

## THERMOCOUPLES or RTD's

- Accuracy** Ability of a sensor to produce a signal in accordance with a standard (ASA C96.1) or true value — usually expressed as a degree or percentage (of temperature being read) deviation from the signal produced.
- Alpha** The resistance vs. temperature characteristics of a given metal used in making an R.T.D. Also known as the temperature coefficient.
- A.N.** “Army-Navy” — precedes military part numbers. Thermo Electric is qualified to supply certain thermocouple designs covered by AN specifications.
- A.N.S.I.** “American National Standards Institute” — sponsored by the “American Society of Mechanical Engineers” to provide standards based upon approved and proven procedures in the construction of power and process plants.
- A.S.A.** “American Standards Association” — (see USASI) sponsored by the “Instrument Society of America” for the purpose of formulating guidelines for the manufacture of temperature and other measurement equipment and electrical hardware and procedures.
- A.S.M.E.** “American Society of Mechanical Engineers” — formulates rules for the construction of steam boilers and other pressure vessels. Also provides material specifications covering contents, performance, packaging, etc. of materials. Many ASME specifications covering materials are identical to ASTM specifications.
- A.S.T.M.** “American Society for Testing Materials” — a scientific and technical organization formed for “the development of standards on characteristics and performance of materials, products, systems and services; and the promotion of related knowledge.” Usually applies to thermowell material.
- Barstock Thermowell** A thermowell manufactured from solid metal bar, hex or round, — offers the advantage of being tapered or straight and generally stronger than pipe wells. (T.E. standard types 11 thru 14 and 42).
- Bell Spring** A flex limiting spring, soldered to transition pieces for the purpose of preventing longitudinal stress.
- Boron** A neutron absorber prohibited in concentrated levels in a nuclear power plant. T.E. CERAMO® wire is low in Boron content.
- Calibration** Refers to the metals combination used to make the thermocouple (e.g. iron-vs-constantan). Also, the act of comparing the output of the sensor to a given standard to determine the exact error at any given temperature.
- Carbide Precipitation** A condition characterized by a loss of carbon content as a result of normal grain growth in Stainless Steels when used at continuously high temperatures, then cooled slowly. The result is increased strength but at the expense of ductibility. Heat treating can be used to prevent carbide precipitation but a more popular option is the use of low carbide content Stainless Steels.
- CERAMO®** A Thermo Electric trade name for a construction consisting of thermocouple conductors surrounded by an insulating medium and a tight fitting metal sheath.
- Coaxial** In thermocouple design, a CERAMO® wire having a second, concentric, sheath separated by an insulating medium (e.g. magnesium oxide).
- Cold End** That end of the thermocouple opposite the measuring junction.
- Cold Junction** The reference junction — usually the lower of the two junctions, hence “cold”.
- Cryogenics** Being or related to very low temperatures (usually below 0°F). Type “T” thermocouples are the predominant calibration for cryogenics.
- Dye Penetrant Test** A dye is applied to the element sheath or thermowell surface then viewed under a light that reveals, by dye residue the extent of surface flaws.
- Electrobestos** An asbestos cement compound used in thermocouple connectors, jack panels and terminal blocks — good to 1000°F.
- Element** Sensor portion of an industrial assembly. — Any basic thermocouple or RTD without hardware.
- EMF** Electro Motive Force — synonymous with millivolt output.
- Error** The degree to which a signal produced has the potential to deviate from a given standard or true value. Stated as a “worst case”.
- “Green Rot”** See preferential oxidation.
- “H” Clamp** A clamp used when joining CERAMO® wire to lead wire when the CERAMO® wire is 1/8” O.D. or smaller. It absorbs stress from the soldered joint therefore minimizing the possibility of an open circuit in the transition area.

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<b>Helium Leak Test</b>	Used to verify the integrity of a weld or mechanical joint — helium is a “light” gas that would “leak through” an imperfect weld.
<b>Homogeneous</b>	Of the same composition throughout.
<b>Hot Junction</b>	The measuring junction — usually warmer than the reference junction hence “hot”.
<b>Immersion Length</b>	That portion of the sensor that will or could be subjected to the temperature being measured. (exception: bayonet thermocouples where the immersion is measured below the cap.)
<b>Inert</b>	Lacking chemical or biological action — does not contain active properties.
<b>I.R.</b>	Internal Resistance — the opposition offered by the magnesium oxide in CERAMO® wire to the passage of a steady electric current — measured from conductor to conductor or conductor to sheath.
<b>I.S.A.</b>	Instrument Society of America — a society that provides standards and practices that define products and procedures relative to all types of measuring instruments and components. Its standards are a consensus of those in the industry concerned with the society's scope and provisions.
<b>Junction Box Connector</b>	An adapter that secures to armour cable and threads into a junction box opening. It provides strain relief for wire entering a junction box.
<b>Lag</b>	That portion of the well above the threads and below the hex, intended to extend through the lagging of a vessel.
<b>Linearity</b>	The extent to which a calibration curve approaches a straight line.
<b>Magnesium Oxide</b>	(MgO) A ceramic type insulating medium that provides high resistivity, excellent purity and very good crush-ability.
<b>N.B.S.</b>	National Bureau of Standards. Provides traceability to true temperature. N.B.S. traceability is necessary to insure the compliance of thermocouples and RTD's to the standards which N.B.S. has established relative to accuracy.
<b>N.P.T.</b>	National Pipe Threads. The standard set up by the A.S.A. which assures uniform threads on all hardware.
<b>Oxidizing</b>	An atmosphere containing a substantial amount of active oxygen.
<b>Pipe Well</b>	Or Protection Tube is made from pipe and designed to accept a thermocouple element, where pressure is not a primary concern.
<b>Potting</b>	An insulating compound used in the transition area of a thermocouple for the purpose of excluding moisture and contaminants as well as protection and strain relief for the joint. Epoxy and sauerisen are common potting compounds.
<b>Phenolic</b>	A resin or plastic used in molding or insulating. Bakelite is a phenolic.
<b>Preferential Oxidation or “Green Rot”</b>	A greenish surface or subsurface scale that develops on CHROMEL® wire when subjected to a marginally oxidizing environment at a high temperature. A sharp negative drift in calibration is common. The normally nonmagnetic CHROMEL® becomes magnetic, often brittle, and the thermocouple should be replaced. (See “titanium getters” and “purge systems”).
<b>Probe Length</b>	The total length of the element, regardless of immersions limitations as a result of fittings.
<b>Purge System</b>	An industrial design that permits the introduction of an oxidizing environment into the thermowell or protection tube thereby eliminating the possibility of preferential oxidation.
<b>Radiograph</b>	An X-ray photograph.
<b>Reducing</b>	An environment devoid of oxygen or containing it in an inactive state (e.g. carbon monoxide).
<b>Resistance Temperature Detector or RTD</b>	A temperature sensor that operates on the principle that the resistance of any given metal changes with temperature.
<b>Response Time</b>	The amount of time necessary for a temperature change to be detected and indicated by the temperature sensor — stated as a step change.
<b>S.A.M.A.</b>	Scientific Apparatus Makers Association — develops standards that eliminate misunderstandings between the manufacturer and purchaser in the selection of the proper product to meet a particular need — in association with ASME, ANSI and ISA.
<b>Sauerisen</b>	A high temperature potting compound.
<b>Secondary Junction</b>	A junction that develops between the measuring and reference junction as a result of a short or third metal — can contribute an error or replace the primary (measuring) junction and the sensor would indicate the temperature at the secondary junction.

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<b>Sheath</b>	The metal encapsulating the conductors and insulation in CERAMO® wire.
<b>Socket Well</b>	A thermowell that is designed to be used with a socket and welded into the vessel.
<b>Tensile Strength</b>	The greatest longitudinal stress a substance can bear without tearing apart.
<b>Temperature Coefficient</b>	See "Alpha".
<b>Test Well</b>	A thermowell used intermittently for checking temperature with an RTD thermocouple or dial thermometer — usually supplied with plug and chain to protect threads and exclude foreign matter when not in use.
<b>Thermocouple</b>	A temperature sensor based on the principle that when two dissimilar metals, in a closed circuit, are subjected to different junction temperatures, a current will flow.
<b>Thermowell</b>	A receptacle designed to accept a sensor and protect it from the environment as well as provide threads or a flange for mounting to the process or vessel.
<b>Titanium Getters</b>	Conductors of titanium provided with type "K" ceramo for the purpose of absorbing trace amounts of oxygen, a potential cause of preferential oxidation.
<b>Tube Skin Thermocouples</b>	Designed to measure tube surface temperatures — commonly supplied with a heat collecting (weld) pad and expansion loops.
<b>U.S.A.S.I.</b>	United States of America Standards Institute — designation for A.S.A.
<b>Van Stone Thermowell</b>	Bar stock well with a built-in collar equal in diameter to the raised portion of the flanges, it is intended to be "sandwiched" in the vessel.
<b>Weld-In Thermowell</b>	Any thermowell without mounting threads or any provision for mounting except to be welded into the vessel.
<b>Wheatstone Bridge</b>	Electrical network of fixed resistors, null detector, RTD sensor and adjustable resistor used primarily to measure the resistance change in an R.T.D.

## WIRE and CABLE

<b>Abrasion Resistance</b>	Ability of a wire, cable or material to resist surface wear.
<b>Accelerated Aging</b>	A test in which voltage, temperature, etc., are increased above normal operating values to obtain observable deterioration in a relatively short period of time. The plotted results give expected service life under normal conditions.
<b>Aging</b>	The change in properties of a material with time under specific conditions.
<b>Air Oven Aging</b>	The change in properties of a material with time under specific conditions of temperature. Tensile and elongation results are referenced to the values of the unaged samples.
<b>Alloy</b>	A metal formed by combining two or more different metals to obtain desirable properties.
<b>Alternating Current</b>	Electric current that continually reverses its direction. It is expressed in cycles per second (Hertz or Hz).
<b>Ambient Temperature</b>	The temperature of a medium (gas or liquid) surrounding an object.
<b>American Wire Gauge (AWG)</b>	A standard system for designating wire diameter. Also referred to as the Brown and Sharpe (B & S) wire gauge.
<b>Armor</b>	A braid or wrapping of metal, usually steel, used for mechanical protection. Generally placed over the outer sheath.
<b>ASTM</b>	Abbreviation for the American Society for Testing and Materials, a non-profit industry-wide organization which publishes standards, methods of test, recommended practices, definitions and other related material.
<b>AWG</b>	Abbreviation for American Wire Gauge.
<b>Braid</b>	A fibrous or metallic group of filaments interwoven in cylindrical form to form a covering over one or more wires.
<b>Breakdown Voltage</b>	The voltage at which the insulation between two conductors breaks down.
<b>B &amp; S Gauge</b>	The same as American Wire Gauge (AWG).
<b>Bunch Stranding</b>	A group of wires of the same diameter twisted together without a predetermined pattern.
<b>Cable</b>	An insulated conductor, or group of individually insulated conductors in twisted or parallel configuration.
<b>Cabling</b>	The twisting together of two or more insulated conductors to form a cable.

## WIRE and CABLE

<b>Capacitance</b>	That property of a condenser which determines how much charge can be stored in it for a given potential difference across its terminals unit of measurement is micro farad.
<b>Cold Bend</b>	The lowest temperature wire or cable is capable of being manipulated without cracking insulation or jacket.
<b>Cold Flow</b>	Permanent deformation of the insulation due to mechanical force or pressure (not due to heat softening).
<b>Concentric Stranding</b>	A central wire surrounded by one or more layers of helically wound strands in a fixed round geometric arrangement.
<b>Condenser</b>	A device consisting of two or more conductor plates separated from one another by a dielectric and used for receiving and storing an electric charge.
<b>Conductor</b>	An uninsulated wire suitable for carrying electrical current.
<b>Control Cable</b>	A multiconductor cable made for operation in control or signal circuits.
<b>Core</b>	In cables, a component or assembly of components over which additional components (shield, sheath, etc.) are applied.
<b>Coverage</b>	The percent of completeness with which a metal braid covers the underlying surface.
<b>Current Carrying Capacity</b>	The maximum current an insulated conductor can safely carry without exceeding its insulation and jacket temperature limitations.
<b>Cut-Through Resistance</b>	The ability of material to withstand mechanical pressure, usually a sharp edge or small radius, without separation.
<b>Dielectric</b>	Is a non-conducting material that permits the passage of the lines of force of an electrostatic field, but does not conduct the current i.e. plastic, rubber, glass.
<b>Dielectric Constant</b>	Or permittivity is that property of a dielectric which determines the electrostatic energy stored within the solid material. (Best insulation have lowest dielectric constant i.e. Air 1.0, Teflon FEP 2.1, PVC 6.0).
<b>Dielectric Strength</b>	The voltage which an insulation can withstand before breakdown occurs. Usually expressed as a voltage gradient (such as volts per mil).
<b>Dielectric Test</b>	A test in which a voltage higher than the rated voltage is applied for a specified time to determine the adequacy of the insulation under normal conditions.
<b>Drain Wire</b>	In a cable, the uninsulated wire laid over the component or components and used as a ground connection.
<b>Drawing</b>	In wire manufacture, pulling the metal through a die or series of dies to reduce diameter to a specified size.
<b>Elastomer</b>	A rubber-like substance.
<b>Elongation</b>	The fractional increase in length of a material stressed in tension.
<b>Flame Resistance</b>	Horizontal-Vertical-Tests devised to provide the user with information about the burning characteristics of insulation-jackets.
<b>Flammability</b>	A measure of a materials ability to support combustion. Many products contain ingredients which make them self-extinguishing in slow burning without a major effect on other desirable properties.
<b>Flex Life</b>	The measurement of the ability of a conductor or cable to withstand repeated bending.
<b>Flexible</b>	That quality of a cable or cable component which allows for bending under the influence of outside force, as opposed to limpness which is bending due to the cable's own weight.
<b>FR-1</b>	A flammability rating established by Underwriters Laboratories for wires and cables that pass a specially designed vertical flame test.
<b>Heat Distortion</b>	Distortion or flow of a material or configuration due to application of heat.
<b>Hi-Pot</b>	A test designed to determine the highest voltage that can be applied to a conductor without breaking through the insulation.
<b>Hygroscopic</b>	Capable of absorbing moisture from the air.
<b>Hypalon</b>	Duponts trade name for their chlorosulfonated polyethylene, an ozone resistant synthetic rubber.
<b>Impact Strength</b>	A test for determining the punishment a cable can withstand without physical or electrical breakdown by impacting with a given weight, dropped a given distance, in a controlled environment.

# Glossary of Terms

## WIRE and CABLE

<b>Impedance</b>	The total opposition that a circuit offers to the flow of alternating current or any other varying current at a particular frequency. It is a combination of resistance R and reactance X, measured in ohms.
<b>Increase in Capacitance</b>	A change in the electrical properties of an insulator after immersion in water or being subjected to high humidity. Usually the dielectric constant increases.
<b>Insulation</b>	A material having high resistance to the flow of electric current. Often called a dielectric in radio frequency cable.
<b>Insulation Resistance</b>	The ratio of the applied voltage to the total current between two electrodes in contact with a specific insulation, usually expressed in megohms-M feet.
<b>Insulation Resistance Constant</b>	A specific minimum IR value for an insulating material determined at an ambient temperature of 60°F (15.6°C).
<b>IPCEA</b>	Abbreviation for Insulated Power Cable Engineers Association.
<b>Jacket</b>	An outer non-metallic protective covering applied over an insulated wire or cable.
<b>Lay</b>	The length measured along the axis of a wire or cable for a single strand (in stranded wire) or conductor (in cable) to make one complete turn about the axis of the conductor or cable.
<b>Low Loss Dielectric</b>	An insulating material that has a relatively low dielectric loss such as Polyethylene or Teflon.
<b>Modulus of Elasticity</b>	The ratio of stress to strain in an elastic material.
<b>Moisture Absorption</b>	The amount of moisture (expressed in percentage). A insulation dielectric will absorb under specified conditions. The electrical properties are affected I.R. decreases, breakdown voltage decreases and the dielectric constant increases.
<b>Offgassing</b>	Percentage of a specified gas released during the combustion of insulation or jacketing material.
<b>Oil Immersion</b>	The ability of an insulation jacket to retain useful physical or electrical properties after immersion in a liquid or vapor i.e. transformer, oil, gasoline. These type elements usually cause swelling.
<b>Overlap</b>	The amount the trailing edge laps over the leading edge of a spiral tape wrap.
<b>Oxygen Index</b>	The percentage of oxygen in atmosphere, required to maintain or support combustion of a dielectric. Index refers to percent of oxygen in normal air (approximately 21%).
<b>Ozone Resistance</b>	Not damaged by ozone which is an allotropic (the property of certain elements to exist in two or more different forms) form of oxygen usually formed by an electrical discharge in air.
<b>Pick</b>	Distance between two adjacent crossover points of braid filaments. The measurement in picks per inch indicates the degree of coverage.
<b>Power Factor</b>	In an alternating current circuit, it is the number of watts indicated by a wattmeter, divided by the apparent watts. The latter being the watts as measured by a voltmeter and ammeter. It is the multiplier used with the apparent watts to determine how much of the supplied power is available for use.
<b>Surface Resistivity</b>	The resistance of a material between two opposite sides of a unit square of its surface. Since insulating materials are used to isolate the conductors from ground as well as each other, a high insulation resistance is desirable. Surface resistivity is measured after the cable sample has been immersed in water for a specified time, excess moisture removed, then a voltage is applied and surface resistance calculated.
<b>Tank Test</b>	A voltage dielectric test in which the test sample is submerged in water and voltage is applied between the conductor and water as ground.
<b>Tape Wrap</b>	A spirally applied tape over an insulated or uninsulated wire.
<b>Temperature Rating</b>	Maximum temperature which wire insulation can be used for extended periods without loss of its basic properties, (i.e. elongation). Long time exposure to high temperature is one of the principal factors in determining temperature rating.
<b>Tensile Strength</b>	Resistance to lengthwise stress measured by the greatest load in weight per unit area pulling in the direction of length that a given substance can bear without tearing apart. (i.e. PSI).
<b>Thermoplastic</b>	A material which softens when heated and becomes firm on cooling.
<b>Thermoset</b>	A material which hardens or sets when heat is applied and which once set, cannot be resoftened by heating. The application of heat is called "curing".
<b>Tray Cable</b>	A factory-assembled multiconductor control, signal and power cable specifically approved under the National Electrical Code for installation of trays.

## WIRE and CABLE

<b>Tubing</b>	A tube of extended non-supported plastic material.
<b>UL</b>	Abbreviation for Underwriters Laboratories, a non-profit independent organization, which operates a listing service for electrical and electronic material and equipment.
<b>Ultimate Elongation</b>	Insulation (elongated or stretched) to rupture of sample expressed as % of original sample. 200% modulus-Tensile strength of a specimen at 200% elongation.
<b>Voltage Rating</b>	The highest voltage that may be continuously applied to a wire in conformance with standards or specifications.
<b>Volume Resistivity</b>	(Specific Insulation Resistance). The electrical resistance between opposite faces of a 1 cm, cube of insulating material, commonly expressed in ohms/centimeter.

## INSTRUMENTS

<b>Accuracy</b>	Conformity to an indicated standard or true value — usually expressed as a percentage (span or full scale) deviation from the indicated, standard or true value.
<b>Controller Accuracy</b>	The maximum error or deviation between the expected value of the controlled variable and the actual measured value.
<b>Indication Accuracy</b>	The maximum error or deviation between the indicated value of some variable, e.g. temperature, and the actual measured value.
<b>Setpoint Accuracy</b>	The maximum error or deviation between the setpoint value and the actual value of the controlled variable.
<b>Ambient Temperature Range</b>	The allowable range of the temperature of the medium (usually air) surrounding an object.
<b>Amplification</b>	The dimensionless ratio of output/input in a device intended by design to increase this ratio.
<b>Amplifier</b>	A device whose output is, by design, an enlarged reproduction of the input signal and which is energized from a source other than a signal.
<b>Attenuation</b>	A decrease in signal magnitude — the reciprocal of gain.
<b>Automatic Controller</b>	A device or combination of devices which measures the value of a variable, quantity or condition and operates so as to correct or limit deviation of this measured value from a selected setpoint reference.
<b>Automatic Control System</b>	An operable arrangement of one or more automatic controllers along with their associated equipment connected in closed loops with one or more processes.
<b>Automatic Reset</b>	A means of obtaining reset action using an electronic circuit which automatically senses that the input is not at the desired setpoint and adjusts the output at a specified rate to bring the input to setpoint.
<b>BCD</b>	Abbreviation for “binary coded decimal”. Used to describe digital logic code for expressing decimal numbers with four logic lines.
<b>Breakpoint</b>	The junction of two confluent straight-line segments of a plotted curve.
<b>Capacitance</b>	The property which may be expressed as the time integral of flow rate (heat, electric current, etc.) to or from a storage divided by the associated potential change.
<b>Capacity</b>	Measure of capability to store liquid volume, mass electrical charge, heat, information or any form of energy or matter.
<b>Cascade Control System</b>	A control system in which the output of one controller is the input for another.
<b>Closed Loop (Feedback Loop)</b>	Several automatic control units connected so as to provide a signal path which includes a forward path, a feedback path and summing point. The controlled variable is constantly measured and if it deviates from that which has been prescribed, corrective action is applied to the final element in such direction as to return the controlled variable to the desired value.
<b>Common (Mode) Noise</b>	The AC potential that exists between the inputs of a (differential input) device and common point (usually circuit ground or earth ground).
<b>Control Accuracy</b>	The degree of correspondence between the controlled variable and the desired value after stability has been achieved.
<b>Controlling Means</b>	The elements in a control system which contribute to the required corrective action.
<b>Control Point</b>	The value at which the controlled system or process settles out or stabilizes. It may or may not agree with the setpoint (instruction) applied to the controller.

## INSTRUMENTS

<b>Current</b>	The movement of electrons in a conductor. The direction of current is opposite to the direction of flow of electrons.
<b>Alternating Current (AC)</b>	1. Refers to an electrical current which reverses its direction on a regular basis. Typically, although not necessarily, sinusoidal waveform with respect to reference or ground. Current flow from zero (average value) to maximum through zero to minimum and back to zero constitutes one cycle. The number of cycles per second (Hertz) is the frequency. 2. Used to describe any time varying current to distinguish it from the steady state (DC) component.
<b>Direct Current (DC)</b>	1. An electrical current which flows in one direction. 2. Used to describe any time independent (steady state) current.
<b>Current Proportional Control</b>	A type of control which changes the output current from its maximum to some equilibrium value when the signal is within the proportional band.
<b>Cycle Time</b>	The time to complete one cycle, i.e., output on time plus output off time, for a (time-base) proportional control with a constant input signal.
<b>Cycling</b>	A periodic change in the factor under control usually resulting in equal excursions above and below the control point of sinusoidal wave shape oscillation.
<b>Damping</b>	Progressive reduction in the amplitude of cycling of a system — critically damped describes a system which is damped just enough to prevent overshoot following an abrupt stimulus.
<b>Dead Band (Dead Zone)</b>	The change through which the input to an instrument can be varied without initiating instrument response.
<b>Dead Time</b>	The time that elapses while the input to an instrument varies sufficiently to pass through the dead-band zone and causes the instrument to respond.
<b>Derivative Action</b>	Control action in which the rate of change of the error signal determines the magnitude of the corrective action to be applied. Unit is calibrated in the time units. When subjected to a ramp change the derivative output precedes the straight proportional action by this time.
<b>Deviation</b>	The departure from a desired value; the system deviation that exists after transients have expired is synonymous with offset.
<b>DIN</b>	Abbreviation for Deutsches Institute Fur Normung, A German Standard.
<b>Direct Action Control</b>	Increasing input causes a proportional increase in the output variable. Decreasing input causes a decrease in the output.
<b>Drift</b>	In electronics, a change in a parameter due to a temperature change.
<b>Dual Setpoint, Dual Output</b>	A control device which contains two independent outputs with each having an independently adjustable setpoint.
<b>Dynamic Behavior</b>	Behavior as a function of time.
<b>Equilibrium</b>	When all inputs and outputs (supply and demand) have steadied down and are in balance.
<b>Error</b>	The difference between the actual and the true value, often expressed as a percentage of either span or full-scale value.
<b>Feedback</b>	Information about the status of the controlled variable which may be compared with that which is desired, in the interest in making them coincide.
<b>Final Control Element</b>	Component of a control system (such as a valve) which directly regulates the flow of energy or material to the process.
<b>Frequency</b>	Occurrence of a periodic function (with time as the independent variable), generally specified as a certain number of cycles per unit time.
<b>Gain (Magnitude Ratio)</b>	The ratio of change in output divided by the change in input which caused it. Both output and input must be expressed in the same units making gain a pure (dimensionless) number.
<b>Gain Loop</b>	The combined output input magnitude ratios of all the individual loop components multiplied together to obtain the overall gain.
<b>Gain Static (Zero Frequency Gain)</b>	The output input amplitude ratio of a component or system as frequency approaches zero.
<b>Galvanometric</b>	A measurement which indicates relative deviation by a null-balance method.
<b>Gate Signal</b>	An electrical signal capable of driving a solid state switching device such as SCR, triac, or solid state relay.
<b>Ground Loop</b>	Condition which exists when two circuit points are connected by two or more paths. This allows current flow in the loop to vary the potential of the connected points.

## INSTRUMENTS

<b>Hunting</b>	Oscillation or cycling that may be of appreciable amplitude caused by the system's over-zealous effort to achieve a prescribed level of control.
<b>Hysteresis</b>	Difference between upscale and downscale results in instrument response when subjected to same input approached from opposite directions.
<b>Impedance</b>	The total opposition to the flow of current (in ohms).
<b>Indication Resolution</b>	The smallest change that can be read with a given indication.
<b>Inductive Load</b>	A load which is predominantly inductive, i.e. affecting only varying or alternating currents and having low impedance for direct currents.
<b>Input</b>	Incoming signal to measuring instrument control unit or system.
<b>Input Impedance</b>	The total opposition to current flow into a device measured in ohms. If input is purely resistive, the term "input resistance" may be used.
<b>Instability</b>	Lack of stability.
<b>Instrument</b>	In process measurement and control this term is used broadly to describe any device that performs a measuring or controlling function.
<b>Instrumentation</b>	The application of instruments to an industrial process for the purpose of measuring or controlling its activity; the term is also applied to the instruments themselves.
<b>Integral Control Action</b>	Action in which the controller's output is proportional to the time integral of the error input; when used in combination with proportional action, it is often called reset action.
<b>Lag</b>	A delay in output with respect to a change in input.
<b>Limiting</b>	A boundary imposed on the upper or lower range of a variable; e.g., the pressure in a steam boiler as limited by a safety valve.
<b>Linearity</b>	The nearness with which the plot of a signal or other variable plotted against a prescribed linear scale approximates a straight line.
<b>Load</b>	Change in level of material force, torque, energy, power or other variables applied or removed from a process or other component in the system.
<b>Manipulated Variable</b>	That which is altered by the automatic control equipment so as to change the variable under control and make it conform with the desired value.
<b>Manual Reset</b>	A means of obtaining "reset" action by manual adjustment by the operator of an instrument.
<b>Measuring Element</b>	The element which converts into a form or language that the controller can understand.
<b>Measuring Means</b>	The device used to perform the actual measurement.
<b>Noise</b>	Unwanted signal components that obscure the genuine signal information that is being sought.
<b>Normal (Mode) Noise</b>	The AC potential that exists between the two inputs of a (differential input) device.
<b>Off-Set</b>	The difference between what we get and what we want; that is, the difference between the point at which the process stabilizes and the instruction introduced into the controller by the setpoint.
<b>On/Off Control</b>	A control mode in which the output is either full on depending on whether or not the input is below or above setpoint.
<b>Open Loop</b>	Control without feedback; e.g., an automatic washer.
<b>Optimum</b>	The highest obtainable proficiency of control; e.g., supply equals demand and offset has been reduced to a minimum, (hopefully zero).
<b>Output</b>	The signal which is provided by an instrument; e.g., the signal which the controller delivers to the valve operator is the controller output.
<b>Overdamped</b>	Damped so that overshoot cannot occur.
<b>Overshoot</b>	The effort of the control system to reach the desired level which frequently results in going beyond (overshooting) the mark.
<b>Phase Angle Firing</b>	The turn on of an electric switch, usually a triac or SCR, at a varying position in the cycle of a periodic voltage or current. The phase angle is measured from the zero-cross of the waveform.
<b>Positioning Proportional Control</b>	A type of control which changes the output variable feeding a positioning device from its maximum to some equilibrium value when the signal is within the proportional band.
<b>Potentiometric</b>	A measurement of DC potential by a null-balance method usually in a resistance bridge.
<b>Power Consumption</b>	The amount of power (in watts) required by an electronic device during operation.

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<b>Process</b>	The equipment to which supply and demand must be balanced — the system under control excluding the equipment which does the controlling.
<b>Proportional Band</b>	The reciprocal of gain expressed as a percentage. Refers to the percentage of the controller's span of measurement over which the full travel of the control valve is divided.
<b>Proportional Control</b>	Control action in which there is a fixed gain or attenuation between output and input.
<b>Proportioning Control</b>	A control mode in which the output varies with respect to the difference between the input signal and desired setpoint. When this difference is within a preset range, or "proportional band", the output is varied, depending on the type of control, until the setpoint is reached.
<b>Rate Action</b>	That portion of controller output which is proportional to the rate of change of input. Also called derivative action.
<b>Reaction Curve</b>	In process control a reaction curve is obtained by applying a step change (either in load or setpoint) and plotting the response of the controlled variable with respect to time.
<b>Reference Junction Compensation</b>	The generation of a temperature dependent voltage (of opposite polarity) to compensate for the temperature dependent voltage generated at the junction of two dissimilar metals.
<b>Repeatability</b>	A measure of the maximum error or deviation that can be expected when the same value is input at two different times.
<b>Reproductivity</b>	The exactness with which a measurement or other condition can be duplicated over a period of time.
<b>Reset</b>	Reset "action" is an electrical means of adjusting (offsetting) the output of a proportional controller to maintain the input at setpoint, by compensating for system losses or gains.
<b>Reset Action</b>	The control action which strives to eliminate offset; correction is made in accordance with the magnitude of the offset and the time involved. Reset is sometimes called integral as it performs an integration of the error.
<b>Reset Time</b>	The calibrated time on the controller reset dial which represents the time that will elapse while the open-loop controller repeats a proportional action.
<b>Reset Windup</b>	The overcharging, in the presence of a continuous error, of the reset capacitor (bellows in a pneumatic controller which must discharge through a long-time constant discharge path and prevents return to the desired control point).
<b>Resistance</b>	An opposition to flow which accounts for the dissipation of energy and limits flow. Flow from water tap, for example, is limited to what the available pressure can push through the tap opening.
<b>Electrical Resistance (ohms)</b>	$= \frac{\text{Potential volts}}{\text{Flow amperes}}$
<b>Resistive Bridge</b>	An electrical circuit consisting of four resistors connected to form a square. A potential is normally connected across one diagonal and a galvanometer across the other. Adjustment of the resistance to null reading of the galvanometer makes possible the determination of one of the resistors if the other three are known.
<b>Resistive Load</b>	A load which is predominantly resistive; affecting direct or alternating current with no frequency dependence.
<b>Response</b>	Reaction to a forcing function applied to the input; e.g., the variation in measured variables which occurs as the result of step, sinusoidal, ramp or other known type known inputs.
<b>Reverse Action Control</b>	Increasing input causes a proportional decrease in the output variable. Decreasing input causes an increase in the output.
<b>Sample Rate (Updating)</b>	The rate, usually expressed in number of times per second, that a device input is measured and/or an output is changed.
<b>SCR</b>	Abbreviation for "silicon controlled rectifier". A three terminal device which acts as a conventional rectifier to block current flow in the reverse direction and as a transistor switch in the forward direction.
<b>Self-Regulation</b>	The ability of an open-looped process or other device to settle out (stabilize) at some new operating point after a load change has taken place.
<b>Temperature Coefficient</b>	The amount of change in a parameter due to a given temperature change. Usually expressed as percent per degree, or ppm per degree.

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<b>Thermocouple</b>	A device constructed of two dissimilar metals which generates a small voltage as a function of temperature difference between a measuring and reference junction; this voltage may be measured and its magnitude used as a measure of the temperature in question.
<b>Thermocouple Burnout Protection</b>	Ability of a control device, which uses a T/C as its sensing element, to maintain a safe condition when the T/C has burned out or opened. A safe condition usually means removing power to heaters or applying power to coolers.
<b>Time-Base Proportional Control</b>	A type of control which varies the output "on" and "off" time while maintaining a fixed total (cycle) time when the signal is within the proportional band.
<b>Time Constant</b>	The product of resistance X capacitance which becomes the time required for a first-order system to reach 63.2% of a total change when forced by a step. In so-called higher-order systems there is a time constant for each of the first-order components.
<b>Transducer</b>	A device which converts information or one physical form to another physical type in its output, e.g., a thermocouple converts temperature into a millivoltage.
<b>Triac</b>	A three terminal device which acts as a transistor switch independent of the polarity of voltage across the main terminals of the device.
<b>Unstable</b>	Not possessing stability.
<b>Value</b>	The level of the signal being measured or controlled.
<b>Variable</b>	A level, quantity or other condition which is subject to change; this may be regulated; e.g., the controlled variable or simply measured; e.g., a barometer measuring atmospheric pressure.
<b>Zero</b>	The lower end of the measuring instrument's scale, zero scale and zero may not coincide; zero error would imply exact accordance between instrument reading and true value.
<b>Sensitivity</b>	Often described as the minimum change of input to which the system is capable of responding. This, in turn, is measured by the zero frequency gain.
<b>Setpoint</b>	The instruction given the automatic controller determining the point at which the controlled variable will stabilize.
<b>Setpoint Resolution</b>	The smallest change that is possible with a given setpoint (that will produce a change in output).
<b>Signal</b>	Information in the form of a pneumatic pressure, an electric current or mechanical position that carries information from one control loop component to another.
<b>Single Setpoint, Dual Output</b>	A control device which contains two separate outputs but uses one setpoint for both; varying the setpoint will affect both outputs.
<b>Solid State Relay</b>	An electronic switch consisting of an isolated control input and triac or dual SCR switching element output predominantly for AC loads.
<b>Span Point</b>	The value of the input signal at which a span or gain adjustment is made during calibration.
<b>Stability</b>	The sought-after state where input and output are in balance and will remain so unless subjected to an external stimulus.
<b>Static Behavior</b>	Behavior which is either not a function of time or which takes place over a sufficient length of time that dynamic changes become of minor importance.
<b>Steady State</b>	That in which the static conditions prevail and all dynamic changes may be assumed completed.
<b>Step Change</b>	A change from one level to another in supposedly zero time.
<b>Stepless Proportional Control</b>	A type of control which changes the output voltage by varying the phase angle of that voltage from its maximum to some equilibrium value when the signal is within the proportional band.
<b>Summing Point</b>	A point at which several signals may be algebraically added.
<b>System</b>	Generally refers to all control components including process, measurement, controller, operator and valve along with any other additional equipment that may contribute to its operation.
<b>Zero Firing (Zero-Cross Firing)</b>	The turn on of an electric switch, usually a triac or SCR, at or near the time the voltage across the device equals zero. This type of control is usually used to minimize current surges and thus reduce generated RFI.
<b>Zero Point</b>	The value of the input signal at which a zero or offset adjustment is made during calibration.
<b>Zero Shift</b>	Change resulting in error at the zero percent scale reading as well as a parallel error throughout the entire scale.