

GLOSSARY

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.

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.

Accuracy - 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.

Aging - The change in properties of a material with time under specific conditions.

Air Oven Aging - 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 nonaged samples.

Alloy - A metal formed by combining two or more different metals to obtain desirable properties.

Alpha - The resistance vs. temperature characteristics of a given metal used in making an R.T.D. Also known as the temperature coefficient.

Alternating Current - Electric current that continually reverses it's direction. It is expressed in cycles per second (Hertz or Hz).

Alternating Current (AC) - 1. Refers to an electrical current which reverses its direction on a regular basis. Typically, although not necessarily, sinusoidal wave-form 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.

Ambient Temperature - The temperature of a medium (gas or liquid) surrounding an object.

Ambient Temperature Range - The allowable range of the temperature of the medium (usually air) surrounding an object.

American Wire Gauge (AWG) - A standard system for designating wire diameter. Also referred to as the Brown and Sharpe (B & S) wire gauge.

Armor - A braid or wrapping of metal, usually steel, used for mechanical protection. Generally placed over the outer sheath.

Austenitic - Refers to the crystal structure of the 300 series Stainless Steels.

Automatic Controller - 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.

Automatic Reset - 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 a setpoint.

AWG - Abbreviation for American Wire Gauge.

B & S Gauge Bunch - The same as American Wire Gauge (AWG).

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).

BCD - Abbreviation for "Binary Coded Decimal". Used to describe digital logic code for expressing decimal numbers with four logic lines.

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.

Braid - A fibrous or metallic group of filaments interwoven in cylindrical form to form a covering over one or more wires.

Breakdown Voltage - The voltage at which the insulation between two conductors breaks down.

Breakpoint - The junction of two confluent straight line segments of a plotted curve.

Cable - An insulated conductor, or group of individually insulated conductors in twisted or parallel configuration.



THERMO ELECTRIC

TEMPERATURE MEASUREMENT DESIGNER'S GUIDE
WWW.THERMO-ELECTRIC-DIRECT.COM

SECTION GLOS

GLOSSARY

The information contained hereon shall be considered the sole property of Thermo Electric Company, Inc. The recipient thereof agrees not to disclose or reproduce said information to parties outside the recipient's organization without the written permission of Thermo Electric.

Doc. No.: TE-CO010109-GLOS-010

GLOSSARY

Cabling - The twisting together of two or more insulated conductors to form a cable.

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.

Capacity - Measure of capability to store liquid volume, mass electrical charge, heat information or any form of energy or matter.

Carbide Precipitation - The process whereby chromium carbides form and precipitate out in the steel. Carbon atoms combine with chromium atoms which leads to local depletion of the chromium thereby reducing the available chromium to form the protective chromium oxide film. This allows localized intergranular attack from salts and acids. Carbide precipitation occurs when a 300 series Stainless Steel is held in the 800°F range.

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 ductility. Heat treating can be used to prevent carbide precipitation but a more popular option is the use of low carbide content stainless steels.

Carbide Stabilized - In order to reduce the chance of carbon precipitation certain 300 series Stainless Steels are stabilized with small amounts of titanium, the chromium alone. This result is also accomplished by the "low carbon" stainless steels which have less carbon to combine with the chromium.

Cascade Control System - A control system in which the output of one controller is the input for another.

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 Bend - The lowest temperature wire or cable is capable of being manipulated without cracking insulation or jacket.

Cold End - That end of the thermocouple opposite the measuring junction.

Cold Flow - Permanent deformation of the insulation due to mechanical force or pressure (not due to heat softening).

Cold Junction - The reference junction - usually the lower of the two junctions, hence "cold."

Common (mode) Noise - The AC potential that exists between inputs of a (differential input) device and common point (usually circuit ground or earth ground).

Concentric Stranding - A central wire surrounded by one or more layers of helically wound strands in a fixed round geometric arrangement.

Condenser - 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.

Conductor - An un-insulated wire suitable for carrying electrical current.

Control Accuracy - The degree of correspondence between the controlled variable and the desired value after stability has been achieved.

Control Cable - A multiconductor cable made for operation in control or signal circuits.

Control Point - 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.

Controller Accuracy - The maximum error or deviation between the expected value of the controlled variable and the actual measured value.

Controlling Means - The elements in a control system which contribute to the required corrective action.

Core - In cables, a component or assembly of components over which additional components (shield, sheath, etc.) are applied.

Coverage - The percent of completeness with which a metal braid covers the underlying surface.

Cryogenics - Being or related to very low temperatures (usually below 0°F). Type "T" thermocouples are the predominant calibration for cryogenics. RTD's are recommended.

Current - The movement of electrons in a conductor. The direction of current is opposite to the direction of flow of electrons.

Current Carrying Capacity - The maximum current an insulated conductor can safely carry without exceeding its insulation and jacket temperature limitations.

Current Proportional Control - A type of control which changes the output current from its maximum to some equilibrium value when the signal is within the proportional band.

Cut - Through Resistance - The ability of material to withstand mechanical pressure, usually a sharp edge or small radius, without separation.

Cycle Time - 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.



TEMPERATURE MEASUREMENT DESIGNER'S GUIDE
WWW.THERMO-ELECTRIC-DIRECT.COM

SECTION GLOS

GLOSSARY

The information contained hereon shall be considered the sole property of Thermo Electric Company, Inc. The recipient thereof agrees not to disclose or reproduce said information to parties outside the recipient's organization without the written permission of Thermo Electric.

Doc. No.: TE-CO010109-GLOS-020

GLOSSARY

Cycling - A periodic change in the factor under control usually resulting in equal excursions above and below the control point of sinusoidal wave shape oscillation.

Damping - 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.

Dead Band (Dead Zone) Dead Time - The change through which the input to an instrument can be varied without initiating instrument response. 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.

Derivative Action - 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 proceeds the straight proportional action by this time.

Deviation - The departure from a desired value; the system deviation that exists after transients have expired is synonymous with offset.

Dielectric - 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.

Dielectric Constant - 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).

Dielectric Strength - The voltage which an insulation can withstand before breakdown occurs. Usually expressed as a voltage gradient (such as volts per mil).

Dielectric Test - A test in which a voltage higher than the rated voltage is applied for a specific time to determine the adequacy of the insulation under normal conditions.

DIN - Abbreviation for Deutsches Institute Fur Normung, A German standard.

Direct Action Control - Increasing input causes a proportional increase in the output variable. Decreasing input causes a decrease in the output.

Direct Current (DC) - 1. An electrical current which flows in one direction. 2. used to describe any time independent (steady state) current.

Drain Wire - In a cable, the un insulated wire laid over the component or components and used as a ground connection.

Drawing - In wire manufacture, pulling the metal through a die or series of dies to reduce diameter to a specified size.

Drift - In electronics, a change in a parameter due to a temperature change.

Drift - In electronics, a change in a parameter due to a temperature change.

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.

Dynamic Behavior - Behavior as a function of time.

Elastomer - A rubber like substance.

Electrical Resistance (ohms) - Potential Volts.

Element - Sensor portion of an industrial assembly. - Any basic thermocouple or RTD without hardware.

Elongation - The fractional increase in length of a material stressed in tension.

EMF - Electro motive force - synonymous with millivolt output.

Equilibrium - When all inputs and outputs (supply and demand) have steadied down and are in balance.

Error - The difference between the actual and true value, often expressed as a percentage of either span or full scale value.

Feedback - Information about the status of the controlled variable which may be compared with that which is desired, in the interest of making them coincide.

Ferritic - Refers to the crystal structure of the 400 series Stainless Steels.

Final Control Element - Component of a control system (such as a valve) which directly regulates the flow of energy or material to the process.

Flame Resistance - Horizontal - Vertical - Test devised to provide the user with information about the burning characteristics of insulation jackets.

Flammability - 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.

Flex Life - The measurement of the ability of a conductor or cable to withstand repeated bending.

Flexible - 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.



THERMO ELECTRIC

TEMPERATURE MEASUREMENT DESIGNER'S GUIDE
WWW.THERMO-ELECTRIC-DIRECT.COM

SECTION GLOS

GLOSSARY

The information contained hereon shall be considered the sole property of Thermo Electric Company, Inc. The recipient thereof agrees not to disclose or reproduce said information to parties outside the recipients organization without the written permission of Thermo Electric.

Doc. No.: TE-CO010109-GLOS-030

GLOSSARY

Frequency - Occurrence of a periodic function (with time as the independent variable), generally specified as a certain number of cycles per unit time.

Gain (Magnitude Ratio) - 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.

Gain Loop - The combined output input magnitude ratios of all the individual loop components multiplied together to obtain the overall gain.

Gain Static (Zero Frequency Gain) - The output input amplitude ratio of a component or system as frequency approaches zero.

Green Rot - See preferential oxidation.

Ground Loop - 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.

Heat Distortion - Distortion or flow of a material or configuration due to application of heat.

Helium Leak Test - Used to verify the integrity of a weld or mechanical joint - helium is a "light" gas that would "leak through" an imperfect weld.

HI - Pot - A test designed to determine the highest voltage that can be applied to a conductor without breaking through the insulation.

Homogenous - Of the same composition throughout.

Hot Junction - The measuring junction - usually warmer than the reference junction hence "hot."

Hunting - Oscillation or cycling that may be of appreciable amplitude caused by the system's over zealous effort to achieve a prescribed level of control.

Hygroscopic - Capable of absorbing moisture from the air.

Hypalon - DuPont's trade name for their chlorosulfonated polyethylene, an ozone resistant synthetic rubber.

Hysteresis - Difference between upscale and downscale results in instrument response when subjected to same input approached from opposite directions.

I.R. - 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.

I.S.A. - 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 societies scope and provisions.

Immersion Length - 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.)

Impact Strength - 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.

Impedance - 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.

Increase In Capacitance - A change in the electrical properties of an insulator after immersion in water or being subjected to high humidity. Usually the dielectric constant increases.

Indication Accuracy - The maximum error or deviation between the indicated value of some variable e.g. temperature, and the actual measured value.

Indication Resolution - The smallest change that can be read with a given indication.

Inductive Load - A load which is predominantly inductive, i.e. affecting only varying or alternating currents and having low impedance for direct currents.

Inert - Lacking chemical or biological action - does not contain active properties.

Input - Incoming signal to measuring instrument control unit or system.

Input Impedance - The total opposition to current flow into a device measured in ohms. If input is purely resistive, the term "input resistance" may be used.

Instability - Lack of stability.

Insulation Resistance - The ratio of the applied voltage to the total current between two electrodes in contact with a specific insulation, usually expressed in megaohms - M feet.

Integral Control Action - Action in which the controllers output is proportional to the time integral of the error input; when used in combination with proportional action, it is often called reset action.

IR Constant - A specific minimum IR value for an insulating material determined at ambient temperature of 60°F (15.6°C).



THERMO ELECTRIC

SECTION GLOS

GLOSSARY

The information contained hereon shall be considered the sole property of Thermo Electric Company, Inc. The recipient thereof agrees not to disclose or reproduce said information to parties outside the recipient's organization without the written permission of Thermo Electric.

Doc. No.: TE-CO010109-GLOS-040

TEMPERATURE MEASUREMENT DESIGNER'S GUIDE
WWW.THERMO-ELECTRIC-DIRECT.COM

GLOSSARY

Jacket - An outer non - metallic protective covering applied over an insulated wire or cable.

Junction Box Connector - An adapter that secures to armor cable and threads into a junction box opening. It provides strain relief for wire entering a junction box.

Lag - That portion of the well above the threads and below the hex, intended to extend through the lagging of the vessel.

Lag - A delay in output with respect to a change in input.

Lay - 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.

Limiting - 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.

Linearity - The extent to which a calibration curve approaches a straight line.

Linearity - The nearness with which the plot of a signal or other variable plotted against a prescribed linear scale approximates a straight line.

Load - Change in level of material force, torque, energy, power or other variables applied or removed from a process or other component in the system.

Low Loss Dielectric - An insulating material that has a relatively low dielectric loss such as polyethylene or Teflon.

Magnesium Oxide - (MgO) A ceramic type insulating medium that provides high resistivity, excellent purity and very good crushability.

Manipulated Variable - 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.

Manual Reset - A means of obtaining "reset" action by manual adjustment by the operator of an instrument.

Measuring Element - The element which converts into a form or language that the controller can understand.

Measuring Means - The device used to perform the actual measurement.

Modulus of Elasticity - The ratio of stress to strain in an elastic material.

Molsture Absorption - The amount of moisture (expressed in percentage) an insulation dielectric will absorb under specified conditions. The electrical properties are affected, I.R. decreases, breakdown voltage decreases, and the dielectric constant increases.

N.I.S.T - (Formerly N.B.S.) traceability is necessary to insure the compliance of thermocouples and RTD's to the standards which N.I.S.T. has established relative to accuracy.

N.P.T. - National Pipe Threads. The standard set up by the A.S.A. which assures uniform threads on all hardware.

Noise - Unwanted signal components that obscure the genuine signal information that is being sought.

Normal (Mode) Noise - The AC potential that exists between the two inputs of a (differential input) device.

OffSet - 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.

Offgassing - Percentage of a specified gas released during the combustion of insulation or jacketing material.

Oil Immersion - 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.

On/Off Control - A control mode in which the output is either full off depending on whether or not the input is below or above setpoint.

Open Loop - Control without feedback; e.g., an automatic washer.

Optimum - The highest obtainable proficiency of control; e.g. supply equals demand and offset has been reduced to a minimum, (hopefully zero).

Output - The signal which is provided by an instrument; e.g. the signal which the controller delivers to the valve operator is the controlled output.

Over damped - Damped so that overshoot cannot occur.

Overlap - The amount the trailing edge laps over the leading edge of a spiral tape wrap.

Overshoot - The effort of the control system to reach the desired level which frequently results in going beyond (overshooting) the mark.

Oxidizing - An atmosphere containing a substantial amount of active oxygen.

Oxidizing Atmospheres - Contain oxygen and will react with metals at elevated temperatures to produce oxides on the surface. The good high temperature performance of the heat-resisting alloys depends on the formation of a stable protective oxide film on the surface. The elements chromium and aluminum when present in an alloy form excellent protective films of chromium oxide and aluminum oxide.



THERMO ELECTRIC

SECTION GLOS

GLOSSARY

The information contained hereon shall be considered the sole property of Thermo Electric Company, Inc. The recipient thereof agrees not to disclose or reproduce said information to parties outside the recipients organization without the written permission of Thermo Electric.

Doc. No.: TE-CO010109-GLOS-050

TEMPERATURE MEASUREMENT DESIGNER'S GUIDE
WWW.THERMO-ELECTRIC-DIRECT.COM

GLOSSARY

Oxygen Index - 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%).

Ozone Resistance - Not damaged by ozone which is a 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.

Passivating - Involves immersing 300 series Stainless Steel in 10% nitric acid for 10-30 minutes. The acid removes any particles of iron which may have become embedded in the surface during processing but doesn't attack the Stainless Steel. Actually, being a strong oxidizing acid, the chromium oxide film is improved thereby increasing the steels ability to withstand corrosion.

Phase Angle Firing - 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.

Phenolic - A resin or plastic used in molding or insulating. Bakelite is a phenolic.

Pick - Distance between two adjacent crossover points of braid filaments. The measurement in picks per inch indicates the degree of coverage.

Pipe Well - A protection tube made from pipe and designed to accept a thermocouple element, where pressure is not a primary concern.

Positioning Proportional Control - 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.

Potentiometric - A measurement of DC potential by a null balance method usually in a resistance bridge.

Potting - 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.

Power Consumption - The amount of power (in watts) required by an electronic device during operation.

Preferential Oxidation or "Green Rot" - 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").

Probe Length - The total length of the element, regardless of immersions limitations as a result of fittings.

Process - The equipment to which supply and demand must be balanced - the system under control excluding the equipment which does the controlling.

Proportional Band - 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.

Proportional Control - Control action in which there is a fixed gain or attenuation between output and input.

Proportioning Control - A control mode in which the output varies with respect to the difference between the input signal and desired setpoint. When this difference is with a preset range, or "proportional band", the output is varied, depending on the type of control, until the setpoint is reached.

Purge System - An industrial design that permits the introduction of an oxidizing environment into the thermowell or protection tube thereby eliminating the possibility of preferential oxidation.

Radiograph - An X - Ray photograph

Rate Action - That portion of controller output which is proportional to the rate of change of input. Also called derivative action.

Reaction Curve - 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.

Reducing Atmospheres - Contain hydrogen or carbon compounds and will not form protective oxides on an alloy. If hydrogen is present this may diffuse into thermowells and ceramocouples and produce "green rot" attack, so called from the dark green surface color produced, although this may not be very obvious. In the case of chromel - alumel thermocouples the "green rot" attack causes the chromel wire to become magnetic and results in an erroneous lower output. This effect is easy to confirm with a magnet; if both wires are magnetic "green rot" has occurred. (Actually this effect is not strictly a "reducing" phenomenon, It occurs only when a very small amount of oxygen is present in an essentially reducing atmosphere. Under these conditions, preferential oxidation of the chromium in the alloy will occur).

Reducing - An environment devoid of oxygen or containing it in an inactive state (e.g. carbon monoxide).

Reference Junction Compensation - 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.

Repeatability - A measure of the maximum error or deviation that can be expected when the same value is input at two different times.

Re-productivity - The exactness with which a measurement or other condition can be duplicated over a period of time.



THERMO ELECTRIC

TEMPERATURE MEASUREMENT DESIGNER'S GUIDE
WWW.THERMO-ELECTRIC-DIRECT.COM

SECTION GLOS

GLOSSARY

The information contained hereon shall be considered the sole property of Thermo Electric Company, Inc. The recipient thereof agrees not to disclose or reproduce said information to parties outside the recipient's organization without the written permission of Thermo Electric.

Doc. No.: TE-CO010109-GLOS-060