
BOD—biological oxygen demand
bp—boiling point
BWG—Birmingham Wire Gauge
BWR—boiling water reactor
CCT—critical crevice-corrosion temperature
CD—current density
CEMS—conversion electron Mossbauer spectroscopy
CERT—constant extension rate test
COD—chemical oxygen demand
CP—cathodic protection
CPT—critical pitting temperature
CPVC—chlorinated polyvinyl chloride
CR—cold-rolled
CRA—corrosion-resistant alloy
CS—carbon steel
CSE—copper/copper sulfate ($Cu/CuSO_4$) electrode
CW—cooling water

CWT—cooling water tower
DC—direct current
DCB—double-cantilever-beam
DCF—discounted cash flow
DFT—dry film thickness
DI—deionized [water]
DI—ductile iron
DIMA—direct imaging mass analyzer
DO—dissolved oxygen
DTA—differential thermal analysis
ECN—electrochemical current noise
ECT—eddy current test/testing
EDS—energy dispersive spectroscopy
EDTA—ethylenediaminetetraacetic acid
EDXA—energy dispersive x-ray analysis
EELS—electron energy loss spectroscopy
EIS—electrochemical impedance spectroscopy
EMF—electromotive force
EN—electrochemical noise [technique]
EPDM—ethylene propylene diene elastomer
EPMA—electron probe microanalysis
EPN—electrochemical potential noise
EPR—electrochemical potentiokinetic reactivation
ER—electrical resistance
ERW—electric resistance weld/welded
ESCA—electron spectroscopy for chemical analysis
ET—electromagnetic test/testing
FBC—fluidized bed combustion
FBE—fusion-bonded epoxy [coating]
FC—furnace-cooled
FCAW—flux-cored arc weld/welding
fcc—face-centered cubic
FCCU—fluid catalytic cracking unit
FEP—fluorinated ethylene propylene [copolymer]
FFKM—perfluorocarbon elastomer
FFT—fast Fourier transform
FGD—flue gas desulfurization
FKM—fluorocarbon elastomer
fp—freezing point
FRA—frequency response analyzer
FRP—fiberglass-reinforced plastic
FRP—fiber-reinforced plastic

FTIR—Fourier transform infrared
GMAW—gas metal arc weld/welding
GRE—glass/fiberglass-reinforced epoxy
GRP—glass/fiberglass-reinforced plastic
GTAW—gas tungsten arc weld/welding
HAZ—heat-affected zone
HB—Brinell hardness
HE—hydrogen embrittlement
HF—high frequency
HIC—hydrogen-induced cracking
HK—Knoop hardness
HLLW—high-level liquid waste [nuclear]
HPWC—high-pressure water cleaning
HPWJ—high-pressure waterjetting
HR—hot-rolled
HRB—Rockwell B hardness
HRC—Rockwell C hardness
HSC—hydrogen stress cracking
HSLA—high-strength low-alloy [steel]
HT—heat treatment/heat-treated
HTHA—high-temperature hydrogen attack
HV—Vickers hardness
HVAC—high-voltage alternating current
HVDC—high-voltage direct current
HX—heat exchanger
IC—impressed current
ICCP—impressed current cathodic protection
ID—inside diameter
IGA—intergranular attack
IGC—intergranular corrosion
IGSCC—intergranular stress corrosion cracking
IMMA—ion microprobe mass analyzer
IOZ—inorganic zinc-rich [coating]
IR—infrared
ISS—ion scattering spectroscopy
LMC—liquid metal cracking
LPR—linear polarization resistance
LPWC—low-pressure water cleaning
LSI—Langelier Saturation Index
LVDT—linear variable differential transformer
LWR—light water reactor
MAWP—maximum allowable working pressure

MCA—multiple crevice assembly
MIC—microbiologically influenced corrosion
mp—melting point
MT—magnetic particle test/testing
N&T—normalized and tempered
NDE—nondestructive examination
NDT—nondestructive test/testing
NHE—normal hydrogen electrode
NMR—nuclear magnetic resonance
NPS—nominal pipe size
NPV—net present value
OCTG—oil-country tubular goods
OD—outside diameter
OQ—oil-quenched
OTEC—ocean thermal-energy conversion
OZ—organic zinc-rich [coating]
PB—polybutylene
PC—polycarbonate
PE—polyethylene
PEEK—polyetheretherketone
PF—power factor
PFA—perfluoroalkoxy [polymer]
pH—hydrogen ion activity [negative logarithm of]
PH—precipitation hardening/hardenable
PP—polypropylene
PREN—pitting resistance equivalent number
PT—liquid penetrant test/testing
PTA—polythionic acid
PTFE—polytetrafluoroethylene
PUR—polyurethane
PVAC—polyvinyl acetate
PVC—polyvinyl chloride
PVDC—polyvinylidene chloride
PVDF—polyvinylidene fluoride
PWHT—postweld heat treatment/heat-treated
PWR—pressurized water reactor
PZC—potential of zero charge
Q&T—quenched and tempered
QA—quality assurance
QC—quality control
RF—radio frequency
RH—relative humidity

rms—root mean square
RSI—Ryzner Stability Index
RT—radiographic test/testing
RT—room temperature
RTP—reinforced thermoset plastic
SA—solution anneal/solution-annealed
SAM—scanning Auger microscopy
SAW—submerged arc weld/welding
SBR—styrene-butadiene rubber
SCC—stress corrosion cracking
SCE—saturated calomel electrode
SEM—scanning electron microscopy
SG—specific gravity
SHE—standard hydrogen electrode
SI—Systeme Internationale d'Unites [metric]
SIMS—secondary ion mass spectroscopy
SMAW—shielded metal arc weld/welding
SMYS—specified minimum yield strength
SOHIC—stress-oriented hydrogen-induced cracking
SR—stress relief/stress-relieved
SRB—sulfate-reducing bacteria
SRET—scanning reference electrode technique
SS—stainless steel
SSC—sulfide stress cracking
SSMS—spark-sources mass spectroscopy
SSR—slow strain rate
SSRT—slow strain rate test/technique
STEM—scanning transmission electron microscopy
STP—standard temperature and pressure
SWG—Standard Wire Gauge [British]
TAN—total acid number
TDS—total dissolved solids
TEM—transmission electron microscopy
TGA—thermogravimetric analysis
TGSCC—transgranular stress corrosion cracking
TH—total hardness
TIG—tungsten inert gas [weld/welding]
TS—tensile strength/stress
TSP—trisodiumphosphate
TTF—time to failure
TTS—time-temperature-sensitization [diagram]
TTT—time-temperature-transformation [diagram]

UHF—ultrahigh frequency
UHP—ultrahigh pressure
UHPWJ—ultrahigh-pressure waterjetting
URD—underground residential distribution
UST—underground storage tank
UT—ultrasonic test/testing
UTS—ultimate tensile strength/stress
UV—ultraviolet
UVS—ultraviolet spectroscopy
VCI—volatile corrosion inhibitor
VOC—volatile organic compound
VPI—vapor phase inhibitor
WC—water cleaning
WCR—water-cooled reactor
WDS—wavelength dispersive spectrometry
WFMT—wet fluorescent magnetic particle test/testing
WJ—waterjetting
WOL—wedge opening load
WQ—water-quenched
XPS—x-ray photoelectron spectroscopy
XRD—x-ray diffraction
XRF—x-ray fluorescence
YS—yield strength/stress
ZRA—zero-resistance ammeter

Source: NACE/ASTM Standard G193-12d, "Standard Terminology and Acronyms Relating to Corrosion" (ASTM International, West Conshohocken, PA, USA: ASTM International, 2012).

STANDARD ABBREVIATIONS AND UNIT SYMBOLS

absolute	abs
academic degrees	use periods and run together (M.S., Ph.D., etc.)
alternating current, *n.*	AC
alternating current. *adj* .	A-C
American	Am.[a]
American wire gage	AWG
ampere	A
ampere hour	Ah
angstrom	A
ante meridiem	a.m.
Association	Assn.[b]
atmosphere	atm
average	avg
barrel	bbl
becquerel	Bq
billion electronvolts	(use GeV, gigaelectronvolts)
Birmingham wire gage	BWG
brake horsepower	bhp
brake-horsepower hour	bhp · h
Brinell hardness number	HB (see ASTM E 10)
British thermal unit	Btu
Brown and Sharpe (gage)	B&S
bushel	bu
calorie	cal
candela	cd
centimeter	cm
centipoise	cP
centistokes	cSt
circular mil	cmil
coefficient	*spell out*
Company	Co.[b]
Corporation	Corp.[b]
coulomb	C
cubic	use exponential form[c]
cubic centimeter	cm^3
cubic decimeter	dm^3
curie	Ci

cycles per minute	cpm
cycles per second	(use Hz. hertz)
day	*spell out*
decibel	dB
degree (angle)	°
degree Celsius	°C
degree Fahrenheit	°F
degree Rankine	°R
degrees of freedom	df
Department	Dept.[b]
diameter	dia (in figures and tables only)
differential	d
direct current, *n*.	DC
direct current, *adj* .	D-C
Division	Div.[b]
dollar	$
effective horsepower	ehp
electromotive force	emf
electronvolt	eV
Engineers	Engrs.[a]
equation(s)	Eq(s)
farad	F
figure(s)	Fig(s).[d]
foot	ft.
footcandle	fc
foot pound-force	ft. · lbf (use for work, energy) (see lbf · ft.)
gallon	gal
gauss	G
gilbert	Gb
grain	*spell out*
gram	g
gravity (acceleration)	*g*
gray Gy	
half hard	½ H
henry	H
hertz	Hz
horsepower	hp
horsepower hour	hp · h
hour	h
Hurter and Driffield scale	H&D (film density)

hydrogen ion concentration. negative logarithm of	pH
inch	in.
inch of mercury	in. Hg
inch of water	in. H_2O
inch pound-force	in. · lbf (use for work, energy) (see lbf · in.)
inclusive	incl (in figures and tables only)
Incorporated	Inc.[(b)]
indicated horsepower	ihp
inside diameter	ID (in figures and tables only)
Institute	Inst.[(b)]
integrated neutron flux	nvt. n/cm^2
iron pipe size	IPS
joule	J
K alpha radiation	K*Đ*
kelvin	K
kilocalorie	kcal
kilocycle per second	(see note on cycles per second)
kilogram	kg
kilogram-calorie	kg · cal
kilogram-force	kgf
kilogram meter	kg · m
kilometer	km
kilovolt	kV
kilovolt ampere	kVA
kiloelectronvolt	keV
kilovolt peak	kVp
kilowatt	kW
kilowatt hour	kWh
kip (1,000 lbf)	*spell out*
kip (1,000 lbf) per square inch	ksi
Knoop hardness number	HK
lambert	L
linear	*spell out*
liter	L
logarithm (common)	log
logarithm (natural)	ln
lumen	lm
lux	lx
magnetomotive force	mmf
mass-to-charge ratio	*m/e*

maximum	max (in figures and tables only)
maxwell	Mx
median effective concentration	EC_{50}
median effective dose	ED_{50}
median lethal concentration	LD_{50}
median lethal dose	LC_{50}
megacycles per second	(see note on cycles per second)
megawatt	MW
meta	*m*
meter	m
microampere	μA
microcurie	μCi
microfarad	μF
microgram	μg
microhenry	μH
microinch	μin.
microliter	μL
micro-micro (prefix. use pico)	p
micrometer (formerly micron)	μm
microroentgen	μR
microsecond	μs
microvolt	μV
microwatt	μW
mil	*spell out*
mile	*spell out*
miles per hour	mph
milliampere	mA
milli-angstrom	mA
millicurie	mCi
milliequivalent	meq
milligram	mg
millihenry	mH
milliliter	mL
millimeter	mm
millimeter of mercury	mm Hg
million electronvolts	MeV
milliroentgen	mR
millisecond	ms
millivolt	mV
milliwatt	mW
minimum	min (in figures and tables only)
minute	min (spell out when used with minimum)

molal	*spell out*
molar	*M*
mole	mol
month (When followed by a date use Jan., Feb., March, April, May, June, July, Aug., Sept., Oct., Nov., Dec. When there is no date, spell out. Examples: Jan. 15, 1983; January 1983)	*spell out*
nanometer (formerly millimicron)	nm
National	Nat.[a]
newton	N
normal	*N*
number(s) (This abbreviation can often be omitted entirely. It is usually understood)	No(s).[d]
oersted	Oe
ohm	
ortho	*o*
ounce	oz
outside diameter	OD (in figures and tables only)
page	p.
pages	pp.
para	*p*
parts per billion	ppb
parts per million	ppm
pascal	Pa
per	use the diagonal line in expressions with unit symbols[e]
percent	%
pico (prefix)	p
picofarad	pF
pint	pt
poise	P
Poisson's ratio	μ (*v* is preferred in applied mechanics)
post meridiem	p.m.
pound	lb.
pound-force	lbf
pound-force foot	lbf · ft. (use for torque) (see ft. · lbf)

pound-force inch	lbf · in. (use for torque) (see in. · lbf)
pound-force per square foot	$lbf/ft.^2$
pound-force per square inch	psi or $lbf/in.^2$
pound-force per square inch absolute	psia
pound-force per square inch gage quart	psig
quart	qt
rad (dose unit)	rd
radian	rad
radio frequency, *n.*	rf
radio frequency, *adj.*	r-f
radius	R (in figures and tables only)
Railway	Ry.[b]
Railroad	R.R.[b]
reference(s)	Ref(s)
relative humidity	RH (in figures and tables only)
revolution per minute	r/min
revolution per second	r/s
Rockwell hardness, C scale	HRC
roentgen	R
root mean square	rms
Saybolt Furol seconds	SFS
Saybolt Universal seconds	SUS
second	s
secondary	*sec*
siemens	S
Society	Soc.[b]
socket joint (tables and drawings only)	*S* J
specific gravity	sp gr
square	use exponential form (exception: psi, ksi)[c]
standard taper (tables and drawings only)	T_S
steradian	sr
stokes	St
tensile strength	*spell out*
tertiary	*tert*
tesla	T
thousand electronvolts	keV

thousand pounds	kip
thousand pounds-force per square inch	ksi
ton	*spell out*
torr	*spell out*
United States, *n.*	*spell out*
United States, *adj.*	U.S.
Unites States Pharmacopeia	USP
versus	*spell out*
Vickers hardness number	HV
volt	V
volume (of a publication)	Vol[(d)]
watt	W
watt hour	Wh
weber	Wb
week	*spell out*
yard	yd
year	*spell out*
Young's modulus	*E*

(a) In footnotes and references only.
(b) At end of name only.
(c) With unit symbols only.
(d) Only when followed by a number.
(e) Exceptions: cpm, mph, psi.

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