

## Eddy Current & Ultrasonic Glossary

**Absolute Coil** – A test arrangement which tests the specimen without any comparison to either another portion of the test specimen or to a known reference.

**Alternating** – A voltage, current or magnetic field that reverses direction at regularly recurring intervals.

**Angle Beam**- A sound beam that hits the part's surface at an angle other than 90 degrees. Longitudinal waves have a greater refracted angle than shear waves so there are two sound beams in the part until a certain angle is reached.

**Bobbin Coil** – A coil or coil assembly used for eddy current testing by insertion into the test piece; e.g., an inside probe for tubing. Also referred to as **Inside Coil or ID Coil**.

**Coil** – Conductor wound in one or more loops to produce an axial magnetic field when current is passed through it.

**Coil Spacing** – The axial distance between two encircling coils of a differential system.

**Conductivity** – The willingness of a test circuit or test specimen to conduct current.

**Coupling** – A measure of the degree to which the magnetic field of the coil passes through the test specimen and is affected by the magnetic field created by the flow of eddy currents.

**Dead Zone/ Near Zone**- The Dead Zone in ultrasonic testing, is the interval following the initial pulse where the transducer ring down prevents detection or interpretation of reflected energy (echoes). In contact ultrasonic testing, the area just below the surface of a test object that can not be inspected because of the transducer is still ringing down and not yet ready to receive signals. The Near Zone is the distance immediately in front of the transducer in which the ultrasonic beam exhibits complex and changing wavefronts. The near zone is also called the Fresnel Field or Fresnel Zone. The near zone may be calculated as it is a function of wavelength and transducer size.

**Defect** – A discontinuity whose size, shape, orientation, or location have the potential to limit the service of the test part in which it occurs or which exceeds the accept/reject criteria for a given design. A defect is a discontinuity that has passed the interruption stage and is now detrimental to the test object based on specifications and standards.

**Defect Resolution** – A property of a test system which enables the separation of signals due to defects in the test specimen that are located in close proximity to each other.

**Diamagnetic** – A material having a permeability less than that of a vacuum.  
 $\mu < 1$  (copper)

**Differentiation /Differentiator** See High Pass Filter.

**Differential Coil** – A test arrangement which tests the specimen by comparing the portion being tested with either another portion of the same specimen or to a known reference specimen.

**Discontinuity** – Sometimes called a flaw, is any interruption in the normal physical structure or configuration of a test object, such as cracks, unwanted inclusions, pits, dent, bulges, and wastage. A discontinuity may or may not affect the usefulness of a part. Once a discontinuity becomes detrimental to the test object, it is considered a defect.

**Discontinuity, Artificial** – Reference discontinuities, such as holes, grooves, or notches, which are introduced into a reference standard to provide accurately reproducible sensitivity levels for electromagnetic test equipment.

**Double Coil** – A test arrangement where the alternating current is supplied through one coil while the change in material condition is measured from a second coil.

**Eddy Current** – A circulating electrical current induced in a conductive material by an alternating magnetic field.

**Eddy Current Testing** – A nondestructive testing method 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 or other magnetic flux sensors for subsequent analysis by suitable instrumentation and techniques.

**Edge and End Effect** - The disturbance of the magnetic field and eddy currents due to the proximity of an abrupt change in geometry (edge, end). The effect generally results in the masking of discontinuities within the affected region.

**Effective Depth of Penetration** – The depth in a material beyond which a test system can no longer detect a change in material properties.

**Effective Permeability** – A hypothetical quantity which is used to describe the magnetic field distribution within a cylindrical conductor in an encircling coil. The field strength of the applied magnetic field is assumed to be uniform over the entire cross section of the test specimen with the effective permeability, which is characterized by the conductivity and diameter of the test specimen and test frequency, assuming values between zero and one, such that its associated amplitude is always less than one within the specimen.

**Electromagnetic Induction** – The process by which a varying or alternating current (eddy current) is induced into an electrically conductive test object by a varying electromagnetic field.

**Electromagnetic Testing** – That nondestructive test method for engineering materials, including magnetic materials, which uses electromagnetic energy have frequencies less than those of visible light to yield information regarding the quality of the tested material.

**Encircling Coil** – A coil, coils, or coil assembly that surrounds the part to be tested. Coils of this type are also referred to as circumferential, OD or feed-through coils.

**External Reference Differential** – A differential test arrangement that compares a portion of the test specimen to a known reference standard.

**Ferromagnetic** – A material which, in general, exhibits hysteresis phenomena, and whose permeability is dependent on the magnetizing force.  $\mu \gg 1$  (Iron)

**Fill Factor** – For an inside coil, it is the ratio of the outside diameter of the coil squared to the inside diameter of the specimen squared. For an encircling coil, it is the ratio of the outside diameter of the specimen squared to the inside diameter of the coil squared.  $FF = d^2/D^2$  ( $d$  = diameter of material;  $D$  = inside diameter of coil).  $FF < 1$ .

**Flux Density** – A measure of the strength of a magnetic field expressed as a number of flux lines passing through a given area. Symbol: **B** (Gauss)

**Henry** – The unit of inductance. Symbol: **H**

**Hertz** – The unit of frequency (one cycle per second). Symbol: **Hz**

**High Pass Filter** – An electronic circuit designed to block signals of low frequency while passing high frequency signals. **Differentiation / Differentiator.**

**IACS** – The International Annealed Copper Standard. A value of conductivity established as a standard against which other conductivity values are referred to in percent IACS.

**Impedance** – The opposition to current flow in a test circuit or a coil due to the resistance of that circuit or coil, plus the electrical properties of the coil as affected by the coil's magnetic field.

**Impedance Analysis** – An analytical method which consists of correlating changes in the amplitude, phase of a complex test signal voltage to the electromagnetic conditions within the specimen.

**Indication**- Refers to the evidence of a response resulting from a nondestructive test that requires additional evaluation to determine its significance. There are three types of indications; relevant, non relevant, and false. *Relevant* indications are actual discontinuities. *Non relevant* is due to the physical condition (geometry) and is too small to be considered a defect. *False* indications occur where no changes exist in geometry or discontinuity.

**Initial Pulse**- Is the response from a UT system display to the transmitter pulse.

**Inductance** – The inertial element of the electric circuit. An inductor resists any sudden change in the current flowing through it.

**Inductive Reactance** – The opposition to current flow in a test circuit or coil when an alternating voltage source is applied and due solely to the electrical properties of the coils as affected by the magnetic field.

**Integration / Integrator** See Low Pass Filter.

**Lift-Off** – The distance between a surface probe coil and the specimen.

**Lift-Off Effect** – The effect observed due to a change in magnetic coupling between a test specimen and a probe coil whenever the distance between them is varied.

**Low Pass Filter** – An electronic circuit designed to block signals of high frequency while passing low frequency signals. **Integration / Integrator**

**Magnetic Field** - A condition of space near a magnet or current-carrying wire in which forces can be detected.

**Magnetic Flux Lines** – A closed curve in a magnetic field through points having equal magnetic force and direction.

**NDT (Non Destructive Testing)** – A testing method whereby the article or specimen being examined is undamaged by the process.

**Noise** – Any undesired signal that tends to interfere with the normal reception or processing of a desired signal. In flaw detection, undesired response to dimensional and physical variables (other than flaws) in the test part is called “part noise”.

**Nonferromagnetic** – A material that is not magnetizable and hence, essentially not affected by magnetic fields.

**Paramagnetic** - A material having a permeability which is slightly greater than that of a vacuum, and which is approximately independent of the magnetizing force.  $\mu > 1$  (Aluminum)

**Permeability** – A measure of the ease with which the magnetic domains of a material align themselves with an externally applied magnetic field.

**Phase Analysis** – An instrumentation technique which discriminates between variables in the test part by the different phase angle changes which these conditions produce in the test signal.

**Phase Angle** – The angle measured in degrees that the current in the test circuit leads or lags the voltage. One complete cycle is equal to  $360^\circ$ .

**Phase Shift** – A change in the phase relationship between two alternating quantities of the same frequency.

**Probe Coil** – A small coil or coil assembly normally used for surface inspections.

**Reference Standard** – A test specimen used as a basis for calibrating test equipment or as a comparison when evaluating test results.

**Rejection Level** – The setting of the signal level above or below which all parts rejectable or in an automatic system at which objectionable parts will actuate the reject mechanism of the system. Also referred to as **Threshold Level**.

**Resistance** – The opposition to current flow in a test circuit or coil based on specific material properties and cross-sectional area and length of conductor.

**Response Amplitude** – The property of the test system whereby the amplitude of the detected signal is measured without regard to phase.

**Saturation** - The degree of magnetization produced in a ferromagnetic material for which the incremental permeability has decreased substantially to unity.

**Self-Comparison Differential** – A differential test arrangement that compares two portions of the same test specimen. Also called **Self-Referencing**.

**Signal-to-noise Ratio** – The ratio of response or amplitude of signals of interest to the response or amplitude of signals containing no useful information.

**Single Coil** – A test arrangement where the alternating current is supplied through the same coil from which the indication is taken.

**Skin Effect** – A phenomenon where, at high frequencies, the eddy current flow is restricted to a thin layer of the test specimen close to the coil.

**Standard** – A reference used as a basis for comparison or calibration; a concept that has been established by authority, custom, or agreement to serve as a model or rule in the measurement of quantity or the establishment of a practice or a procedure.

**Standard Depth of Penetration** – The depth in a test specimen where the magnitude of eddy current flow is equal to 37 percent of the eddy current flow at the surface.

**Straight Beam**- A sound beam that hits the surface at a 90 degree angle producing one signal on the screen because transverse and longitudinal waves travel at the same angle.

**Threshold Level**- See Rejection Level

**Transformer**- An electrical device consisting of two or more coils of wire placed in close proximity to each other. An alternating current applied to the first coil or “primary” sets up a time varying magnetic field which transfers energy to the “secondary” windings by electromagnetic induction.

**Transient**- A high-voltage surge or spike in an electrical transmission system. They may also result from the switching of motors, short circuits, or utility system switching.