

19

CHAPTER

GLOSSARY

Contents

Part 1, Introduction, 19.2

Part 2, Terms, 19.3

References, 19.21

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Introduction

This glossary uses terms found in the third edition of the *Nondestructive Testing Handbook* (ASNT 1998-2012). The definitions have been selected and in many cases modified to satisfy the practical needs of the aerospace community.

The definitions in this *ASNT Industry Handbook* volume should not be referenced for tests performed according to standards or specifications or in fulfillment of contracts. Standards writing bodies take great pains to ensure that their standards are definitive in wording and technical accuracy. People

working to written contracts or procedures should consult definitions referenced in standards when appropriate. For example, persons who work in accordance with standards published by ASTM International are encouraged to refer to definitions in those standards (ASTM 2014).

Some definitions are related to physical processes or quantities and are clarified in the literature (CRC 2014; Mordfin 2002).

This glossary is provided for instructional purposes. No other use is intended.

A

A-scan: One-dimensional display of ultrasonic signal amplitude as function of time or depth in test object.

absolute coil: Coil that responds to the electromagnetic properties of that region of the test part within the magnetic field of the coil, without comparison to the response of a second coil at a different location on the same or similar material.

absorbed dose: Amount of energy imparted to matter by an ionizing event per unit mass of irradiated material at the place of interest. *Absorbed dose* is expressed in *gray* (Gy) or *rad*.

absorption: Phenomenon in which radiant energy enters a material and stays there rather than being transmitted, reflected, or refracted. The energy converts to another form, as when X-ray photons become electrons or sound waves create heat.

absorption coefficient: Fractional decrease in intensity of transmitted energy due to absorption processes per unit of thickness of absorbing material.

absorptivity (absorptance): In thermography, proportion (as a fraction of 1) of the radiant energy impinging on a material's surface that is absorbed into the material. For a blackbody, this is unity (1.0).

accelerator: (1) Device that accelerates charged particles to high energies. Examples are X-ray tubes, linear accelerators, and betatrons.
(2) Linear accelerator.

acceptance criterion: Benchmark against which test results are to be compared for purposes of establishing the functional acceptability of a part or system being examined.

acceptance standard: Specimen, similar to the product to be tested, containing natural or artificial discontinuities that are well defined and similar in size or extent to the maximum acceptable in the product. Examples include plates with notches, holes, or grown cracks of known dimensions.

accommodation: Of the eye, adjustment of the lens' focusing power by changing the thickness and curvature of the lens by the action of tiny muscles attached to the lens. Accommodation facilitates the viewing of objects near and far.

accuracy: Degree of conformity of a particular measurement to a standard or true value.

acoustic emission (AE): Transient elastic waves resulting from local internal microdisplacements in a material. By extension, the term also describes the testing and measurement using this phenomenon.

acoustic emission activity: Number of bursts (or events, if the appropriate conditions are fulfilled) detected during a test or part of a test.

acoustic emission count: Number of times the signal amplitude exceeds the preset reference threshold. Sometimes called *ringdown counts*.

acoustic emission rate: Number of times the amplitude has exceeded the threshold in a specified unit of time.

acoustic impedance: Material property defined as the product of sound velocity and density of the material. The relative transmission and reflection at an interface are governed in part by the acoustic impedances of the materials on each side of the interface.

activation: Process by which neutrons bombard stable atoms and make them radioactive.

activity: Degree of radioactivity of a particular isotope. Activity is expressed as the number of atoms disintegrating per unit of time. Measured in *becquerels*.

acuity: See *neural acuity*; *vision acuity*.

adaptive thresholding: Threshold value varying with inconstant background gray level.

alpha particle: Positively charged helium ion emitted by certain radioactive materials. It is made up of two neutrons and two protons; hence, it is identical with the nucleus of a helium atom.

alternating current magnetization: Magnetization by a magnetic field generated when alternating current is flowing.

ambient light: Light in the environment as opposed to illumination provided by a visual test system.

ambient operating range: Range of ambient temperatures over which an instrument is designed to operate within published performance specifications.

ampere (A): SI unit of electric current.

ampere per meter (A/m): SI compound unit for magnetic field intensity. The measurement 1 A/m, for example, describes a current of 1 A flowing through a coil of 1 m diameter.

amplitude response: Property of a test system whereby the amplitude of the detected signal is measured without regard to phase. Many simple meter-style instruments use this type of readout.

amplitude, echo: Vertical height of a received signal on an A-scan, measured from base to peak for a video presentation or from peak to peak for a radio frequency presentation.

angle beam: Ultrasound beam traveling at an acute angle into a medium. The angle of incidence or angle of refraction is measured from the normal to the entry surface.

angle beam testing: Technique of ultrasonic testing in which transmission of ultrasound is at an acute angle to the entry surface.

angle beam transducer: Transducer that transmits or receives ultrasonic energy at an acute angle to the surface. This may be done to achieve special effects such as setting up transverse or surface waves by mode conversion at an interface.

angle of incidence: Included angle between the beam axis of the incident wave and the normal to the surface at the point of incidence.

angle of reflection: Included angle between the beam axis of the reflected wave and the normal to the reflecting surface at the point of reflection.

angle of refraction: Angle between the beam axis of a refracted wave and the normal to the refracting interface.

anisotropy: Condition in which properties of a medium (velocity, for example) depend on direction in the medium.

anode: (1) In radiologic testing, the positive electrode of a cathode ray tube that generates ionizing radiation. (2) Positively charged terminal, which may corrode electrochemically during production of electric current. Compare *cathode*.

anomaly: Variation from normal material or product quality.

antinode: Point in a standing wave where certain characteristics of the wave field have maximum amplitude.

array: Group of sensors arranged to locate signal sources, to expedite scanning, or to acquire signals whose excitation is phased in its timing.

array transducer: Transducer made up of several piezoelectric elements individually connected so that the signals they transmit or receive may be treated separately or combined as desired. See also *phased array*.

artifact: In nondestructive testing, an indication that may be interpreted erroneously as a discontinuity.

artificial source: Point where elastic waves are created to simulate an acoustic emission event. The term also denotes a device used to create the waves.

attenuation: Decrease in transmitted energy intensity over distance. The loss may be due to absorption, scattering, reflection, leakage, beam divergence, or other material effects.

attenuation coefficient: Fractional decrease in transmitted intensity per unit of material thickness. The attenuation coefficient usually includes scattering and absorption effects of the host material.

B

B-scan: Data presentation technique typically applied to pulse echo techniques of ultrasonic testing. It produces a two-dimensional view of a cross sectional plane through the test object. The horizontal sweep is proportional to the distance along the test object, and the vertical sweep is proportional to depth, showing the front and back surfaces and discontinuities between.

background noise: Extraneous signals caused by random signal sources within or exterior to the ultrasonic testing system, including the test material. It has electrical, mechanical, or chemical origins. Sometimes called *grass* or *hash*.

back reflection: Signal received from the far boundary or back surface of a test object.

backscatter: (1) Interaction of radiation with matter such that the direction of travel after scattering is over 90 degrees and often close to 180 degrees to the original direction of travel. (2) In transmission radiologic testing, interaction of radiation with matter behind the image plane such that scattered radiation returns to the image plane, often adding fog and noise that interfere with production of an image of the specimen. (3) Of scatter imaging, interaction of incident radiation with a specimen that scatters the radiation through large angles frequently greater than 90 degrees to the original direction of travel. Such radiation is used to form an image or to measure a parameter of the specimen, usually through digital techniques.

backscatter imaging: In radiologic testing, a family of radioscopic techniques that use *backscatter*.

backscattering, infrared: Reflection of thermal energy, whether generated by the ground and reflecting off clouds or unwanted front surface reflections from transparent objects.

band pass filter: Frequency filter that has a single transmission band between two cutoff frequencies, neither of the cutoff frequencies being zero or infinity.

bandwidth: Difference between the cutoff frequencies of a bandpass filter.

baseline: (1) Horizontal trace across the A-scan display. It represents time and is generally related to material distance or thickness. (2) Standard measurement, average measurement, prior measurement, or other criterion for comparison and evaluation in quality control.

beam: Defined stream of radiation particles all traveling in parallel paths.

beam quality: Penetrating energy of a radiation beam.

beam spread: Divergence from a beam of radiation in which all particles are traveling in parallel paths. Widening of the sound beam as it travels through a medium. Specifically, the solid angle that contains the main lobe of the beam in the far field.

becquerel (Bq): SI unit for measurement of radioactivity, equivalent to one disintegration per second. Replaces *curie*.

beta particle: Electron or positron emitted from a nucleus during decay.

beta ray: Radiation stream consisting of *beta particles*.

bonds, kissing: Bonded conditions wherein typical test methods indicate a material continuity through the thickness of the bond whereas in fact there is no significant physical strength to the bond.

borescope: Industrial endoscope; a periscope or telescope using mirrors, prisms, lenses, optic fibers, or video signals to transmit images from inaccessible interiors for visual testing. Borescopes take their name from bores because borescopes were originally used in machined apertures and holes such as gun bores. Some borescopes are flexible; some are rigid.

boundary echo: Reflection of an ultrasonic wave from an interface.

Bq: *Becquerel*.

bremsstrahlung: Electromagnetic radiation produced when electrons' path and kinetic energy brings them close to the positive fields of atomic nuclei – as when, for example, electrons strike a target provided for this purpose. The electrons slow down, giving up kinetic energy as X-radiation.

brittleness: Characteristic of a material that leads to crack propagation without appreciable plastic deformation.

broad band: Having a relatively wide frequency bandwidth. Used to describe pulses that display a wide frequency spectrum and receivers capable of amplifying them.

burr: Raised or turned over edge occurring on a machined part and resulting from cutting, punching, or grinding.

burst: Signal whose oscillations have a rapid increase in amplitude from an initial reference level (generally that of the background noise), followed by a decrease (generally more gradual than the initial rise) to a value close to the initial level.

burst duration: Interval between the first and last time a specified threshold is exceeded by a particular burst.

burst emission: Qualitative term denoting acoustic emission when bursts are observed. Opposite of *continuous emission*.

burst rise time: Time interval between the first threshold crossing and the maximum amplitude of the burst.

C

C-scan: Presentation technique applied to acoustic data and displaying an image of two-dimensional test object with scaled grays or colors representing the ultrasonic signals. The amplitude represented in each pixel may be a pulse echo, through-transmission, or pitch catch value calculated from each A-scan datum.

calcium tungstate: Fluorescent chemical compound that emits visible blue violet light when irradiated by X-rays or gamma rays.

calibration, instrument: Adjustment of instrument readings to a known reference standard. Used to ensure instruments are set up in a consistent manner from one inspection to the next.

camera: Device that contains a sealed radiation source, where the source or shielding can be moved so that the source becomes unshielded (to make a radiologic exposure) or shielded (for safe storage).

candela: Base unit of measure in SI for measuring luminous intensity. The luminous intensity in a given direction of a source that emits monochromatic radiation of frequency 5.40×10^{14} Hz and that has a radiant intensity in that direction of 1.4641 mW/sr. Symbolized *cd*. Formerly known as *candle*.

cassette cast structure: Internal physical structure of a casting evidenced by shape, orientation of grains, and segregation of impurities.

cassette, film: Lightproof container for holding radiologic film in position during the radiologic test's exposure. The cassette may be rigid or flexible and may contain intensifying screens, filter screens, both, or neither.

cassette: See *cassette*.

cathode: (1) Negatively charged terminal in an arrangement that produces current by chemical reactions. Compare *anode*. (2) In radiologic testing, the negative electrode of an X-ray tube, the electrode from which electrons are emitted.

cathode ray: Stream of electrons emitted by a heated filament and projected in a more or less confined beam under the influence of a magnetic or electric field.

celsius (centigrade): A relative scale of temperature related to the kelvin scale ($0\text{ }^{\circ}\text{C} = 273.12\text{ K}$; $1\text{ }^{\circ}\text{C} = 1\text{ K}$). Temperature scale based on 273 K ($0\text{ }^{\circ}\text{C} = +32\text{ }^{\circ}\text{F}$) as the freezing point of water and 373 K ($100\text{ }^{\circ}\text{C} = 212\text{ }^{\circ}\text{F}$) as the boiling point of water at standard atmospheric pressure.

centigrade: Celsius.

central conductor: Metal bar passed through a hole in a test object, used for creating a circular magnetic field within the object.

CGS system: Obsolete system of measurement units based on the centimeter, gram, and second. Superseded by *SI*.

characteristic curve: Curve that expresses film density as function of log relative exposure. These curves are useful in determining exposure correction factors and in defining the gamma characteristics of the film.

charge coupled device (CCD): Solid state optical sensor used in imaging systems. Incoming radiation induces electrical charges stored in semiconductor structures for reading.

circular magnetization: Magnetization in an object resulting from current passed longitudinally through the object itself or through an inserted central conductor.

circumferential coil: See *encircling coil*.

closure: Process by which a person cognitively completes patterns or shapes that are incompletely perceived.

coherent radiation: Radiation at the same energy and phase.

coherent scatter: Form of scatter where no energy is lost.

coil: One or more loops of a conducting material; a single coil may be an exciter and induce currents in the material, or it may be a detector or both simultaneously.

- coil spacing:** In eddy current testing, the axial distance between two encircling or inside coils of a differential or remote field test system.
- cold cathode ionization gage:** Pressure measuring gage for low pressures, in the range of 13.3 mPa to below 0.13 nPa (10^{-4} torr to below 10^{-12} torr), that works by measuring a discharge current associated with the ionization of gas by electrons confined in a magnetic field. Also called a *philips discharge gage* or *penning gage*.
- collimator:** Device for restricting the size, shape, and direction of the irradiating beam, thereby limiting beam spread and its consequences.
- color:** Vision sensation by means of which humans distinguish light of differing hue (predominant wavelengths), saturation (degree to which those radiations predominate over others), and lightness.
- comparator coils:** In electromagnetic testing, two or more coils electrically connected in series opposition and arranged so that there is no mutual induction (coupling) between them. Any electromagnetic condition that is not common to the test specimen and the standard will produce an imbalance in the system and thereby yield an indication. Compare *differential coils*.
- compensator blocks:** Material added to regions of a test object to flatten its radiologic test image.
- complex plane diagram:** Graphical presentation of complex quantities where the real and imaginary components are represented along the horizontal and vertical axes, respectively. Types of complex plane diagrams include impedance plane and voltage plane diagrams.
- composite materials:** Engineered materials formed through layering of physical elements aimed at meeting specific mechanical and chemical performance criteria. Examples include honeycomb panels, boron epoxy, and graphite epoxy sheeting.
- compressional wave:** *Longitudinal wave*.
- compton scatter:** Reduction of energy of incident photon by its interaction with an electron. Part of the photon energy is transferred to the electron, giving it kinetic energy, and the remaining photon is redirected with reduced energy.
- computed tomography:** Technique by which radiation passing through an object is displayed as one slice or layer of that object at a time. Image data are processed in three dimensions.
- conductance (G):** Transmission of electric current through a material. Measured in siemens (S). Inversely related to *resistance R* (ohms).
- conduction, thermal:** Heat transfer occurring when more energetic particles collide with – and thus impart some of their heat energy to – adjacent less energetic (slower moving) particles. This action is passed on from one atom (or free electron) to the next in the direction of cooler regions. Thus, heat always flows from a warmer to a cooler region. Compare *conductivity, thermal; thermal diffusion*.
- conductivity, electrical (σ):** Ability of material to transmit electric current. Measured in siemens per meter. Inversely related to *resistivity ρ* .
- conductivity, thermal (k):** Material property defining the relative capability to carry heat by conduction in a static temperature gradient. Conductivity varies slightly with temperature in solids and liquids and with temperature and pressure in gases. It is high for metals (copper has a k of $380 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$) and low for gases and porous materials (concrete has a k of $1.0 \text{ W}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$). Compare *conduction, thermal*.
- contact head:** Electrode assembly used to clamp and support an object to facilitate passage of electric current through the object for circular magnetization.
- contact technique:** Testing technique in which the transducer face makes direct contact with the test object through a thin film of couplant.
- contact transducer:** Transducer used in the contact technique.
- continuous emission:** Qualitative term applied to ongoing acoustic emission in which the bursts or pulses are not individually discernible – for example, emission from a leak.
- continuous wave:** Wave of constant amplitude and frequency.
- contrast:** (1) Difference in color or brightness between a test indication and its background or surroundings. (2) In film radiologic testing, the difference in film blackening or density observed from one area to another and resulting from various radiation intensities transmitted by the object.
- contrast, subject:** Ratio of radiation intensities transmitted by selected portions of object being radiographed.
- control cable:** Cable connected to isotopic radiologic test source and used to move the source in and out of the exposure device.
- corner effect:** Strong reflection obtained when an ultrasonic beam is directed toward the intersection of two or three intersecting surfaces.
- corrosion:** Loss or degradation of metal caused by chemical reaction and appearing as pitting and loss of material. Galvanic corrosion is caused by electrical contact between dissimilar metals and by entrapped fluids that permit the electronic interchange of ions between adjoining metal surfaces. Mechanisms of corrosion include crevice corrosion and stress corrosion in the form of cracking.
- couplant:** Substance used between the transducer and the contacting surface to permit or improve transmission of ultrasonic energy into or from the test object.
- coupled:** (1) Of two electric circuits, having an impedance in common so that a current in one causes a voltage in the other. (2) Of two coils, sharing parts of their magnetic flux paths.
- coupling:** Percentage of magnetic flux from a primary circuit that links a secondary circuit; effectiveness of a coil in inducing eddy currents in the test object.
- coupling coefficient:** Fraction of magnetic flux from one circuit (test coil) that threads a second circuit (test object); the ratio of impedance of the coupling to the square root of the product of the total impedances of similar elements in the two meshes.

crack: (1) Break, fissure, or rupture, sometimes V shaped and relatively narrow and deep. Discontinuity that has a relatively large cross section in one direction and a small or negligible cross section when viewed in a direction perpendicular to the first. (2) Propagating discontinuity caused by applied stresses such as mechanical flexing (fatigue crack). Difficult to detect unaided because of fineness of line and pattern (may have a radial or latticed appearance).

crack, fatigue: Progressive crack that usually is initiated at a free surface such as a fastener hole and is caused by the repeated mechanical loading and unloading of the object.

critical angle: Incident angle of the ultrasound beam where the refracted beam is parallel to the surface and above which a specific mode of refracted energy no longer exists.

cross talk: Unwanted signal leakage (acoustical or electrical) across an intended barrier, such as leakage between the transmitting and receiving elements of a dual transducer. Also called cross noise and cross coupling.

crushed core: Mechanically deformed inner core of honeycomb composite components.

crystal mosaic: Multiple crystals mounted in the same surface on one holder and connected so as to cause all to vibrate as one unit.

cumulative bursts: Number of bursts detected from the beginning of a test.

cumulative characteristic distribution: In acoustic emission signal processing, a display of the number of times a characteristic meets a preselected criterion.

curie (Ci): Unit for measurement of the quantity of radioactivity, corresponding originally to radiation from atomic disintegrations from 1 g of radium; replaced by *becquerel* (Bq) in SI, where 1 Ci = 3.7×10^{10} Bq.

current flow technique: Magnetizing by passing current through an object using prods or contact heads. The current may be alternating current or rectified alternating current.

current induction technique: Magnetization in which a circulating current is induced in a ring component by a fluctuating magnetic field.

cutoff frequency: Upper or lower spectral response of a filter or amplifier, at which the response is a specified amount less (usually 3 or 6 dB) than the maximum response.

D

damping capacity: Measure of the ability of a material to dissipate mechanical energy.

damping material: Highly absorbent material used to cause rapid decay of vibration.

damping, transducer: Material bonded to the back of the piezoelectric element of a transducer to limit the duration of vibrations.

damping, ultrasonic: Decrease or decay of ultrasonic wave amplitude controlled by the instrument or transducer.

damping: (1) Limiting the duration or decreasing the amplitude of vibrations, as when damping a transducer element. (2) Deliberate introduction of energy absorbers to reduce vibrations.

dead zone: Interval following the initial pulse at the surface of a test object to the nearest inspectable depth. Any interval following a reflected signal where additional signals cannot be detected.

decay curve: Graph showing radioactive intensity as a function of time for an isotope. Decay curves are used in determining exposure times in radiologic testing.

decibel (dB): Logarithmic unit for expressing relative signal power, such as the loudness of a sound, in proportion to the intensity of a reference signal. One tenth of a *bel*. Decibel in signal amplitude is twice that in signal power. One decibel equals ten times the base ten logarithm of the ratio of two powers.

defect: Discontinuity whose size, shape, orientation, or location make it detrimental to the useful service of its host object or which exceeds the accept/reject criteria of an applicable specification. Some discontinuities do not exceed an accept/reject criterion and are therefore not defects. Compare *crack*; *discontinuity*; *indication*.

definition: Description of linear demarcation sensitivity or the detail sharpness of object outline in a radiologic test image. It is a function of screen type, exposure geometry, radiation energy, and characteristics sensor (such as film).

deformation: Change of shape under load.

delamination: Separation of plies in composite layered materials.

delay line: Material (liquid or solid) placed in front of a transducer to cause a time delay between the initial pulse and the front surface reflection.

depth of field: The range of distance over which an imaging system gives satisfactory definition when its lens is in the best focus for a specific distance. Compare *depth of focus*; *field of view*.

depth of focus: *Focal zone*. Distance a sensor may be moved from a lens system and still produce a sharp image.

depth of penetration: See *skin effect* and *standard depth of penetration*.

detail: In radiologic testing, the degree of sharpness of outline of an image or the clear definition of an object or discontinuity in the object. See also *definition*.

detector coil: See *sensing coil*.

detector, X-ray: *Sensor, X-ray*.

developer: In film radiologic testing, a chemical solution that reduces exposed silver halide crystals to metallic silver.

dewaxing: Removing the expendable wax pattern from an investment mold by heat or solvent.

differential coils: Two or more physically adjacent and mutually coupled coils connected in series opposition such that an imbalance between them, causing a signal, will be produced only when the electromagnetic conditions are different in the regions beneath the coils. In contrast, comparator coils are not adjacent or mutually coupled. Compare *comparator coils*.

diffraction: (1) In acoustics, the reflection of a wave front when passing the edge of an ultrasonically opaque object. (2) In radiation technologies, a special case of scatter, where coherently scattered photons undergo interference or reinforcement, resulting in patterns indicative of the scattering medium. See also *X-ray diffraction*.

diffuse reflection: Scattered, incoherent reflections from rough surfaces.

direct current: Electric current flowing continually in one direction without variation in amplitude through a conductor. See also *full-wave rectified direct current* and *half-wave direct current*.

direct current field: Active magnetic field produced by direct current flowing in a conductor or coil.

direct viewing: (1) Viewing of a test object in the viewer's immediate presence. The term *direct viewing* is used in the fields of robotics and surveillance to distinguish conventional from remote viewing. (2) Viewing of a test object during which the light image is not mediated through a system of two or more lenses (as in a borescope) or transduced through an electronic signal (as with a charge coupled camera). The term *direct viewing* is used in some specifications to mean viewing possibly with a mirror or magnifier but not with a borescope. Compare *indirect viewing*; *remote viewing*.

disbonds: Separation of bonded surfaces in structures such as skins from honeycomb core structures, patches from aluminum structures and similar adjoining laminated sheet-like materials.

discontinuity: Interruption in the physical structure or configuration of a test object. After nondestructive testing, a discontinuity indication may be interpreted to be a defect. Compare *defect*; *indication*.

discontinuity, artificial: Reference discontinuity such as hole, indentation, crack, groove, or notch introduced into a reference standard to provide accurately reproducible indications for determining test sensitivity levels.

discontinuity characterization: The process of quantifying the size, shape, orientation, location, growth, or other properties of a discontinuity based on test data.

discontinuity resolution: Property of a test system that enables the separation of nearby indications in a test specimen.

dispersion: In acoustics, variation of wave phase with frequency.

dispersive medium: Medium in which the propagation velocity depends on the wave frequency.

distal: In a manipulative or interrogating system, of or pertaining to the end opposite from the eyepiece and farthest from the person using the system. Objective; tip.

distance amplitude correction: Compensation of gain as a function of time for difference in amplitude of reflections from equal reflectors at different sound travel distances. Refers also to compensation by electronic means such as swept gain, time corrected gain, time variable gain and sensitivity time control.

divergence: Term sometimes used to describe the spreading of ultrasonic waves beyond the near field. It is a function of transducer diameter and wavelength in the medium. See *beam spread*.

dose: See *absorbed dose*.

dose rate: Radiation dose delivered per a specified unit of time and measured, for instance, in sieverts per minute. See also *absorbed dose*.

dosimeter: Device that measures radiation dose, such as a film badge or ionization chamber.

double-crystal technique: See *pitch catch technique*.

dual transducer: See *send/receive transducer*.

dynamic range: Ratio of maximum to minimum reflective areas that can be distinguished on the display at a constant gain setting.

E

echo: Reflected acoustic energy or signal indicating such energy.

eddy current: Electrical current induced in a conductor by a time varying magnetic field.

eddy current testing: Nondestructive test technique in which eddy current flow is induced in the test object. Changes in the flow caused by variations in the specimen are reflected into a nearby coil, coils, hall effect device, or other magnetic flux sensor for subsequent analysis by suitable instrumentation and techniques.

edge effect: In electromagnetic testing, the disturbance of the magnetic field and eddy currents because of the proximity of an abrupt change in geometry, such as an edge of the test object. Sometimes called *end effect*. The effect generally results in the masking of discontinuities within the affected region.

effective depth of penetration: In electromagnetic testing, the minimum depth beyond which a test system can no longer practically detect a further increase in specimen thickness. Usually equal to about three standard depths of penetration.

effective focal spot: Size and geometry of focal spot after target interaction. Viewed from along the primary beam central axis at the target, the effective focal spot would appear nearly square and smaller than the actual focal spot area covered by the electron stream.

effective penetration: In a material, the maximum depth at which a test signal can reveal discontinuities.

electrical noise: Extraneous signals caused by external sources or electrical interferences within an ultrasonic instrument. A component of *background noise*.

electromagnet: Ferromagnetic core surrounded by a coil of wire that temporarily becomes a magnet when an electric current flows through the wire.

electromagnetic acoustic transducer (EMAT): Transmitting transducer based on the force exerted on a current flowing in a magnetic field. A receiving transducer that detects the current produced by moving a conductor in a magnetic field.

electromagnetic testing (ET): Nondestructive test method for materials, including magnetic materials, that uses electromagnetic currents, either alternating or direct current, to yield information about the test object. In nondestructive testing, the term electromagnetic testing is not applied to methods such as radiologic and thermographic testing, in which the interrogating energy is a form of electromagnetic radiation.

electronvolt (eV): Kinetic energy acquired by an electron in passing through a potential difference of 1 V in vacuum; 1 eV = ~1.60 J. The electronvolt is commonly used to express the energy of X-rays.

EMAT: See *electromagnetic acoustic transducer*.

encircling coil: In electromagnetic testing, a coil or coil assembly that surrounds the test object. Such a coil is also called an *annular coil*, *circumferential coil*, or *feed-through coil*. It is commonly used for testing wire, tubing, and bar materials as well as small components in production.

end effect: Alternative term used for edge effect when testing bar and tube shaped materials.

eV: *Electronvolt*.

evaluation: Review, following interpretation of indications, to determine whether they meet specified acceptance criteria.

excitation coil: Coil that carries the excitation current. Also called *primary coil* or *winding*. See *sensing coil*.

exfoliation: Corrosion that progresses approximately parallel to the outer surface of the metal, causing layers of the metal to be elevated by the formation of corrosion product.

expanded sweep: Short duration horizontal sweep positioned to allow close examination of a signal.

exposure factor: In X-ray radiologic testing, the quantity that combines source intensity (milliamperage), time (usually minute), and distance. It is the product of milliamperage and time divided by distance squared and determines the degree of film density.

F

far field: Zone beyond the near field in front of a plane transducer in which signal amplitude decreases monotonically in proportion to distance from the transducer. Also called the *fraunhofer zone*.

fatigue fracture: Progressive fracture of a material that begins at a discontinuity and increases under repeated cycles of stress. The phenomenon leading to fracture under repeated or fluctuating stresses having a maximum value less than the tensile strength of the material.

feature extraction: From an enhanced image, derivation of some feature values, usually parameters for distinguishing objects in the image.

felicity effect: Appearance of significant acoustic emission at a load (or pressure) level below the previous maximum applied.

felicity ratio: Measurement of the felicity effect.

Defined as the ratio between (1) the applied load (or pressure) at which acoustic emission reappears during the next application of loading and (2) the previous maximum applied load.

ferrite: Any of several magnetic substances that consist of an iron oxide combined with one or more metals (such as manganese, nickel, or zinc) having high magnetic permeability and high electrical resistivity.

ferromagnetic material: Material such as iron, nickel, or cobalt whose relative permeability by magnetizing force is much greater than unity. A ferromagnetic material is strongly affected by magnetism and exhibits hysteresis.

fiber optics: Technology of efficient transmission of light through transparent fibers such as glass, quartz, and plastic by means of total internal reflection.

field of view (FOV): Range or area where things can be seen through an imaging system, lens, or aperture. Angular subtense (expressed in angular degrees or radians per side if rectangular or in angular degrees or radians if circular) over which an instrument will integrate all incoming radiant energy. In a radiation thermometer, the *field of view* is the target spot size; in a scanner or imager, the *field of view* is the scan angle, picture size, or total field of view. Compare *depth of field*.

field of vision: Range or area where things can be perceived organoleptically at a point in time, assuming the eye to be immobile.

film badge: Package of photographic film worn as a badge by radiologic test personnel (and by workers in the nuclear industry) to measure exposure to ionizing radiation. Absorbed dose can be calculated by degree of film darkening caused by irradiation.

film holder: See *cassette*, *film*.

film speed: Relative exposure required to attain a specified film density for a particular film.

filter: (1) Data processing component or function that excludes a selected kind of signal or part of a signal. (2) Network or device that passes electromagnetic wave energy over a described range of frequencies and attenuates energy at all other frequencies. In radiologic testing, the thickness of absorbing material placed in a primary radiation beam to selectively remove longer wavelength radiation, thereby adjusting the quality of the image.

fire damage: Reduction in strength caused by subsequent heating to alloys of aluminum and detectable using eddy current detection of changes in electrical conductivity.

fixing: Procedure used in film processing that removes undeveloped silver salts in the emulsion from the surface of the film, leaving only the developed black silver of the image on the film.

flat bottom hole: Type of reflector commonly used in reference standards. The end (bottom) surface of the hole is the reflector.

flaw: Unintentional anomaly. Compare *defect*; *discontinuity*.

focal point: Point at which the instrument optics image the radiation detector at the target plane. In a radiation thermometer, this is where the spot size is the smallest. In a scanner or imager, this is where the instantaneous field of view is smallest.

focus: Position of a viewed object and a lens system relative to one another to offer a distinct image of the object as seen through the lens system. See *accommodation* and *depth of field*.

focus, principal plane of: Single plane actually in focus in a photographic scene.

focused beam: Sound beam that converges to a cross section smaller than that of the element.

focused transducer: Transducer that produces a focused sound beam.

fog: In film radiologic testing, increase of film density caused by sources other than from the intended primary beam exposure. Heat, humidity, pressure, and scatter radiation can all cause fogging of the film.

foil: Metal in sheet form less than 0.15 mm (0.006 in.) thick.

foreign materials: Inclusions that may be sand, slag, oxide, dross metal, or any dissimilar material in the material being examined. In radiologic test film, foreign materials may appear as isolated, irregular, or elongated variations of film density not corresponding to variations in thickness of material or to cavities.

FOV: *Field of view*.

frequency: Number of complete wave cycles passing a given point per second or the number of vibrations per second.

frequency, fundamental: In resonance testing, the frequency at which the wavelength is twice the thickness of the test material.

frequency, pulse repetition: Number of pulses per second.

frequency, response: Amplification (gain) of a receiver over a range of frequencies.

frequency, test: In ultrasonic testing, the nominal wave frequency in a given test.

front surface: First surface of the test object encountered by an ultrasonic beam.

full-wave rectified direct current: Single-phase or three-phase alternating current rectified to produce a unidirectional current. The rectified current contains ripple.

G

gamma rays: High energy, short wavelength electromagnetic radiation emitted by the nucleus of a radioactive isotope. Energies of gamma rays are usually between 0.01 and 10 MeV. X-rays also occur in this energy range but are of nonnuclear origin.

gate: (1) Electronic device for selecting signals in a segment of the trace on an A-scan display.
(2) The interval along the baseline that is monitored.

gauss (G): Traditional unit of magnetic flux density, replaced in SI by *tesla* (T). 1 G = 0.1 mT.

gauss meter: Gage that measures magnetic flux density in gauss (or tesla).

geometric unsharpness: See *unsharpness*, *geometric*.

ghost: False indication arising from certain combinations of pulse repetition frequency and time base frequency. See also *wrap around*.

gradient: Slope of *characteristic curve* for specified film density.

graininess: Film characteristic that results from improper film processing and that consists of the grouping or clumping together of many small silver grains into masses visible to the naked eye or with slight magnification.

grains: (1) Solid particle or crystal of metal. As molten metal solidifies grains grow and lattices intersect, forming irregular grain boundaries.

(2) Individual crystals that make up the crystalline structure of metal.

grass: See *background noise*.

gray (Gy): SI unit for measurement of the dose of radiation absorbed per unit mass at a specified location. Replaces the *rad* where *rad* denotes radiation *absorbed dose*, not *radian*. 1 Gy = 1 J/kg = 100 rad.

gray level: Integer number representing the brightness or darkness of a pixel or, as a composite value, of an image comprised of pixels.

guide tube: Cable connected to isotopic radiation source and used to move the source in and out of the exposure device.

Gy: Gray.

H

halation: Spreading of light around a bright image on a fluorescent screen or developed film.

half-wave direct current: Single-phase alternating current half-wave rectified to produce a pulsating unidirectional current. Also called *half-wave current*.

hall detector: Semiconductor element that produces an output electromotive force proportional to the product of the magnetic field intensity and a biasing current.

hardness: Resistance of metal to plastic deformation, usually by indentation. However, the term may also refer to stiffness or temper or to resistance to scratching, abrasion, or cutting.

harmonic: Vibration frequency that is an integral multiple of the fundamental frequency.

heat affected zone: Base metal that was not melted during brazing, cutting, or welding but whose microstructure and physical properties were altered by the heat.

hertz (Hz): Measurement unit of frequency, equivalent to one cycle per second.

horizontal linearity: Measure of proportionality between positions of indications on the horizontal trace and the physical positions of their corresponding reflectors.

hysteresis: Apparent lagging of the magnetic effect when the magnetizing force acting on a ferromagnetic body is changed; phenomenon exhibited by a magnetic system wherein its state is influenced by its previous history.

hysteresis loop: Curve showing flux density **B** plotted as a function of magnetizing force **H** as magnetizing force is increased to the saturation point in both negative and positive directions sequentially. The curve forms a characteristically shaped loop.

image: Visual representation of a test object or scene.

image enhancement: Any of a variety of image processing steps, used singly or in combination to improve the detectability of objects in an image.

image orthicon: Television tube that uses the photoemission method. Compare *vidicon tube*.

image processing: Actions applied singly or in combination to an image, in particular the measurement and alteration of image features by computer.

image quality indicator: Strip of material of the same composition as that of the test material, representing a percentage of object thickness and provided with a combination of steps, holes, slots, or series of wires. When placed in the path of the rays, its image provides a check on the radiologic test technique. Also called *penetrameter*.

image segmentation: Process in which the image is partitioned into regions, each homogeneous.

immersion technique: Test technique in which the test object and the transducer are submerged in a liquid (usually water) that acts as the coupling medium. The transducer is not usually in contact with the test object.

impact damage: A condition found in composite layered structures wherein internal disbonding occurs with little external sign of its existence.

impedance (Z): Opposition that a circuit presents to the flow of an alternating current. Often expressed for a coil as being comprised of a resistance R plus an inductive reactance X_L .

impedance analysis: In electromagnetic testing, an analytical technique that consists of correlating changes in the amplitude, phase, quadrature components, or all of these of a complex test signal voltage to the condition of the test specimen.

impedance, acoustic: See *acoustic impedance*.

impedance diagram, normalized: Diagram in which the impedance of the probe in air is a reference value to which impedance values in other conditions are compared. Usually the plotted data are (1) the measured reactance divided by the reactance of the coil in air versus (2) the measured resistance less the resistance in air divided by the coil reactance in air.

impedance plane diagram: Graphical representation of the locus of points indicating the variations in the impedance of a test coil as a function of a parameter, such as *conductivity* or *lift-off*.

in-motion radiologic testing: Technique in which either the object being radiographed or the source of radiation is in motion during the exposure.

incident radiation: Primary radiation striking an object at closest point.

indication: Nondestructive test response that requires interpretation to determine its relevance. These include such things as meter deflections, shadows on radiographs, blips on screens, or localized discolorations on surfaces. See also *defect*; *discontinuity*; *indication, false*; *indication, nonrelevant*.

indication, discontinuity: Visible evidence of a material discontinuity. Subsequent interpretation is required to determine the significance of an indication.

indication, false: Test indication that could be interpreted as originating from a discontinuity where no discontinuity exists. Compare *defect*; *ghost*; *indication, nonrelevant*. False indications are an economic liability for inspection because they must be investigated.

indication, nonrelevant: Indication due to misapplied or improper testing. May also be an indication caused by an actual discontinuity that does not affect the usability of the test object (a change of section, for instance).

indication, relevant: Indication from a discontinuity (as opposed to a nonrelevant indication) requiring evaluation by a qualified inspector, typically with reference to an acceptance standard, by virtue of the discontinuity's size, shape, orientation, or location.

indirect viewing: Visual test during which the light image is mediated through a system of two or more lenses (as in a borescope) or transduced through an electronic signal (as with a charge coupled camera). Compare *direct viewing*.

inductance (L): The ratio of the magnetic flux to the current causing it; more accurately, the self-inductance of the circuit.

inductive reactance (X_L): Reaction of the inductor to the changing value of alternating current. Inductive reactance is measured in ohms. Numerically it is equal to the product of the coil's inductance L , its excitation frequency f , and 2π . It is often written as ωL , where angular frequency $\omega = 2\pi f$.

inductor: Passive electrical device employed in circuits for its property of inductance. With or without a ferromagnetic core, it can be a coil that impedes the flow of alternating current.

infrared: Beyond infrared, referring to radiation with frequency lower than, and wavelength greater than, that of the color red. See *infrared radiation*.

infrared radiation: Radiant energy beyond the color red, of wavelengths from the red visible (0.75 μm) to about 300 μm , between the visible and microwave regions of the electromagnetic spectrum.

infrared thermography: Imaging of a temperature field through the emitted infrared radiation. See *infrared radiation*. Compare *thermography*.

inherent discontinuities: Discontinuities produced in the material at the time it is formed (for example, in metal, during solidification from the molten state).

initial permeability: Slope of the induction curve at zero magnetizing force as the test specimen begins to be magnetized from a demagnetized condition (slope at the origin of the B,H curve before hysteresis is observed).

initial pulse: Pulse applied to excite the transducer. It is the first indication on the screen if the sweep is undelayed. Also called the *main bang*. May refer to an electrical pulse or an acoustic pulse.

inside diameter coil: Coil or coil assembly used for electromagnetic testing by insertion into the test piece, as with an inside-surface probe for tubing. Sometimes called *bobbin coil* or *inserted coil*.

inspection reliability: Level of confidence, expressed explicitly in statistical terms or implied in noncritical cases, that is believed to exist while performing nondestructive tests. Sometimes expressed in terms of probability of detection (POD), percentages of hits, misses, or false calls.

interface: Physical boundary between two adjacent media.

interface triggering: Triggering the sweep and auxiliary functions from an interface echo occurring after the initial pulse. Also called *interface synchronization*.

interlaced scanning: Process whereby the picture appearing on a video screen is divided into two parts. Interlaced scanning reduces flicker by increasing the electron beam's downward rate of travel so that every other line is sent. When the bottom is reached, the beam is returned to the top and the alternate lines are sent. The odd and even line scans are each transmitted at 1/60 s, totaling 1/30 s per frame and retaining the standard rate of 30 frames per second. The eye's persistence of vision allows the odd and even lines to appear as a single image without flicker.

International Annealed Copper Standard (IACS): Conductivity measurement system in which the conductivity of annealed, unalloyed copper is arbitrarily rated at 100 percent and in which the conductivities of other materials are expressed as percentages of this standard.

interpretation: Determination of the cause and relevance of test indications and their significance to the evaluation of the test object.

inverse square law: Physical law stating that, from a point source of radiation, the intensity of energy is inversely proportional to the square of the distance from the origin.

ionizing radiation: Form of radiation that can displace orbital electrons from atoms. Types include X-rays, gamma rays, and particles such as neutrons, electrons, and alpha particles.

IQI: Image quality indicator.

irradiance: Power of electromagnetic radiant energy incident on or radiated from the surface of a given unit area. Compare *radiance*.

isotropy: Condition in which significant medium properties (sound speed, for example) are the same in all directions.

K

kaiser effect: Absence of detectable acoustic emission until the previous maximum applied stress level has been exceeded.

kelvin: Absolute temperature scale related to the celsius (or centigrade) relative scale. The kelvin unit is equal to 1 °C; 0 kelvin = -273.16 °C; the degree sign and the word *degree* are not used in describing kelvin temperatures.

L

lamb wave: Type of ultrasonic wave propagation in which the wave is guided between two parallel surfaces of the test object. Mode and velocity depend on the product of the test frequency and the thickness. Also called *plate wave*.

leakage flux: (1) Magnetic flux of the coil that does not link with the test object. (2) Magnetic flux that leaves a saturated or nearly saturated specimen at a discontinuity.

lens: Transparent object that refracts light passing through it in order to focus the light.

liftoff: Distance between the probe coil and the test object. In an electromagnetic test system output, the effect observed due to a change in coupling between a test object and a probe whenever the distance between them is varied.

light: Visible radiation; radiant energy that can excite the retina and produce a visual sensation; visible portion of the electromagnetic spectrum, from about 380 to 800 nm.

light metal: Low density metal such as aluminum, magnesium, titanium, or beryllium.

linearity, amplitude: Constant proportionality between the signal input to the receiver and the amplitude of the signal appearing on the display of the ultrasonic instrument or on an auxiliary display. Also called *vertical linearity*.

line pair: Pair of adjacent, parallel lines used to evaluate the resolution of an imaging system.

location plot: Spatial representation of acoustic emission sources computed using an array of transducers.

longitudinal wave: Acoustic wave in which particle motion in the material is parallel to the direction of wave propagation. Also called *compressional wave*.

loss of back reflection: Absence or significant reduction of an indication from the back surface of the test object.

low pass filtering: Linear combination of pixel values to smoothen abrupt transitions in a digital image. Also called *smoothing*.

lumen (lm): Luminous flux per steradian from a source whose luminous intensity is 1 cd.

luminance: Ratio of a surface's luminous intensity in a given direction to a unit of projected area. Measured in candela per square meter.

luminosity: Luminous efficiency of radiant energy.

lux (lx): SI unit of illuminance, equal to one lumen per square meter (1 lx = 1 lm/m²).

M

machine vision: Automated system function of acquiring, processing, and analyzing images to evaluate a test object or to provide information for human interpretation. A typical system consists of a light source, a video camera, a video digitizer, a computer, and an image display.

magnetic field: Distribution of a vector quantity that is a measure of an exerted magnetic force. May be used with both magnetic flux density \mathbf{B} and magnetizing force \mathbf{H} . The flux lines of a typical magnetic field traverse the component in a direction essentially parallel with its longitudinal axis.

magnetic field intensity (\mathbf{H}): Strength of a magnetic field at a specific point. Measured in ampere per meter.

magnetic flux density (\mathbf{B}): Normal magnetic flux per unit area, measured in *tesla* (T).

magnetic flux leakage field: Magnetic field that leaves or enters the surface of an object. Excursion of magnetic lines of force from the surface of a test specimen. It is the basis for the electromagnetic test technique for the detection and analysis of a surface discontinuity or near surface discontinuity using the flux that leaves a magnetically saturated, or nearly saturated, test object at a discontinuity.

magnetic flux meter: Electronic device for measuring magnetic flux leakage. Included are items such as gauss meters and hall effect field meters.

magnetic particle testing: Nondestructive test method using magnetic leakage fields and indication materials to disclose surface and near-surface discontinuities.

magnetic permeability: Ratio of magnetic induction to magnetizing force. This relationship is either (1) absolute permeability μ , in general the quotient of magnetic induction \mathbf{B} divided by the magnetizing force \mathbf{H} , or (2) *relative permeability* μ_r (or specific permeability), the magnetic permeability of a material in comparison to that of free space. For nonferromagnetic materials, the relative permeability is equal to unity. For ferromagnetic materials, the relative permeability varies from some specific material's nonmagnetized initial value through a peak value and then drops to unity under magnetic saturation conditions due to increases in the applied magnetizing force.

magnetic saturation: That degree of magnetization where a further increase in magnetizing force produces no significant increase in magnetic flux density in an object. In this region, the permeability of the material is the same as that found in air or nonmagnetic materials.

magnitude: Absolute value of a complex quantity (number) without reference to the phase of the quantity.

main bang: See *initial pulse*.

maintenance philosophy: The organized approach to keeping operational systems in satisfactory condition through use of fleet management and prescribed inspection practices. "Fail safe design," "retirement for cause," "condition based maintenance," and "structural health monitoring" are different protocols for ensuring the integrity of critical test articles.

manipulator: In immersion testing, a device for angular orientation of the transducer and for scanning motion in three axes.

mask: (1) Square matrix of $n \times n$ with different values that serves as a filter in image processing. (2) In radiologic testing, a cover with an aperture to view a specific area; *mask plate*. (3) In radiologic testing, a selective radiation filter.

match plate: Device used in a high intensity illuminator to limit the light to a specific area, typically less than the size of the film radiograph. See *mask*.

matte: Tending to diffuse light rather than reflect it; not shiny. The term *matte* is generally applied to smooth surfaces or coatings.

mechanical properties: Strength, hardness, toughness, elasticity, plasticity, brittleness, ductility, and malleability are mechanical properties used as measures of how metals behave under a load (stress).

microwave testing: Nondestructive testing method that uses, for its probing energy, electromagnetic radiation at radio frequencies – from 0.3 to 300 GHz, with wavelengths from 1 mm to 1 m.

MKS system: Obsolete system of measurement units based on the meter, kilogram, and second. Superseded by *SI*.

mode conversion: Change of ultrasonic wave propagation mode upon reflection or refraction at an interface.

mode converted signal: Unintended signal from mode conversion of primary test angle, due to interaction with component geometry such as the signals after a back wall signal in a long narrow bar.

mode of vibration: Manner in which an acoustic wave is propagated, as characterized by the particle motion in the wave (longitudinal, transverse, lamb, or surface).

modulus of elasticity: Ratio between stress and strain in a material deformed within its linear elastic range.

mottle: In radiologic test images, nonuniform density where it should be uniform, resulting from scattered radiation, secondary radiation, forward scatter, and film irregularities. Often confused with *graininess*.

MT: Magnetic particle testing.

multifrequency: Two or more frequencies applied sequentially or simultaneously to the test coil.

multifrequency technique: Use of the response of a test specimen to more than one frequency, usually to separate effects that would be indistinguishable at a single frequency.

multiple back reflections: Repetitive echoes from the far boundary of the test object.

multiple-echo technique: Technique where thickness is measured between multiple back reflections, minimizing error from coatings or from changes in temperature or contact pressure.

mutual inductance: Property of two electrical circuits whereby a voltage is induced in one circuit by a change of current in the other circuit.

N

narrow band: Relative term denoting a restricted range of frequency response.

NDE: (1) Nondestructive evaluation.
(2) Nondestructive examination. See *nondestructive testing*.

NDI: Nondestructive inspection. See *nondestructive testing*.

NDT: See *nondestructive testing*.

near field: Distance immediately in front of a plane transducer in which the ultrasonic beam exhibits complex and changing wavefronts. Also called the *fresnel field* or *fresnel zone*.

near ultraviolet radiation: Ultraviolet radiation with wavelengths ranging from about 320 to about 400 nm. Formerly called *black light*.

neural acuity: Ability of the eye and brain together to discriminate patterns from background. Discrimination is influenced by knowledge of the target pattern, by the scanning technique, and by an indication's relationship of figure to ground.

neutron: Uncharged elementary particle with mass nearly equal to that of the proton.

neutron fluence: Integrated exposure (product of current and time) of neutrons per unit area.

neutron flux: Neutron current; quantity of neutrons passing through a unit area per unit time.

neutron radiologic testing: *Radiologic testing* using a neutron beam.

neutron radioscopy: *Radioscopy* using a neutron beam.

nodal points: In angle beam testing, the locations of reflections at opposite surfaces as a wave progresses along a test object.

noise: In electromagnetic testing, any nonrelevant signals that tend to interfere with normal reception or processing of a discontinuity signal of interest. The origin may be an electric or acoustic source, nondetrimental discontinuities, or abrupt changes in the acoustic properties of the test material. See also *signal-to-noise ratio*.

noncontact transducer: In ultrasonic testing, a sensor designed for wave propagation through gas.

nondestructive characterization (NDC): Subelement of nondestructive testing concerned with the description of material properties and their behavior within components and systems. An example includes the use of eddy current techniques to identify the presence of fire damage in aluminum alloys.

nondestructive evaluation (NDE): Another term for nondestructive testing. In research and academic communities, the word *evaluation* is often preferred because it emphasizes interpretation by knowledgeable personnel.

nondestructive inspection (NDI): Alternative term for nondestructive testing used in the aviation industry, particularly associated with military inservice maintenance.

nondestructive testing (NDT): Determination of the physical condition of an object without affecting that object's ability to fulfill its intended function. Nondestructive test methods typically use an appropriate form of energy to determine material properties or to indicate the presence of material discontinuities (surface, internal, or concealed). Sometimes called *nondestructive evaluation*, *nondestructive examination*, or *nondestructive inspection*.

nonferromagnetic material: Material not magnetizable and essentially not affected by magnetic fields. Examples include aluminum, brass, austenitic stainless steel, and all nonmetallics with a relative permeability of unity.

nonrelevant indication: See *indication, nonrelevant*.

normal incidence: Condition in which the axis of the ultrasonic beam is perpendicular to the entry surface of the test object; that is, where the angle of incidence is zero.

null: To adjust a bridge circuit so that the test sample and reference arms produce equal and opposite currents through the detector.

O

ohm (Ω): Measurement unit of electrical impedance, both resistance and reactance.

optimum frequency: In electromagnetic testing, that frequency that provides the largest signal-to-noise ratio obtainable for the detection of an individual material property.

orientation: Angular relationship of a surface, plane, discontinuity, or axis to a reference plane or surface.

P

pancake coil: Probe coil whose axis is normal to the surface of the test material and whose length is not larger than its radius.

parallax: Apparent difference in position of an imaged point according to two differently positioned sensors.

parameter distribution: Display of the number of times an acoustic emission parameter falls between the values x and $x + \delta x$ as a function of x . Typical parameters are amplitude, rise time, and duration.

particle motion: Movement of particles of material during wave propagation.

pencil break source: Artificial source using the fracture of a brittle graphite or equivalent cylinder in a suitable fitting to simulate an acoustic emission signal. Also called *hsu-nielson source*.

penetrameter: See *image quality indicator*.

period: Value of the minimum duration after which the same characteristics of a periodic waveform or a periodic feature repeat.

phantom: Reference standard used to verify the performance of diagnostic ultrasonic systems.

phase analysis: Analytical technique that discriminates between variables in a part undergoing electromagnetic testing by the different phase angle and amplitude changes that these conditions produce in the test signal. See also *phase detection*.

phase angle: Angular equivalent of the time displacement between corresponding points on two sine waves of the same frequency. A phase shift is a change in the phase relationship between two alternating quantities of the same frequency.

phase detection: Derivation of a signal whose amplitude is a function of the phase angle between two alternating currents, one of which is used as a reference. A phase sensitive system is one whose output signal depends on the phase relationship between the voltage returned from a pickup or sensing coil and a reference voltage.

phase velocity: Velocity of a single-frequency continuous wave.

phased array: In ultrasonic testing, a phased array is a mosaic of transducer elements in which the timing of the elements' excitation can be individually controlled to produce certain desired effects, such as steering or focusing the beam.

photoelectric effect: Emission of free electrons from a surface bombarded by sufficiently energetic photons. Such emissions may be used in an illuminance meter, calibrated in lux. Interaction of photons with atoms in which the full energy of the photon is absorbed by an orbital electron, removing the electron from the atom.

photoemission: Method by which an image orthicon television camera tube produces an electrical image, in which a photosensitive surface emits electrons when light reflected from a viewed object is focused on that surface. Compare *photoconduction*.

photon: Particle of electromagnetic radiation.

photoreceptor: Photon sensor. Examples include film and electronic detector elements.

physical properties: Nonmechanical properties such as density, electrical conductivity, magnetic permeability, thermal diffusivity, dielectric constant, and thermal expansion.

picture element: See *pixel*.

piezoelectric effect: Ability of certain materials to convert electrical energy (voltage) into mechanical energy (stress) and vice versa.

pitch catch technique: Ultrasonic test technique that uses two transducers, one transmitting and the other receiving on the same or opposite surface. Also called *double-crystal technique* or *two-transducer technique*.

plane wave: See *longitudinal wave*.

plate wave: See *lamb wave*.

point of incidence: Point at which the axis of the sound beam leaves the wedge of an angle beam transducer and enters the test object. See also *probe index*.

primary radiation: Radiation emitting directly from the target of an X-ray tube or from a radioactive source.

primary reference response level: Ultrasonic response from the basic reference reflector at the specified sound path distance, electronically adjusted to a specified percentage of full screen height.

probability of detection (POD): Measure of inspection reliability based on the statistical performance of detection during a controlled study using a collection of precise test targets providing indications of interest for a given test scenario. Statistical statement from a test procedure indicating how likely a given discontinuity length may be reliably found.

probe: See *sensor*; *transducer*.

probe index: Point on a transverse wave or surface wave transducer through which the emergent beam axis passes. See also *point of incidence*.

process control: Application of quality control principles to the management of a repeated process.

pulse: Transient electrical or ultrasonic signal that has a rapid increase in amplitude to its maximum value, followed by an immediate return.

pulse echo technique: Ultrasonic test technique in which discontinuities are revealed by echoes from the transmitted pulses.

pulse frequency: In ultrasonic testing, the number of pulses generated or transmitted per unit of time (usually seconds). Also called *repetition rate*.

pulse length: Measure of pulse duration expressed in time per pulse or in number of cycles per unit of time.

pulse technique: Multifrequency technique in which a broadband excitation such as an impulse is used. Either the frequency components are extracted and analyzed or the interpretation is based directly on characteristics of the time domain waveform.

pulse tuning: Control of pulse frequency to optimize system response.

Q

Q, or quality factor, of a coil: *Quality factor* of a coil, as the ratio of inductive reactance to resistance.

quadrature: Relation between two periodic functions when the phase difference between them is 90 degrees.

quality: Ability of a process or product to meet specifications or to meet the expectations of its users.

quality assurance: Administrative actions that specify, enforce, and verify a quality program.

quality control: Physical and administrative actions required to ensure compliance with the quality assurance program. Quality control may include nondestructive testing in manufacturing or service.

R

- rad:** (1) SI symbol for *radian*. (2) Radiation absorbed dose; unit of absorbed dose of ionizing radiation. One rad is equal to the absorption of 10^{-5} J (100 erg) of radiation energy per gram of matter. Replaced by the *gray* (Gy).
- radian (rad):** Measurement unit of plane angle subtending, in a circle, an arc equal in length to the radius.
- radiance:** Radiant flux per unit solid angle and per unit projected area of the source. Measured in watts per square meter steradian. Compare *irradiance*.
- radiant energy:** Energy emitting as electromagnetic waves. Also called *radiation*.
- radiant flux:** Radiant energy's rate of flow, measured in watts.
- radiant intensity:** Electromagnetic energy emitted per unit time per unit solid angle.
- radiant power:** Total radiant energy emitted per unit time.
- radiation safety officer:** Individual supervising program to provide radiation protection. The representative appointed by the licensee for liaison with the applicable regulatory agency.
- radio frequency display:** Presentation of unrectified signals. See also *video presentation*.
- radio operating characteristic (ROC):** A measure of inspection performance that uses both probability of detection and probability of false calls as its major variables.
- radiographer:** Person that performs, supervises, and is responsible for industrial radiologic test operations.
- radiologic test interpretation:** Determination of the cause and significance of discontinuities indicated on a radiologic image.
- radiologic test screens:** Thin sheets used to intensify the effect of radiation on films. The screens can be made of a fluorescent material or a metal such as lead. Metallic screens absorb secondary and scattered radiation, which helps to improve image quality.
- radiologic testing:** Use of penetrating radiant energy in the form of X-rays, gamma rays, or neutrons for nondestructive testing of objects to provide images of the objects' interiors. Also called *radiography*; *radiologic testing*.
- radiography:** See *radiologic testing*.
- radiologic testing (RT):** Use of penetrating radiant energy in the form of X-rays, gamma rays, or neutrons for nondestructive testing of objects to provide images of the objects' interiors. Also called *radiography*; *radiographic testing*.
- radiology:** (1) That branch of medicine which uses ionizing radiation for diagnosis and therapy. (2) Science of electromagnetic radiation, particularly ionizing radiation.
- radiometer:** Device used to measure irradiance or radiant energy of specified frequencies. Different radiometers exist for different frequencies. In nondestructive testing, radiometers are used to measure UV-A output, or leaked visible light, in microwatt per square centimeter ($\mu\text{W}/\text{cm}^2$). See also *irradiance*. Compare *photometer*.
- radiometric photometer:** Radiometer for measuring radiant power over a variety of wavelengths.
- radioscopy:** Radiographic testing technique in which gamma rays, X-rays, or neutrons are used to produce an image on a video or screen display as opposed to a latent image on a film. The test object or interrogating optics may move in real time to present a moving radiologic test image.
- range:** In ultrasonic testing, the maximum path length displayed. See also *sweep length*.
- rarefaction:** Thinning or separation of particles in a propagating medium due to the decompression phase of a longitudinal ultrasonic cycle. Opposite of compression. A compressional wave is composed of alternating compressions and rarefactions.
- rayleigh wave:** Ultrasonic wave that propagates along the surface of a test object. The particle motion is elliptical in a plane perpendicular to the surface, decreasing rapidly with depth below the surface. The effective depth of penetration is considered to be about one wavelength. Also called *surface wave*.
- receiver:** (1) Section of the ultrasonic instrument that amplifies echoes returning from the test object. (2) Transducer that picks up the echoes.
- reference coil:** In electromagnetic testing, the section of the coil assembly that excites or detects the electromagnetic field in the reference standard of a comparative system.
- reference standard:** A material or object for which the relevant chemical and physical characteristics are known and measurable, used as a comparison for, or standardization of equipment or instruments used for, nondestructive testing. A simulated test article with artificial discontinuities used for establishing and periodically checking required test sensitivity settings.
- reference threshold:** Preset voltage level that has to be exceeded before an acoustic emission signal is detected and processed. This threshold may be adjustable, fixed, or floating. See also *threshold level*.
- reflection probe:** Coil system that uses both an excitation and a detection or sensing coil on the same side of the sample.
- reflectivity:** Ability of a surface to reflect electromagnetic radiation, expressed as ratio ρ of the intensity of the total energy reflected from a surface to total radiation on that surface. For a perfect mirror, reflectivity ρ approaches 1.0; for a blackbody, the reflectivity is zero.
- refracted beam:** Beam transmitted in the second medium when an ultrasonic beam is incident at an acute angle on the interface between two media having different sound speeds.
- refraction:** Change in direction of an acoustic wave as the ultrasonic beam passes from one medium into another having different acoustic speeds. A change in both direction and mode occurs at acute angles of incidence. At small angles of incidence, the original mode and a converted mode may exist simultaneously in the second medium.
- refractive index:** Ratio of the speed of the incident wave to that of a refracted wave. It is known as the refractive index of the second medium with respect to the first.

reject: Minimize or eliminate low amplitude signals (such as electrical or material noise) so that other signals may be further amplified. This control can reduce vertical linearity. Also called *suppression*.

rejection level: Level above or below which a signal is an indication of a rejectable discontinuity.

rem: Roentgen equivalent man. A unit of absorbed ionizing radiation in biological matter. See *sievert*.

remote viewing: (1) Term introduced in the late twentieth century to denote visual testing mediated through a system of two or more lenses (as in a borescope) or transduced through an electronic signal (as with a charge coupled camera). *Indirect viewing*. (2) In telemetry and robotics, the technology and visual display of scenes not in the viewer's immediate presence.

repetition rate: See *pulse frequency*.

reserve vision acuity: Ability of an individual to maintain vision acuity under poor viewing conditions. A visual system with 20/20 near vision acuity under degraded viewing conditions has considerable reserve vision acuity compared to that of an individual with 20/70 near vision acuity.

resistance, electrical (R): Opposition to transmission of electric current through a material; ratio of voltage to current. Measured in ohms (Ω). Inversely related to conductance.

resistivity (ρ): Ability of a material to resist electric current. Measured in ohm meter ($\Omega\cdot m$), the resistance of a cube made of the material whose dimensions are 1 m on each side. Inversely related to electrical *conductivity* σ (siemens per meter)

resolution: Aspect of image quality pertaining to a system's ability to reproduce objects, often measured by resolving a pair of adjacent objects or parallel lines. See also *line pair*; *resolving power*.

resolving power: Ability of detection systems to separate two points or lines in time or distance. Resolving power depends on the angle of vision and the distance of the sensor from the test surface. Compare *resolution*.

resonance: Condition in which the frequency of a forcing vibration (ultrasonic wave) is the same as the natural vibration frequency of the propagation body (test object), possibly resulting in large amplitude vibrations. The resonance principle is used for determining acoustic speed, object thickness, or presence of laminar discontinuities.

resonant frequency: Frequency at which a body vibrates freely after being set in motion by some outside force.

retina: In the eye, the tissue that senses light.

ringing signals: (1) Closely spaced multiple signals caused by multiple reflections in a thin material. (2) Signals caused by continued vibration of a transducer.

ringing technique: Test technique for bonded structures in which unbonds are indicated by increased amplitude of ringing signals.

ringing time: Time that the mechanical vibrations of a transducer continue after the electrical pulse has stopped.

roentgen (R): Unit for measurement of radiation intensity; amount of radiation that will generate one electrostatic unit in 1 cm³ of air at *standard atmospheric conditions*. The roentgen (R) has been replaced by an SI compound unit, coulomb per kilogram (C/kg).

roof angle: In a dual-element delay line transducer, the tilt angle by which the transducer elements of the delay line are oriented to direct the beams of the two elements to intersect at a specified zone in the medium.

root mean square (RMS): Statistical measure of the magnitude of a varying quantity, such as current. Square root of the mean square of a set of measures, usually a time series.

RT: *Radiographic testing*; *radiologic testing*.

S

saturation: Condition in which high amplitude signals on a display screen do not increase with increased gain and appear flattened.

scalar: Quantity completely specified by a single number and unit. Examples include weight and speed.

scanning: Movement of the transducer over the surface of the test object in a controlled manner so as to achieve complete coverage. May be either a contact or immersion technique.

scattering: Reflection of ultrasonic waves by small discontinuities or surface irregularities.

scintillation: Emission of light of specific frequencies after the absorption of electromagnetic radiation, such as X-rays or gamma rays.

scintillation detector: Radiation measuring device based on a scintillating material.

search unit: See *transducer*.

selectivity: Characteristic of a test system, a measure of the extent to which an instrument can differentiate between the desired signal and disturbances of other frequencies or phases.

send/receive transducer: Transducer consisting of two piezoelectric elements mounted side by side separated by an acoustic barrier. One element transmits; the other receives.

sensing coil: Coil that detects changes in the flow of eddy currents induced by an excitation coil. In simple probes, the sensing and excitation coils are usually one and the same.

sensitivity: Measure of a sensor's ability to detect small signals. See *resolution*.

sensitization: Condition of exposed silver halide emulsion in radiologic film before development.

sensor, X-ray: In radiologic testing, a device or material that changes with and provides evidence of contact with ionizing radiation. Examples include X-ray film, X-ray sensitive phosphors, and electronic devices such as linear detector arrays. See *detector, X-ray*.

shadow: Region in a test object that cannot be reached by ultrasonic energy traveling in a given direction. Shadows are caused by geometry or the presence of intervening large discontinuities.

shear wave: See *transverse wave*.

- shielding:** Material or object used to reduce intensity of or exposure to penetrating radiation or external interference.
- shoe:** Device used to adapt a straight beam transducer for use in a specific type of testing, including angle beam or surface wave tests and tests on curved surfaces. See also *wedge*.
- SI (International System of Units):** Measurement system in which the following seven units are basic: meter, mole, kilogram, second, ampere, kelvin, and candela.
- siemens per meter (S/m):** SI unit of conductivity.
- sievert:** SI unit for measurement of exposure to ionizing radiation, replacing rem. $1 \text{ Sv} = 1 \text{ J/kg} = 100 \text{ rem}$.
- signal:** Physical quantity, such as voltage, that contains relevant information.
- signal processing:** (1) Acquisition, storage, analysis, alteration, and output of digital data through a computer. (2) In infrared and thermal testing, manipulation of temperature signal or image data to enhance or control a process. Examples for infrared radiation thermometers are *peak hold*, *valley hold*, averaging, and *sample and hold*. Examples for scanners and imagers are usually referred to as *image processing* and include qualitative characterization, quantitative characterization, alignment, isotherm enhancement, image subtraction, image averaging, and image filtering.
- signal-to-noise ratio:** Ratio of signal values (responses that contain relevant information) to baseline noise values (responses that contain nonrelevant information). See *noise*.
- skin effect:** Phenomenon wherein the depth of penetration of electrical currents into a conductor decreases as the frequency of the current is increased. At very high frequencies, the current flow is restricted to an extremely thin outer layer of the conductor. See *standard depth of penetration*.
- skip distance:** In angle beam tests of plate or pipe, the distance from the sound entry point to the exit point on the same surface after reflection from the back surface. Also called *V path*.
- Snell's law:** Physical law that defines the relationship between the angle of incidence and the angles of reflection and refraction.
- source, acoustic emission:** (1) Unique mechanism that generates acoustic emission. (1) Place of an acoustic emission event.
- source location:** Determination of the location of an acoustic emission source from arrival times by using multiple transducers and triangulation schemes.
- source:** Machine or material from which ionizing radiation emanates.
- specification:** Set of instructions or standards invoked by a specific customer to govern the results or performance of a specific set of tasks or products.
- spectral power distribution:** Radiant power per unit wavelength as a function of wavelength. Also known as *spectral energy distribution*, *spectral density*, and *spectral distribution*.
- spectrophotometry:** Measurement of the luminance or illuminance produced by electromagnetic radiation as a function of wavelength.
- spectroradiometry:** Measurement of electromagnetic radiant power and spectral emittance, used particularly to examine colors and to measure the spectral emittance of light sources.
- spectroscopy:** Spectrophotometry or spectroradiometry in which the spectrum, rather than being analyzed only by a processing unit, is presented as a digital signal for computer analysis or in a visible form to the operator for organoleptic examination.
- spectrum:** (1) Amplitude distribution of frequencies in a signal. (2) Representation of radiant energy in adjacent bands of hues in sequence according to the energy's wavelengths or frequencies. A rainbow is a well known example of a visible spectrum.
- speed of light:** Speed of all radiant energy, including light, is $2.997925 \times 10^8 \text{ m/s}$ in vacuum (approximately 186 000 mi/s). In all transparent materials the speed is less and varies with the material's index of refraction, which itself varies with wavelength.
- spherical wave:** Wave in which points of the same phase lie on surfaces of concentric spheres. Often associated with point sources of sound.
- spurious echo:** General term denoting any ill defined indication that cannot be associated with a discontinuity or boundary at the location displayed. Also called *parasitic echo*.
- squirter system:** An inspection apparatus composed of two or more immersion transducers acoustically connected through a stream of flowing water. Test parts are positioned between the two transducers and are thus mostly inspected with the through-transmission approach.
- standard:** (1) Physical object usually containing an artificial discontinuity and used for comparison or calibration, such as a calibration block. (2) Concept or practice that has been established by authority, custom, or agreement to serve as a model rule in the measurement of quality or the establishment of a practice or procedure. (3) Document to control and govern practices in an industry or application, applied on a national or international basis and usually produced by consensus.
- standard atmospheric conditions:** Atmospheric pressure of 101.325 kPa (14.6959 lb_f/in.²). Temperature of 293.15 K (20 °C or 68 °F). The density of dry air at these conditions is 1.2041 kg/m³ (0.07517 lb_f/ft³).
- standard depth of penetration:** In electromagnetic testing, the depth at which the magnetic field intensity or intensity of induced eddy currents has decreased to 37 percent of its surface value. The square of the depth of penetration is inversely proportional to the frequency of the signal, the conductivity of the material, and the permeability of the material. See also *skin effect*.
- standing wave:** Wave in which the energy flux is zero at all points. Such waves result from the interaction of similar waves traveling in opposite directions as when reflected waves meet advancing waves. A particular case is that of waves in a body whose thickness is an integral multiple of half-wavelengths, as in resonance testing.

Stefan-Boltzmann law: Relationship governing the wavelength independent rate of emission of radiant energy per unit area. The law relates the total radiation intensity to the fourth power of absolute temperature and emissivity of the material surface. For example, intensity (heat flow) from a copper block at 100 °C (212 °F) is 300 W/m² (95 BTU·ft⁻²·h⁻¹). (Stefan-Boltzmann constant for photon emission = 1.52041 × 10¹⁵ photon·s⁻¹·m⁻²·K⁻².)

stepped wedge: Reference object, with steps of various thicknesses in the range of tested parts' thicknesses, for the radiologic testing of parts having thickness variations or complex geometries. The stepped wedge must be made of material radiologically similar to that of the radiologic test object and may include penetrametric features (such as calibrated holes) in any or all steps.

stereo imaging: Imaging technique involving the capture and display of two images of the same object from different angles. Binocular viewing simultaneously of the two images simulates a three-dimensional viewing.

straight beam: Ultrasonic longitudinal wave traveling normal to the test surface.

stress corrosion cracking (SCC): A form of corrosion caused within ductile metals by the presence of tensile stresses and a corrosive environment. For aluminum, the presence of chlorides, even in minute quantities, can lead to rapid crack growth even if the stress is below a typical crack growth stress level.

surface wave: See *rayleigh wave*.

survey meter: Portable instrument that measures rate of exposure dose or ionizing radiation intensity.

Sv: *Sievert*.

sweep: Uniform and repeated movement of a spot across the display screen to form the horizontal baseline. Also called *time base*.

sweep delay: (1) Delay in time of starting the sweep after the initial pulse. (2) Control for adjusting the time. Also called *time delay*.

sweep length: Length of time or distance represented by the horizontal baseline on an A-scan.

T

tesla (T): SI unit of measurement for magnetic flux density. 1 T = 1 Wb/m² = 10 000 G.

thermal diffusion: Process by which thermal energy is transferred from hot or cold regions and finally is spread out. See also *conduction*, *thermal*.

thermogram: Thermal map or image of a target where the gray tones or color hues correspond to the distribution of infrared thermal radiant energy over the surface of the target (qualitative thermogram). When correctly processed and corrected, a thermogram graphically represents surface temperature distribution (quantitative thermogram).

thermography: Imaging or viewing of an object or process through sensing of heat emitted by it. The temperature patterns on the material surface produce corresponding radiation patterns. Thus, heat flow by both conduction and radiation may be observed and used to locate material discontinuities. Most often, thermography is based on sensing of infrared radiation. See also *infrared thermography*.

threshold level: Setting of an instrument that causes it to register only those changes in response greater or less than a specified magnitude.

through-transmission technique: Test technique in which ultrasonic energy is transmitted through the test object and received by a second transducer on the opposite side. Changes in received signal amplitude are taken as indications of variations in material continuity.

time of flight: Time for an acoustic wave to travel between two points. For example, the time required for a pulse to travel from the transmitter to the receiver via diffraction at a discontinuity edge or along the surface of the test object.

tone burst: Wave train consisting of several cycles of the same frequency.

transducer: (1) Device that converts mechanical energy to electrical output or vice versa. (2) Piezoelectric device that converts attributes of the stress-versus-strain field of an acoustic wave into an electrical signal of voltage versus time. *Sensor; probe*.

transducer, differential: Piezoelectric twin-element or dual-pole transducer.

transducer element: In an ultrasonic transducer, the piezoelectric crystal to be coupled to the test surface. Also called the *crystal*.

transducer, flat response: Transducer whose frequency response has no resonance or characteristic response within its specified frequency band. The ratio between the upper and lower limits of the frequency band are typically not less than 500 kHz.

transducer, resonant: Transducer that uses the mechanical amplification due to a resonant frequency (or several close resonant frequencies) to give high sensitivity in a narrow band, typically ±10 percent of the principal resonant frequency at the -3 dB points.

transducer, wide band: Transducer whose response to surface displacements is relatively flat over a broad frequency range.

transmission angle: Incident angle of a transmitted ultrasonic beam. It is zero degrees when the beam is perpendicular (normal) to the test surface.

transmission technique: See *through-transmission technique*.

transmitter: (1) Transducer that emits ultrasonic energy. (2) Electrical circuits that generate the signals emitted by the transducer.

transverse vertical (polarized) wave: Transverse wave in which the plane of vibration is normal to the incidence surface.

transverse wave: Type of wave in which the particle motion is perpendicular to the direction of propagation. Also called *shear wave*.

transverse wave transducer: Transducer that generates transverse waves in a test object. Also called a *shear wave* transducer.

two-transducer technique: See *pitch catch technique*.

ultrasonic: Of or relating to acoustic vibration frequencies greater than about 20 kHz.

ultrasonic absorption: Damping or dissipation of ultrasonic waves as they pass through a medium. See also *attenuation coefficient*.

ultrasonic spectroscopy: Analysis of the frequency content of an acoustic wave. Generally performed mathematically using a fast fourier transform.

ultrasonic spectrum: Usually the frequency range from 20 kHz to 50 MHz, which may extend much higher in special applications.

ultrasonic testing: Method of nondestructive testing, using acoustic waves at inaudibly high frequencies as the interrogating energy.

Unified Numbering System (UNS): Alphanumeric system for identifying alloys according to a registry maintained by ASTM International and SAE International.

unsharpness, geometric: Fuzziness or lack of definition in a radiologic image resulting from the source size, object-to-sensor distance, and the source-to-object distance.

UT: Abbreviation for the ultrasonic method of nondestructive testing.

V

V path: See *skip distance*.

vector quantity: Any physical quantity whose specification involves both magnitude and direction. Examples include magnetic and electric fields, electrical impedance, and velocity.

vertical limit: Maximum useful readable level of vertical indication on an A-scan.

vertical linearity: See *linearity, amplitude*.

video: Pertaining to the transmission and display of moving images in an electronic format that can be displayed on a monitor or screen.

video presentation: Display presentation of moving images in which radiofrequency signals have been rectified and usually filtered.

vidicon tube: Television tube that uses the *photoconduction* method. Compare *image orthicon*.

visible light: Radiant energy in the 400 to 700 nm wavelength range.

vision acuity: Ability to distinguish fine details visually at a given distance. Quantitatively, it is the reciprocal of the minimum angular separation in minutes of two lines of width subtending one minute of arc when the lines are resolvable as separate.

visual testing: Method of nondestructive testing using electromagnetic radiation at visible frequencies.

volt (V): Measurement unit of electric potential.

W

water column: Tube filled with water and attached to the front of a transducer to couple an ultrasonic beam to a test object. A delay line between the initial pulse and the front surface signal. Also serves as a coupling device. See also *delay line*.

water entrapment: A condition wherein water has entered into the hollow spaces making up the core of a honeycomb structure.

water jet: Unsupported stream of water carrying ultrasonic signals between the transducer and the test object surface. Also called a *squirter* or *water column*.

water path: In immersion testing or with a water column, the distance from the receiving transducer's face to the test object's front surface.

wavefront: In a wave disturbance, the locus of points having the same phase.

waveguide: Device to transmit elastic energy from a test object to a remote transducer – for example, a wire joined at one end to a test object and at the other end to a transducer.

wave interference: Production of a series of maxima and minima of sound pressure as a consequence of the superposition of waves having different phases. Often used to describe near and far field effects.

wavelength: Distance between repeating values of a wave – for example, the distance from one peak to the next peak on a sine wave. Wavelength is a fundamental descriptor when discussing wave behavior, system sensitivity, and diffraction effects.

wave train: Series of waves or groups of waves passing along the same course at regular intervals.

wear face: Protective material on the face of a transducer to prevent wear of the piezoelectric element.

wedge: Device used to direct ultrasonic energy into a test object at an acute angle. See also *shoe*.

wheel transducer: Device that couples ultrasonic energy to a test object through the rolling contact area of a wheel containing a liquid and one or more transducers.

wobble: In electromagnetic testing, an effect that produces variations in an output signal of a test system caused by probe rocking on a surface or coil displacement within an encircling coil. Often used to set variable phase displays to a horizontal orientation as a means for standardizing signal presentations on vector displays.

wrap around: Display of misleading ultrasonic reflections from a previously transmitted pulse because of excessive pulse repetition frequency. See also *ghost*. Largely corrected with modern digital instruments.

X

X-ray: Penetrating electromagnetic radiation emitted when the inner orbital electrons of an atom are excited and release energy. Radiation is nonisotropic in origin and is generated by bombarding a metallic target with high speed charged particles, usually electrons.

X-ray diffraction (XRD): Radiologic testing technique used for material characterization, based on change in scattering of X-radiation as a result of interaction with test material. See also *diffraction*.

X-ray fluorescence (XRF): Radiologic testing technique used for material characterization, based on wavelengths of fluorescence from object irradiated by X-rays.

XRD: *X-ray diffraction*.

XRF: *X-ray fluorescence*.

References

- ASNT. 1998. *Nondestructive Testing Handbook 1: Leak Testing*, third edition. Columbus, OH: American Society for Nondestructive Testing.
- ASNT. 1999. *Nondestructive Testing Handbook 2: Liquid Penetrant Testing*, third edition. Columbus, OH: American Society for Nondestructive Testing.
- ASNT. 2001. *Nondestructive Testing Handbook 3: Infrared and Thermal Testing*, third edition. Columbus, OH: American Society for Nondestructive Testing.
- ASNT. 2002. *Nondestructive Testing Handbook 4: Radiographic Testing*, third edition. Columbus, OH: American Society for Nondestructive Testing.
- ASNT. 2004. *Nondestructive Testing Handbook 5: Electromagnetic Testing*, third edition. Columbus, OH: American Society for Nondestructive Testing.
- ASNT. 2005. *Nondestructive Testing Handbook 6: Acoustic Emission Testing*, third edition. Columbus, OH: American Society for Nondestructive Testing.
- ASNT. 2007. *Nondestructive Testing Handbook 7: Ultrasonic Testing*, third edition. Columbus, OH: American Society for Nondestructive Testing.
- ASNT. 2008. *Nondestructive Testing Handbook 8: Magnetic Testing*, third edition. Columbus, OH: American Society for Nondestructive Testing.
- ASNT. 2010. *Nondestructive Testing Handbook 9: Visual Testing*, third edition. Columbus, OH: American Society for Nondestructive Testing.
- ASNT. 2012. *Nondestructive Testing Handbook 10: Nondestructive Testing Overview*, 3rd edition. Columbus, OH: American Society for Nondestructive Testing.
- ASTM. 2007. ASTM E 1316, *Standard Terminology for Nondestructive Examinations*. West Conshohocken, PA: ASTM International. doi:10.1520/E1316.
- CRC. 2014. *CRC Handbook of Chemistry and Physics*, 95th edition. Boca Raton, FL: CRC Press.
- Mordfin, L. 2002. *Handbook of Reference Data for Nondestructive Testing*. West Conshohocken, PA: ASTM International.