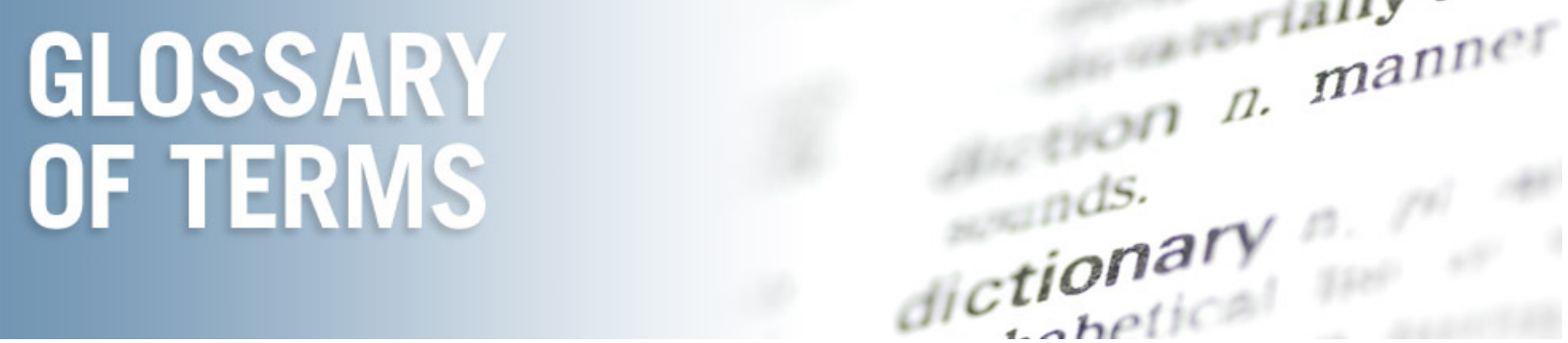

For the Magnetics Industry

This glossary is available for download at www.arnoldmagnetics.com. Additional specialized glossaries are also available from Arnold for solenoids (shaped-field electromagnets) and for precision thin metals.

We strive to continuously improve and would welcome suggestions for terms to include in our glossaries and for advice regarding existing definitions. Please send your input to infoNA@arnoldmagnetics.com.

Other glossaries can be found on the internet. Credible ones include:

- The glossary included in MMPA PMG-88 which is available at www.smma.org/pdf/permanent-magnet-guideline.pdf. The Magnetic Material Producers Association (which was renamed IMA and ceased to exist as of ~2007) had published documents titled Permanent Magnet Guidelines and Standard Specifications for Permanent Magnetic Materials both of which contain useful glossaries. The Permanent Magnet Division of SMMA assumed responsibility for the permanent magnet documents of the MMPA and they are available on the SMMA website. As of June 30, 2015, SMMA has merged with the Motion Control Association to form the MCMA and the MMPA documents will likely be available on the MCMA site when the integration is complete.

- The SMMA compiled a glossary of terms associated with the motor industry and this can be downloaded from www.smma.org/pdf/SMMA_motor_glossary.pdf.

GLOSSARY OF TERMS
FOR THE MAGNETICS INDUSTRY

Absolute Permeability	The permeability of a magnetic material expressed in actual physical units, not relative to permeability of free space. The permeability of magnetic materials is rarely expressed in terms of absolute permeability. The usual mode is in terms of relative permeability.
AC Filter	A filter circuit that removes unwanted frequencies (harmonics) from a mostly AC current. This would include some EMI filters.
Air Gap	A non-magnetic discontinuity in a ferro-magnetic circuit. For example, the space between the poles of a magnet, although filled with brass or wood or any other non-magnetic material, is nevertheless called an air gap.
Amorphous	Refers to magnetic materials that are metallurgically non-crystalline in nature.
Ampere-Turns Per Meter	The MKSA unit of magnetizing force, H. Ampere's Law defines it. The ampere-turns are per meter of magnetic path length.
Anisotropic	Having properties which are dependent upon direction within the material. See also, "isotropic" and "grain oriented".
Anneal	A high-temperature conditioning of magnetic material to relieve the stresses introduced when the material was formed. To prevent oxidation, the anneal is usually performed in a vacuum or inert-gas atmosphere.
AWG	American Wire Gauge. A gauging system used to size magnet wire.
B – Magnetic Induction	The magnetic field induced by a field strength, H. It is the vector sum, of each point within the substance, of the magnetic field strength and resultant intrinsic induction. Magnetic induction is the flux per unit area normal to the direction of the magnetic path.
Bd – Remanent Induction	Any magnetic induction that remains in a magnetic material after removal of an applied saturating magnetic field, Hs. (Bd is the magnetic induction at any point on the demagnetization curve; measured in gauss or tesla.)
Bd/Hd – Slope Of The Operating Line	The ratio of the remanent induction, Bd, to a demagnetizing force, Hd. It is also referred to as the permeance coefficient, shear line, load line and unit permeance.
Bd x Hd – Energy Product	Indicates the energy that a magnetic material can supply to an external magnetic circuit when operating at the Bd, Hd point on its demagnetization curve; measured in megaGauss-Oersteds (MGOe) or kiloJoules per cubic meter (kJ/m^3).
BHmax – Maximum Energy Product	The maximum product of (Bd x Hd) which can be obtained on the demagnetization curve, i.e. in the second quadrant of the hysteresis loop.
Bis (or Js) – Saturation Intrinsic Induction	The maximum intrinsic induction possible in a material.
Bg – Magnetic Induction In The Air Gap	The average value of magnetic induction over the area of the air gap, Ag; or it is the magnetic induction measured at a specific point within the air gap; measured in Gauss.
Bi (or J) – Intrinsic Induction	The contribution of the magnetic material to the total magnetic induction, B. It is the vector difference between the magnetic induction in the material and the magnetic induction that would exist in a vacuum under the same field strength, H. This relation is expressed by the equation: Bi = B - Hem where; Bi = intrinsic induction in gauss (or tesla); B = magnetic induction in gauss (or tesla); Hem = field strength in oersteds (or kA/m).
Br – Residual Induction (or Flux Density)	The magnetic induction corresponding to zero magnetizing force in a magnetic material after saturation in a closed circuit; measured in gauss or tesla.
Band Pass	The frequency range over which an inductor or a capacitor exhibits low impedance.
Band Stop	The frequency range over which an inductor or a capacitor exhibits high

	impedance.
BH Loop	A hysteresis loop of four quadrants. In practice, usually only the first and second or, more typically, only the second quadrant is shown.
Bifilar Winding	Two strands of magnet wire wound side-by-side.
B_m	Maximum induction.
Bobbin	The injection molded form upon which the coil is wound on many C-cores, pot cores, and laminations.
Boost Converter	A switch-mode power supply (SMPS) that switches the input voltage to a higher output voltage. Also called an "up switcher."
Bridge	See Inductance bridge.
Buck Converter	A switch-mode power supply (SMPS) that switches the input voltage to a lower output voltage. Also called a "down switcher."
CGS System	Centimeter-Gram-Second system, the oldest system of units and the one used for presenting powder core data. Only the units for magnetizing force, magnetic flux density, length, mass and time are utilized. Statvolts and abamperes can be avoided by using the simple conversions and the magnetizing force equation provided in the Group Arnold Powder Cores catalog.
Calibration (of a permanent magnet)	The process of reducing the magnetic output of a saturated permanent magnet to a precise value. Usually achieved by applying a reverse magnetic field in stepped increments until the desired output is achieved. Also referred to as "tuning".
Capacitor	A device that stores electrical energy in a manner similar to the way an inductor stores magnetic energy. The unit of capacitance is the farad.
Carbonyl Iron	A relatively expensive iron powder used in low-permeability, high-frequency powdered iron cores.
Case	The enclosure surrounding a toroidal tape core, which protects it from being stressed by the environment of the application. Sometimes called a core "box." Standard materials are nylon, glass-nylon, and aluminum.
Chemical Etch	A process for making laminations from thin-gauge sheet. The lamination design is silk-screened onto the magnetic material, and light-sensitive chemicals are used to etch away the excess. This process is popular for low-volume laminations where tooling costs normally would be prohibitive.
Choke	An inductor.
Closed Circuit Condition	Exists when the external flux path of a permanent magnet is confined within high permeability material.
Coercive Force, Hc	The value of demagnetizing force that reduces residual induction to zero. The maximum coercive force, as measured on a saturated magnet, is proportional to the remanent flux density. See "flux density." It is expressed in oersteds or kiloAmps per meter (kA/m).
Coercivity, Hci or iHc	The resistance of a magnetic material to demagnetization. It is equal to the value of H where the intrinsic curve intersects the H axis in the second quadrant of the hysteresis loop. It is expressed in oersteds or kiloAmps per meter (kA/m).
Coil Base Tube, or Coil Form	For larger cores, where injection molded bobbins are not available, fabricated coil base tubes are used on which to wind the turns of wire.
Common Mode Filter	An often-used type of EMI filter, which is wound with both conductors of the power source in such a way that noise not common to both conductors is filtered. The desired signal passes through the common mode filter unimpeded.
Control Winding	The winding on a mag amp or a saturable reactor used to control the amount of magnetic energy the core will absorb before saturating.
Core Loss	Power lost in a magnetic material when flux density changes. Also called iron losses or excitation losses.
Cruciform	A core cross-section that has been "stepped" so it approximates a circle. This is desirable on high-voltage devices because it allows the use of circular cross-section coils without the loss of coupling that would be apparent if the core had a squared cross-section. The round

	coil is preferred because of corona.
Current Density	The amps per unit of cross-section in the conductor.
Curie Temperature, Tc	Tc or T_c: The temperature above which ferromagnetic materials become paramagnetic, losing substantially all of their permanent magnetic properties. Some references state materials become non-magnetic above the Curie temperature.
Cut Tape Cores	Cores that are impregnated for mechanical rigidity.
DC Bias	Direct Current (DC) applied to the winding of a core in addition to any time-varying current. Inductance with DC bias is a common specification for powder cores. The inductance decreases or "rolls-off" gradually and predictably with increasing DC bias.
DC Filters	A filter circuit that removes the AC ripple from a mostly DC current.
DC Stress	Annealing a magnetic material in the presence of a DC magnetic field to enhance magnetic properties.
Decoupling	Refers to a magnetic circuit where comparatively more of the flux generated by the MMF fringes around the magnetic material instead of entering it.
Demagnetization Curve	That portion of the hysteresis loop which lies between the residual induction point, Br, and the coercive force point, Hc (normal curve) or Hci (intrinsic curve). Points on the normal curve are designated by the coordinates Bd and Hd.
Demagnetized	A material condition where a ringing AC field has reduced the remanent induction to or near zero. A ringing AC field is a continually decreasing sinusoidal field. A pulsed DC field can be used to achieve gross demagnetization, but with much effort and with residual local magnetization.
Discrete Air Gap	Mechanical air gap created by a small number of breaks in the magnetic path. In a standard C-core this number is generally two.
Distortion	Any deviation from the mathematical ideal of a real-world periodic waveform, which is specified as a per cent of the desired signal. Distortion can be expressed mathematically in terms of the harmonics of the fundamental frequency. This parameter is of considerable importance in instrumentation transformers.
Distributed Air Gap	Major feature of powder cores. It is the cumulative effect of many small gaps distributed evenly throughout the core. In a typical MPP core, the number of separate air gaps results from the use of powder to construct the core and numbers in the millions. The result is minimal fringing flux density compared to a core with one or two air gaps in the magnetic path. (Flux that passes around a discrete air gap and through the sides of a core is "fringing." Fringing flux enters the surrounding winding and causes a substantial amount of eddy current loss.)
Distribution Transformer	The transformer that is immediately "upstream" of the wall outlet.
Drive Transformer	A low-power isolation transformer used in electronic circuits to control semiconductors.
Duty Cycle	Maximum recommended usage (cycles) per unit time. Alternatively, the fraction of percent of "on" time, between 0 and 1 or 0 to 100%.
Eddy Current Loss	Core loss associated with the electrical resistivity of the magnetic material and induced voltages within the material. Eddy currents are inversely proportional to material resistivity and proportional to rate of change of flux density. Eddy current and hysteresis losses are the two major core loss factors. Eddy current loss becomes dominant in powder cores as the frequency increases.
EI Loop Test	A method of observing the dynamic hysteresis loop properties of a soft magnetic core. This test is frequently used when cores are to be matched in pairs, etc.
Electrical Resitivity	The electrical resistance to current flow in ohms per unit length of the material being evaluated.
Electromagnet	A magnet formed by current flowing through a conductor. The electrical conductor may be wire, copper plate or strips of foil and may exist with a permeable material such as steel to conduct the field to desired

	areas. The magnetic field exists only so long as current flows through the coil.
EMI Filters	Filter unwanted noise (EMI = electromagnetic interference).
Energy Product	The energy that a magnetic material can supply to an external magnetic circuit when operating at a point on its demagnetization curve; measured in megaGauss-Oersteds (MGOe). See also BHmax.
Energy Storage Inductors	Inductors used for power conversion rather than filtering or tuning.
Epoxy Impregnated	Cut cores are impregnated with an epoxy to make the core rigid. No insulative purpose is intended.
Epstein Test	A standardized method of evaluating unprocessed thin-gauge alloy for core loss and permeability.
Excitation Current	The current which produces magnetic energy (or flux) in an inductor.
Faraday's Law	The law that defines the relationship of the voltage induced across the winding of a core to the flux density within the core.
Ferrites	A soft ferrite material that has lower permeability with very low eddy-current loss. The common ferrites are nickel-zinc, manganese-zinc and magnesium-zinc ferrite.
Ferromagnetism	Ferromagnetic materials have atomic fields that align themselves parallel with externally applied fields creating a total magnetic field much greater than the applied field. Ferromagnetic materials have permeabilities much greater than 1. Above the Curie temperature, the ferromagnetic materials become paramagnetic.
Filter Capacitor	A capacitor, quite often used in conjunction with an inductor, that filters unwanted frequencies by storing electrostatic energy.
Flux	In magnetics, the magnetic field. Flux implies flow which is not the case in magnetics. That is, no one has measured a magnetic "flow". Flux is represented conceptually as "magnetic lines of force". Flux density is measured in gauss or tesla.
Flux 0	In the special pulse test used to evaluate bobbin tape cores, this corresponds to $B_m - B_r$.
Flux 1	In the special pulse test used to evaluate bobbin tape wound cores, this corresponds to $B_m + B_r$.
Flux Density	*Magnetic (B)* - The fundamental magnetic force field. "Flux" means to flow (around a current carrying conductor, for example) and "density" refers to its use with an enclosed area and Faraday's Law to determine induced voltage. Also called the "induction field." From Faraday's Law, the MKSA unit of flux density is a volt-second per square meter per turn or "Tesla." (The CGS unit of magnetic flux density is the Gauss. There are 10,000 Gauss per Tesla). *Remanent* or *residual* ~ – The flux density that remains in a magnetic material after an applied magnetic field (magnetizing force) is removed. *Saturation* - This is the flux density of maximum material magnetization. Magnetization (M) is the contribution of a magnetic material to the total flux density. $B = \mu_o(H+M)$ in MKSA units. $B = H+4\pi M$ in CGS units. Saturation magnetization is the maximum value of magnetization. Also, the term "saturation" is sometimes used as a reference to the decrease of permeability with increasing magnetizing force. In an inductor, this corresponds to a decrease of inductance with current.
Flux Transfer Ratio	The numeric ratio of the amount of flux intercepted by the secondary winding and the total flux created by the applied amp-turns.
Fluxmeter	An instrument that measures the change of flux linkage with a search coil. The current in the search coil caused by relative motion with the magnet is integrated (totalized). Using a calibrated coil allows

	calculation of field and magnet properties.
Flyback Transformer	A device that functions as an inductor and a transformer.
Fringing Fields; Fringing Flux	The field(s) associated with the divergence of the flux from the shortest path between poles in a magnetic circuit. Where flux passes from a high permeability into a lower permeability material, the flux redistributes. See also, Leakage Flux.
Gap Compound	An adhesive applied to the gap surfaces of C and E -cores to reduce mechanical noise levels. On small cores, it occasionally is used instead of banding to hold the two halves together.
Gauss	The unit of magnetic induction, B, in the CGS electromagnetic system. One gauss is equal to one maxwell per square centimeter or 10^{-4} tesla.
Gauss-Oersted	See energy product and maximum energy product (BHmax).
Gaussmeter	An instrument that measures the instantaneous value of magnetic induction, B. Its principle of operation is usually based on one of the following: the Hall effect, nuclear magnetic resonance (NMR), or the rotating coil principle.
Gilbert	A unit of magnetomotive force, F, in the CGS system.
GHz	1,000,000,000 Hz (gigaHertz).
Graded Cores	MPP and HF cores are graded into increments of permeability within their normal ± 8% tolerance. It is expressed as a per cent deviation from the nominal value.
Grain Oriented	Silicon steel or other granular magnetic material that has a preferred direction of magnetization.
Ground Fault Indicator	A device that detects very low-level currents in the neutral conductor of an electrical line. This requires a very high-permeability core; generally Ni-Fe alloys are used.
H – Magnetic Field Strength	(magnetizing or demagnetizing force) The measure of the vector magnetic quantity that determines the ability of an electric current, or a magnetic body, to induce a magnetic field at a given point; measured in oersteds (or kA/m).
H_c – Coercive Force	Equal to the demagnetizing force required to reduce residual induction, B_r, to zero; measured in oersteds (or kA/m). The material characteristic of coercivity is taken as the maximum coercivity -- that value of H required to reduce the residual induction to zero after the material has been saturated (fully magnetized).
H_{ci} – Intrinsic Coercive Force	Indicates a material's resistance to demagnetization. It is equal to the demagnetizing force which reduces the intrinsic induction, Bi, in the material to zero; measured in oersteds (or kA/m). As for coercivity, the maximum value of intrinsic coercivity is obtained after the material has been saturated (fully magnetized).
Hd	The value of H corresponding to the remanent induction, Bd; measured in oersteds (or kA/m). See also BdHd.
Hs – Net Effective Magnetizing Force	The magnetizing force required in the material, to magnetize to saturation; measured in oersteds (or kA/m).
Hall Effect Transducer	A device which produces a voltage output dependent upon an applied DC voltage and an incident magnetic field. The magnitude of the output is a function of the field strength and the angle of incidence with the Hall device.
Hard Magnetic Material	A "permanent" magnet material that has an intrinsic coercivity greater than or equal to about 300 oersteds (24 kA/m).
Henry	A unit of inductance.
High Q Filters	A filter circuit (inductor and/or capacitor) that exhibits high Q. It is very frequency-sensitive and filters out or allows to pass, only those frequencies within a narrow band.
H_m	Common symbol for maximum applied magnetizing force.
Hysteresis and Hysteresis Loss	Hysteresis is the tendency of a magnetic material to retain its magnetization. Hysteresis causes the graph of magnetic flux density versus magnetizing force to form a loop rather than a line. The area of the loop represents the difference between energy stored and energy released per unit volume of material per cycle. This difference is called

	hysteresis loss. It is one of two major loss mechanisms in inductor cores; the other is eddy current loss. Hysteresis loss is measured at low frequency to distinguish it from eddy current loss.
Hysteresis Loop	A closed curve obtained for a material by plotting (usually to rectangular coordinates) corresponding values of magnetic induction, B, for ordinate and magnetizing force, H, for abscissa when the material is passing through a complete cycle between definite limits of either magnetizing force, H or magnetic induction, B. If the material is not "driven" to saturation, it is said to be on a minor loop.
Hysteresis, Magnetic	The property of a magnetic material by virtue of which the magnetic induction for a given magnetizing force depends upon the previous conditions of magnetization.
Hysteresisgraph	An instrument that draws hysteresis loops. Also called permeameter.
Hz	Frequency in units of Hertz (cycles per second).
Impedance	The effective electrical “resistance” (ratio of voltage to current) that inductors, capacitors, and resistors present to current flow in a circuit.
Impedance Matching Transformers	Transformers that electrically isolate two circuits but are designed so energy transfer is optimized.
Induced Flux Density	The flux density generated in a core (or soft magnetic material) by the applied MMF.
Inductance	Inductance is the ratio of voltage to time rate of change of current. By definition, it has dimensions of volt-seconds per ampere. A volt-second per ampere is called a “Henry.”
Inductance Bridge	An instrument used to measure the inductance of a device directly.
Inductance Factor (A_L)	Core constant used to calculate inductance based on the number of winding turns squared. Value is given in millihenries per 1000 turns squared, which is the same as nanohenries per turn squared. $L = A_L N^2$ nanohenries
Induction (B)	Magnetic induction, B, is the magnetic field induced by an applied field, H. It is measured as the flux per unit area normal to the direction of the magnetic path.
Induction Curve, Normal	A graph depicting the relation between normal induction and magnetizing force.
Inductor	A coil that has significant self inductance, typically many turns of wire and with a permeable core. It is a device that stores and releases electromagnetic energy. See Inductance.
Initial Permeability	The relative permeability of a magnetic material at a very low flux level.
Insulator, Insulation	Opposite of conductor, that is, does not conduct an electrical current. In soft magnetic cores, refers to electrical insulation between adjacent laminations, layers of thin gauge tape, or powder particles. Also associated with some of the finishes, which have dielectric capacity, applied to cores.
Intrinsic Coercivity	Same as Hci. Indicates a material's resistance to demagnetization. It is equal to the demagnetizing force which reduces the intrinsic induction, Bi, in the material to zero; measured in oersteds (or kA/m). As for coercivity, the maximum value of intrinsic coercivity is obtained after the material has been saturated (fully magnetized).
Intrinsic Demagnetization Curve	The hysteresis loop corresponding to B versus H where B is the magnetization resulting from only the magnetic material. For the Normal Curve, B corresponds to the sum of the externally applied field and the field of the magnetic material.
Inverter Transformer	A transformer driven in such a manner that an applied DC power is converted to AC power (approximately square wave). Quite often the core is driven into saturation to accomplish this function better.
Irreversible Losses	Defined as partial demagnetization of the magnet, caused by exposure to high or low temperatures, external demagnetizing fields or other factors. These losses can be recovered by re-magnetization. Magnets can be stabilized against irreversible losses by partial demagnetization induced by temperature cycles or by external magnetic fields. Stabilization results in the “loss” prior to placing the magnet in the

	application and the application is designed around the output of the stabilized magnet.
Isotropic	Having magnetic properties which are independent of the magnet orientation. Most magnetic materials are anisotropic as cast or powdered: each crystallite has a preferred direction of magnetic orientation. If the particles are not physically oriented during manufacture of the magnet, this results in a random arrangement of the particles and magnetic domains and produces isotropic magnet properties. Conversely, orienting the material during processing results in an anisotropic magnet.
J – See Bi	Intrinsic Induction
Js – See Bis	Saturation Intrinsic Induction
Joule	SI unit for energy
kHz	1,000 Hz (kiloHertz)
Keeper	A piece(s) of magnetically soft iron that is placed on or between the pole faces of a permanent magnet to decrease the reluctance of the air gap and thereby reduce the flux leakage from the magnet. It also makes the magnet less susceptible to demagnetizing influences.
KiloGauss	1 kiloGauss is equal to 1,000 Gauss.
Knee (of the demagnetization curve)	In the second and fourth quadrants of the hysteresis loop, some materials such as ferrite and rare earth magnets exhibit a distinct "knee" or rapid change in slope of the intrinsic curve. The location of the knee is of interest to designers. If the magnet operates below the knee, irreversible loss of magnetic output occurs.
Lg – Length Of The Air Gap	The length of the path of the central flux line of the air gap; measured in centimeters.
Lm – Length Of The Magnet	The total length of magnet material traversed in one complete revolution of the center-line of the magnetic circuit; measured in centimeters.
Lm/D – Dimension Ratio	The ratio of the length of a magnet to its diameter, or the diameter of a circle of equivalent cross-sectional area. For simple geometries, such as bars and rods, the dimension ratio is related to the slope of the operating line of the magnet, Bd/Hd.
Leakage Flux; Leakage Field	That portion of the flux, which does not pass through the air gap, or useful part of the magnetic circuit due to a shunting to the opposite pole. See also, Fringing Field.
Leakage Inductance	The inductance associated with the leakage flux of a core coil.
Legg's Equation	An expression for total core loss at low flux densities. The sum of hysteresis loss, residual loss and eddy current loss. The equation is: $R_{ac}/\mu L = aB_{max}f + cf + ef^2$ where R_{ac} = effective resistance due to core losses μ = permeability of the core L = inductance in henries a = hysteresis loss coefficient B_{max} = maximum flux density in Gausses f = frequency c = residual loss coefficient e = eddy current loss coefficient
Linear Material	Magnetic material that exhibits fairly constant permeability over a wide range of MMF.
Litz Wire	A special type of wire that consists of many strands (sometimes hundreds) of magnet wire woven together to form a single conductor. This type of wire offers advantages over single strand at high frequency.
Load	That part of an electrical circuit that receives energy.
Load Line	Graphic representation of permeance.
Loading Coils	Inductors used to compensate for capacitance of long transmission lines.

Mag amp (Magnetic Amplifier)	A device that utilizes a square loop core material to provide a series impedance. The impedance is switched off at a predetermined time during a voltage pulse.
Magnetic Circuit	The combination of magnet, permeable flux carriers and air gaps through or around which the magnetic flux path passes.
Magnetic Energy	The product of the flux density (B) in a magnetic circuit and the (de)magnetizing force (H) required to reach that flux density. See Energy Product.
Magnetic Flux	A contrived but measurable concept that has evolved in an attempt to describe the "flow" of a magnetic field. Unlike electric current where there is an actual flow of electrons, a magnetic field is the result of the energy state of a series of magnetic domains. Conceptually, one could imagine that the sequential change of energy state as the result of an applied field represents a “flow”.
Magnetic Line of Force	An imaginary line representing a magnetic field, which at every point has the direction of the magnetic flux at that point. Flux is a vector quantity having both magnitude and direction.
Magnetic Path	The route magnetic flux follows in a magnetic circuit.
Magnetic Path Length	The length of the closed path that magnetic flux follows around a magnetic circuit. Ampere’s Law determines it. For a toroidal (ring-shaped) powder core, an effective path length is defined to account for the decrease in flux density from inside diameter to outside diameter. The path length is approximately the average circumference of the ring.
Magnetizing Force or Field (H)	An applied magnetic field used to drive another material to a condition of being magnetized. It may be applied by current through a coil of wire or by using permanent magnets to generate the applied field. By Ampere’s Law, the MKSA unit of magnetic field (magnetizing force) is the ampere-turn per meter. The CGS unit of magnetizing force is the oersted. One oersted is equivalent to $1000/(4\pi)$ or 79.58 ampere-turns per meter; one kOe = 0.0796 kA/m.
Magnetometer	Same as flux gate magnetometer.
Magnetomotive Force	Most commonly produced by a current flowing through a coil of wire where its magnitude is proportional to the current, and to the number of turns. The cgs unit of magnetomotive force is called a Gilbert and is defined by the equation: $F = 0.4\ \Pi\ NI$ where I is in amperes and N is the number of turns The rationalized unit is the ampere-turn (*ni*). Magnetomotive force may also result from a magnetized body.
Magnetostriction	The expansion and contraction of a magnetic material with changing magnetic flux density. The saturation magnetostriction coefficient has the symbol λ_s. It is change of length divided by original length (a dimensionless number) and is measured at the saturation flux density. Magnetostriction causes audible noise if the magnetostriction is sufficiently large and the applied field is AC and in the audible frequency range, e.g., 50 or 60 Hz.
Magnet Wire	Copper or aluminum wire with electrical insulating material applied to the surface to prevent continuity between adjacent turns in a winding.
Mandrel	The piece that defines the shape and size of the “window” in a tape wound product when it is manufactured. This includes tape and silectron cores.
Manganese-Zinc Ferrites	A soft magnetic material used in powder cores and characterized by very low eddy current loss. Used for transformer and inductor cores. Compared to nickel-zinc ferrites, they have higher saturation flux density but with greater loss with high frequency current.

Maximum Energy Product (BHmax)	The product of Bd and Hd which yield a maximum. See also, “BHmax”.
Maxwell	The unit of magnetic flux in the cgs electromagnetic system. One maxwell is one line of magnetic flux.
Mean Length Turn	The average length of a single turn in the winding of the device.
Mean Magnetic Path Length	The path the average flux in a magnetic structure follows. In a toroid, this is approximately the average circumference.
MHz	1,000,000 Hz (MegaHetrz)
Mil	0.001 inch. One thousandths of an inch; 0.0254 mm.
MKSA System	Meter-Kilogram-Second-Ampere system. In 1960, the Eleventh General Conference on Weights and Measures redefined some of the original metric units and expanded the system to include other physical and engineering units. The expanded system is called Le Système Internationale d’Unités, abbreviated **SI**. It is one of two commonly used systems of units for measuring electromagnetic quantities. The other is the CGS System, which is also the older. The advantage of the MKSA (SI) system is that the practical units for measuring current and voltage are the same as the ones used in Faraday’s and Ampere’s Laws. In contrast, for example, the CGS system employs “statvolts” and “abamperes” which are not the same as the volts and amperes measured by normal test equipment.
MMF	Magneto-motive force.
MMF Drops	The portions of a magnetic circuit that “consume” the applied MMF.
MPP cores	Molybdenum Permalloy Powder cores which are pressed from powder made of 81% nickel, 2% molybdenum and 17% iron.
Multifilar Winding	A winding technique where a single turn consists of two or more stands of magnet wire operating in parallel. This reduces some of the second-order effects associated with a single strand of wire. Typical would be a bifilar, trifilar, etc.
Mumetal	Sometimes used to describe Permalloy (especially in Europe); strictly speaking, a 65% nickel alloy.
Net Permeability	The permeability of a magnetic circuit when all materials, air gaps, and applied MMFs are taken into account. Same as effective permeability.
Neutral Section	Defined by a plane passing through a magnet perpendicular to its central flux line at the point of maximum flux.
Nickel-Zinc Ferrites	A soft ferrite material that has lower permeability with very low eddy-current loss. The other common ferrites are manganese-zinc and magnesium-zinc.
Nonlinear Material	Magnetic material that exhibits a permeability which changes dramatically when MMF is varied.
Oersted	The unit of magnetic field strength, H, in the cgs electromagnetic system. One oersted equals a magnetomotive force of one Gilbert per centimeter of flux path. One oersted x 0.0796 = one kA/m.
Ohm	Unit of electrical resistance.
Open Circuit Condition	Exists when a magnetized magnet is by itself with no nearby external flux path of permeable material, i.e., permeability greater than 1.
Operating Line	The operating line for a given permanent magnet circuit is a straight line passing through the origin of the demagnetization curve with a slope of negative Bd/Hd. Although the slope is negative, by convention the values are usually referred to in the absolute value of the slope. (Also known as permeance coefficient line.)
Operating Point	That point on a demagnetization curve defined by the coordinates (Bd/Hd) or that point within the demagnetization curve defined by the coordinates (Bm,Hm).
Permalloy	4-79 Molybdenum Permalloy. A 4% molybdenum, 79% nickel, 17% iron alloy used to make tape-wound and laminated cores.
Permanent Magnet Material	Shaped piece of ferromagnetic material, which once having been magnetized, shows definite resistance to external demagnetizing forces, i.e., requires a high demagnetizing force to remove the residual magnetism.
Permeability	The ratio of the ability of a material to carry magnetic flux in comparison

	to air or a vacuum, the permeability of which is, by definition, one.
Permeability, Incremental	The ratio of change in magnetic flux density to change in magnetic field (magnetizing force). $\mu = (1/\mu_o)\Delta B/\Delta H$ in MKSA units $\mu = \Delta B/\Delta H$ in CGS units The magnetic field variations are small or "incremental" and can be in addition to a steady (DC) bias field. For magnetic powder core data, "permeability" is incremental permeability unless otherwise noted. Because of the distributed air gap in powder cores, the initial permeability and incremental permeability, without bias, are essentially the same.
Permeability, Initial	The limit of incremental permeability as a changing unbiased magnetizing force approaches zero. Because of the distributed gap in powder cores, the initial permeability and incremental permeability without bias are essentially the same.
Permeability, Normal - μ	The ratio of the normal induction to the corresponding magnetizing force. In the cgs system, the flux density in a vacuum is numerically equal to the magnetizing force and, consequently, the magnetic permeability is numerically equal to the ratio of the flux density to the magnetizing force. Thus: $\mu = B/H$ Note: In a non-isotropic (anisotropic) medium the permeability is a function of the orientation of the medium, since, in general, the magnetizing force and the magnetic flux are not parallel.
Permeability of Free Space	μ_o – The permeability of a volume occupied by a vacuum. Sometimes called the magnetic constant. Free space permeability is an arbitrary constant used with relative permeability to define the magnetic field (magnetizing force), H, and account for the contribution of a magnetic material to total flux density. In the MKSA system, it has a magnitude of $4\pi \times 10^{-7}$ and dimensions of Henries per meter. In the CGS System, free space permeability has a magnitude of 1 and no dimensions. The MKSA free space permeability was chosen so that the practical units for electrical measurements match the ones used for relating magnetic quantities to voltage and current.
Permeability, Recoil	The ratio of change in flux density as a function of incremental change in applied field (H) in the vicinity of H=0. It has no dimensions in either the MKSA or CGS system. $\mu_o\mu_r = B/H$ in MKSA units. $\mu_r = B/H$ in CGS units.
Permeameter	An instrument used to check permeability on low-permeability cores such as MPP and powdered iron. This type of instrument is preferred over an inductance bridge because it is better suited to high-speed testing. In permanent magnet material, the instrument is used to measure, and often record, the magnetic characteristics of a specimen. Also called a hysteresisgraph.
Permeance	The reciprocal of the reluctance, R, measured in maxwells per Gilbert.
Permeance Coefficient (Pc)	Also known as the "load line" or operating point of a magnet. The Pc is

	affected by the dimensions of the magnet and the associated magnetic circuit. A calculation to determine the Pc of simple magnet geometries in free space can be made or tables and graphs referred to.
Poles, North and South Magnetic	The north pole of a magnet, or compass, is attracted toward the north geographic pole of the earth (which is actually, by definition, a magnetic south pole), and the south pole of a magnet is attracted toward the south geographic pole of the earth. The north-seeking pole of a compass or of a magnet is designated by the letter "N", and the other pole by the letter "S". The N (north) pole of the magnet will attract the S (south) pole of another magnet: unlike poles attract.
Post Regulation	A technique utilizing cores to regulate the "unregulated" outputs of a multiple-output switch-mode power supply. Can use a transistor or a mag amp.
Pot Core	A core configuration that looks like a "pot" or a cup with a center post, consisting of two halves assembled around the coil. Because of this, the core is considered to be self-shielding of stray flux (EMI). This type of core generally is available only in soft ferrites.
Powdered Iron	Material used in the manufacture of soft magnetic powder cores. Iron in the form of small particles is mixed with insulation and binding materials. The mixture is pressed and cured to form inductor cores.
Precase Test	Tape cores normally are tested after being annealed, but before being cased or epoxy coated. This permits re-annealing if the core fails the test, which could reclaim an otherwise scrap core.
Primary Winding	The winding in a transformer that supplies the exciting MMF to the core.
Pulse Losses	Core losses during pulse excitation are quite different from sinusoidal or symmetrical square wave losses. Special loss curves generally are required to determine core loss accurately. Otherwise, there are methods to approximate pulse losses from conventional loss curves.
Pulse Permeability	The permeability of a magnetic material when the excitation is in the form of a short-duration unipolar pulse.
Pulse Transformers	Transformers designed for excitation that consists of short-duration pulses repeated at a specific rate.
Pure Inductors	Used at all frequencies to provide an electronic circuit with inductive reactance.
Q	Q is 2π times the ratio of peak energy stored to energy dissipated during one period of current flow through an inductor. Higher Q can be achieved by lowering the energy dissipation in the core material (lowering the core loss). Eddy current core loss is largely responsible for Q dropping with increased frequency as shown by the MPP Q curves.
Radiated Interference	EMI radiated through air.
Reactance	The apparent "resistance" that a capacitor or an inductor provides to a circuit.
Rectangularity Ratio	See squareness ratio.
Rectangular Loop	See square loop.
Rectifier Transformer	A transformer designed to produce a DC voltage when used with a rectifier circuit (changes AC to unregulated DC). Depending upon the type of rectifier, it may be necessary for the core to accommodate a DC bias.
Regulation	In transformer design, the percentage of the total power rating that is winding loss. This is significant because it indicates how much the output voltage will change as the load goes from no-load to full load.
Relative Permeability	The permeability of a material compared with the permeability of free space. This is what normally is specified as material permeability.
Reluctance	Somewhat analogous to electrical resistance, it is the quantity that determines the magnetic flux, ø, resulting from a given magnetomotive force, F. $R = F / ø$

	where: R = reluctance, in gilberts per maxwell F = magnetomotive force, in gilberts ø = flux, in maxwells
Remanence	The magnetic induction remaining in a material when the magnetizing force has been reduced to zero. Also called “remanent induction”.
Residual Flux	The flux that remains in a core when the applied MMF is returned to a value of zero.
Return Path	A magnet typically forms only part of the magnetic circuit. Soft magnetic materials such as steels are used to carry the magnetic flux to the gap or working region for interaction with other components. This conductor of magnetic flux is referred to as the return path. It is usually designed to minimize fringing and leakage flux.
RF Transformer	Radio Frequency Transformer
Reversible Temperature Coefficient	Changes in flux which occur with temperature change. They are spontaneously regained when the temperature is returned to its original point. There are two values reported: Reversible Temperature Coefficients of Inductance (Br) and of Coercivity (Hci). The temperature range over which they have been measured and specified should be stated. Most materials exhibit a non-linear response with temperature.
Round Loop	Refers to a hysteresis loop where the difference between B_m and B_r of a material is large, resulting in a rounded appearance.
Saturable Reactor	Describes the main element of a magnetic amplifier used to control electrical power such as for electrical resistance element heating of furnaces.
Saturation	Exists when an increase in magnetizing force, H, does not cause a corresponding increase in the intrinsic magnetic induction, B, of the material.
Saturation Flux Density	The flux density at which a material saturates.
Search Coil	A coil conductor, usually of known area and number of turns, that is used with a fluxmeter to measure the change of flux linkage with the coil.
Secondary Winding	The winding in a transformer that supplies the load with electrical energy which has been converted from the induced magnetic energy in the core.
Self-Inductance	Same as inductance.
Sendust	A 9% silicon, 6% Aluminum, 85% iron alloy in particulate form. The particles are coated with a dielectric film, compacted and cured to form magnetic parts such as inductor cores.
Shielding	Thin-gauge sheet material used to protect sensitive devices from radiated EMI (electromagnetic interference).
Sintered Iron	Powdered iron that has been pressed and sintered into a structural form. This type of material occasionally is used in a magnetic application, but they normally exhibit excessive core losses.
Skewing Of The Loop	When air gap is added to the magnetic path, the hysteresis loop is made to lean over (permeability is reduced); it is said to be skewed or sheared.
Slug Core	A core shaped like a rod, with the winding put around the diameter. Needless to say, leakage flux is a problem.
Soft Magnetic Material	Shaped piece of ferromagnetic material that once having been magnetized is very easily demagnetized, i.e. requires a slight coercive force to remove the resultant magnetism. Generally accepted as having a coercivity of less than 300 oersteds (24 kA/m) though most soft materials used in inductors have coercivities of under 10 oersteds.
Sponge Iron	This is a low-cost powdered iron used to make high-permeability powdered iron cores. This same material also is widely used in the sintered powdered-metal industry.
Square Loop	Refers to a hysteresis loop where the difference between B_m and B_r of

	a material is quite small, resulting in a rectangular appearance of the intrinsic curve.
Square Wave	An excitation that consists in an abrupt off-on cycling of the voltage. This typically goes in both the positive and negative direction. A positive-only square wave would be typical of pulse excitation.
Stabilization	A treatment of a magnetic material designed to increase the permanency (stability) of its magnetic properties or condition in an application by causing the loss prior to or during installation or assembly, but prior to testing and use.
Strain Sensitive	Refers to the fact that the properties of magnetic materials can change if the part is subjected to a physical stress.
Swinging Inductors	A special type of inductor that exhibits high inductance at low MMF and moderate inductance at high MMF. There are two popular techniques for accomplishing this: putting a common winding on a high-permeability and a low-permeability core, and putting a staggered gap into a high-permeability core.
Switch Mode Power Supply	A power conversion technique that involves breaking the input power into pulses at a high frequency (by switching it on and off) and re-combining (filtering) these pulses at the output stage. This facilitates easy regulation because the amount of time (the amount of volt-seconds of energy) that the voltage is turned on can be controlled electronically. Generally the output power is monitored and the time of the switch is adjusted in response to the load. On switch mode power supplies with multiple outputs, control still is based on the activity of one of the outputs. But secondary regulation techniques are used on the unregulated" outputs (See mag amp). Abbreviation is SMPS.
Switch Time	A parameter measured on bobbin cores as part of the special pulse test they receive. It is a direct indication of magnetic permeability and core loss.
Tape Cores	Cores manufactured from thin-gauge iron alloy material that has been slit to a predetermined width.
Tc – Curie Temperature	The transition temperature above which a material loses its (ferro)magnet properties. Most references state that the ferromagnetic material becomes paramagnetic (weakly magnetic).
Tmax – Maximum Service Temperature	The maximum temperature to which the magnet may be exposed with no significant long-range instability or structural changes. A proposed magnetic definition is that the hysteresis normal curve is substantially a straight line in the second quadrant up to the Tmax temperature and becomes curved above Tmax.
Temperature Coefficient	A factor which describes the reversible change in a magnetic property with a change in temperature. The magnetic property spontaneously returns when the temperature is cycled to its original point so long as a limit condition is not exceeded – see note below. It usually is expressed as the percentage change per unit of temperature over a specified temperature range. Note: above (or below) a critical temperature, dependent upon the material and its magnetic characteristics and magnetic circuit, an irreversible loss may take place which is recovered when the magnet is re-saturated. See Reversible Temperature Coefficients
Temperature Stabilization	After manufacture, many types of hard and soft magnetic materials can be thermally cycled to make them less sensitive to subsequent temperature extremes.
Tesla	MKSA (SI) unit for magnetic flux density, defined by Faraday's Law. A Tesla represents a volt-second per square meter per turn. One Tesla equals 10,000 Gauss

Weber	The practical unit of magnetic flux. It is the amount of magnetic flux which, when linked at a uniform rate with a single-turn electric circuit during an interval of 1 second, will induce in this circuit an electromotive force of 1 volt. 1 Weber = 10^8 Maxwells.