

GLOSSARY

- A -

Absolute Pressure Transducer: A transducer which measures pressure in relation to zero pressure (a vacuum on one side of the diaphragm).

Absolute Pressure: Gage pressure plus atmospheric pressure.

Absolute Zero: Temperature at which thermal energy is at a minimum. Defined as 0 Kelvin, calculated to be -273.15°C or -59.67°F .

AC: Alternating current; an electric current that reverses its direction at regularly recurring intervals.

Acceleration: A change in the velocity of a body or particle with respect to time. The parameter that an accelerometer measures (dv/dt). Units expressed in "g".

Accelerometer: A device which converts the effects of mechanical motion into an electrical signal that is proportional to the acceleration value of the motion. A sensor. A transducer.

Accuracy: The closeness of an indication or reading of a measurement device to the actual value of the quantity being measured. Usually expressed as \pm percent of full scale output or reading.

Acoustics: The degree of sound. The nature, cause, and phenomena of the vibrations of elastic bodies; which vibrations create compressional waves or wave fronts which are transmitted through various media, such as air, water, wood, steel, etc.

Adapter: A mechanism or device or attaching non-mating parts.

ALOMEGA®: An aluminum nickel alloy used in the negative leg of a type K thermocouple (trade name of HOSKINS MANUFACTURING COMPANY).

Alphanumeric: A character set that contains both letters and digits.

Alumel: An aluminum nickel alloy used in the negative leg of a Type K thermocouple (Trade name of Hoskins Manufacturing Company).

Ambient Compensation: The design of an instrument such that changes in ambient temperature do not affect the readings of the instrument.

Ambient Conditions: The conditions around the transducer (pressure, temperature, etc.).

Ambient Pressure: Pressure of the air surrounding a transducer.

Ambient Temperature: The average or mean temperature of the surrounding air which comes in contact with the equipment and instruments under test.

Ammeter: An instrument used to measure current.

Ampere (amp): A unit used to define the rate of flow of electricity (current) in a circuit; units are one coulomb (6.25×10^8 electronics) per second.

Amplifier: A device which draws power from a source other than the input signal and which produces as an output an enlarged reproduction of the essential features of its input.

Amplitude Span: The Y-axis range of a graphic display of data in either the time or frequency domain. Usually a log display (dB) but can also be linear.

Amplitude: A measurement of the distance from the highest to the lowest excursion of motion, as in the case of mechanical body in oscillation or the peak-to-peak swing of an electrical waveform.

Analog Output: A voltage or current signal that is a continuous function of the measured parameter.

Analog-to-Digital Converter (A/D or ADC): A device or circuit that outputs a binary number corresponding to an analog signal level at the input.

Anemometer: An instrument for measuring and/or indicating the velocity of air flow.

Angular Frequency: The motion of a body or a point moving circularly, referred to as the circular frequency ω which is the frequency in cycles per second (cps) multiplied by the term (2) and expressed in radians per second (2 π).

Anion: A negatively charged ion (C_1^- , NO_3^- , S_2^- etc.)

ANSI: American National Standards Institute.

Application Program: A computer program that accomplishes specific tasks, such as word processing.

ASCII: American Standard Code for Information Interchange. A seven or eight bit code used to represent alphanumeric characters. It is the standard code used for communications between data processing systems and associated equipment.

ASME: American Society of Mechanical Engineers.

ATC: Automatic temperature compensation.

Auto-Zero: An automatic internal correction for offsets and/or drift at zero voltage input.

Automatic Reset: 1. A feature on a limit controller that automatically resets the controller when the controlled temperature returns to within the limit bandwidth set. 2. The integral function on a PID controller which adjusts the proportional bandwidth with respect to the set point to compensate for droop in the circuit, i.e., adjusts the controlled temperature to a set point after the system stabilizes.

AWG: American Wire Gage.

- B -

Background Noise: The total noise floor from all sources of interference in a measurement system, independent of the presence of a data signal.

Bandwidth: A symmetrical region around the set point in which proportional control occurs.

Baud: A unit of data transmission speed equal to the number of bits (or signal events) per second; 300 baud = 300 bits per second.

BCD, Buffered: Binary-coded decimal output with output drivers, to increase line-drive capability.

BCD, Parallel: A digital data output format where every decimal digit is represented by binary signals on four lines and all digits are presented in parallel. The total number of lines is 4 times the number of decimal digits.

BCD, Serial: A digital data output format where every decimal digit is represented by binary signals on four lines and up to five decimal digits are presented sequentially. The total number of lines is four data lines plus one strobe line per digit.

BCD, Three-State: An implementation of parallel BCD, which has 0, 1 and high-impedance output states. The high-impedance state is used when the BCD output is not addressed in parallel connect applications.

Bearing: A part which supports a journal and in which a journal revolves.

Best Fit Straight Line (BFSL): A line midway between two parallel straight lines enclosing all output vs. pressure values.

BIAS Current: A very low-level DC current generated by the panel meter and superimposed on the signal. This current may introduce a measurable offset across a very high source impedance.

Binary Coded Decimal (BCD): The representation of a decimal number (base 10, 0 through 9) by means of a 4 bit binary nibble.

Binary: Refers to base 2 numbering system, in which the only allowable digits are 0 and 1. Pertaining to a condition that has only two possible values or states.

Bipolar: The ability of a panel meter to display both positive and negative readings.

Bit: Acronym for binary digit. The smallest unit of computer information, it is either a binary 0 or 1.

Blackbody: A theoretical object that radiates the maximum amount of energy at a given temperature, and absorbs all the energy incident upon it. A blackbody is not necessarily black. (The name blackbody was chosen because the color black is defined as the total absorption of light energy.)

BNC: A quick disconnect electrical connector used to inter-connect and/or terminate coaxial cables.

Boiling Point: The temperature at which a substance in the liquid phase transforms to the gaseous phase; commonly refers to the boiling point of water which is 100°C (212°F) at sea level.

Breakdown Voltage Rating: The dc or ac voltage which can be applied across insulation portions of a transducer without arcing or conduction above a specific current value.

Bridge Resistance: See Input impedance and Output impedance.

Buffer: A storage area for data that is used to compensate for a speed difference, when transferring data from one device to another. Usually refers to an area reserved for I/O operations, into which data is read, or from which data is written.

Buffer: Any substance or combination of substances which, when dissolved in water, produces a solution which resists a change in its hydrogen ion concentration on the addition of an acid or alkali.

Bulb (Liquid-in-Glass Thermometer): The area at the tip of a liquid-in-glass thermometer containing the liquid reservoir.

Burn-In: A long term screening test (either vibration, temperature or combined test) that is effective in weeding out failures because it simulates actual or worst case operation of the device, accelerated through a time, power, and temperature relationship.

Burst Pressure: The maximum pressure applied to a transducer sensing element or case without causing leakage.

Burst Proportioning: A fast-cycling output form on a time proportioning controller (typically adjustable from 2 to 4 seconds) used in conjunction with a solid state relay to prolong the life of heaters by minimizing thermal stress.

Byte: The representation of a character in binary. Eight bits.

- C -

Calibration: The process of adjusting an instrument or compiling a deviation chart so that its reading can be correlated to the actual value being measured.

Calorie: The quantity of thermal energy required to raise one gram of water 1°C at 15°C .

Celsius: (centigrade) A temperature scale defined by 0°C at the icer point and 100°C at boiling point of water at sea level.

Center of Gravity (Mass Center): The center of gravity of a body is that point in the body through which passes the resultant of weights of its component particles for all orientations of the body with respect to a uniform gravitational field.

Centripetal Force: A force exerted on an object moving in a circular path which is exerted inward toward the center of rotation.

Ceramic Insulation: High-temperature compositions of metal oxides used to insulate a pair of thermocouple wires. The most common are Alumina (Al_2O_3), Beryllia (BeO), and Magnesia (MgO). Their application depends upon temperature and type of thermocouple. High-purity alumina is

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required for platinum alloy thermocouples. Ceramic insulators are available as single and multihole tubes or as beads.

Ceramic: Polycrystalline ferroelectric materials which are used as the sensing units in piezoelectric accelerometers. There are many different grades, all of which can be made in various configurations to satisfy different design requirements.

CFM: The volumetric flow rate of a liquid or gas in cubic feet per minute.

Character: a letter, digit or other symbol that is used as the representation of data. A connected sequence of characters is called a character string.

Charge Sensitivity: For accelerometers that are rated in terms of charge sensitivity, the output voltage (V) is proportional to the charge (Q) divided by the shunt capacitance (C). This type of accelerometer is characterized by a high output impedance. The sensitivity is given in terms of charge; picocoulombs per unit of acceleration (g).

Chatter: The rapid cycling on and off of a relay in a control process due to insufficient bandwidth in the controller.

CHROMEGA®: A chromium-nickel alloy which makes up the positive leg of type K and type E thermocouples (registered trademarks of OMEGA ENGINEERING, INC.).

Clock: The device that generates periodic signals for synchronization.

CMR (Common-Mode Rejection): The ability of a panel meter to eliminate the effect of AC or DC noise between signal and ground. Normally expressed in dB at dc to 60 Hz. One type of CMR is specified between SIG LO and PWR GND. In differential meters, a second type of CMR is specified between SIG LO and ANA GND (METER GND).

CMV (Common-Mode Voltage): The AC or DC voltage which is tolerable between signal and ground. One type of CMV is specified between SIG LO and PWR GND. In differential meters, a second type of CMV is specified between SIG HI or LO and ANA GND (METER GND).

Common Mode Rejection Ratio: The ability of an instrument to reject interference from a common voltage at its input terminals with relation to ground. Usually expressed in db (decibels).

Common Mode: The output form or type of control action used by a temperature controller to control temperature, i.e. on/off, time proportioning, PID.

Communication: Transmission and reception of data among data processing equipment and related peripherals.

Compensated Connector: A connector made of thermocouple alloys used to connect thermocouple probes and wires.

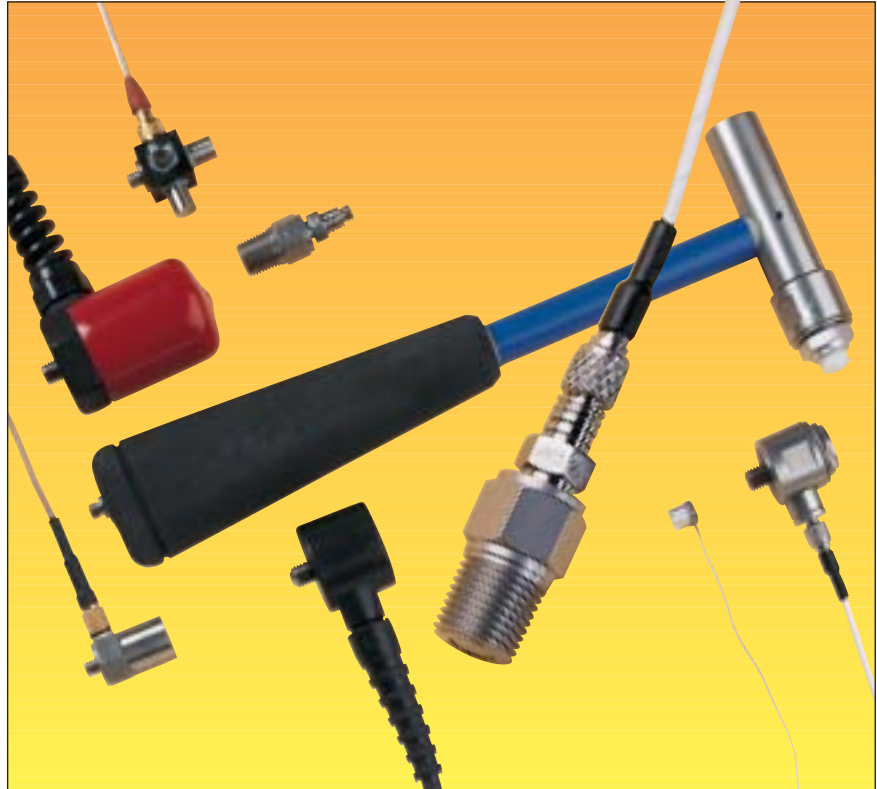
Compensating Alloys: Alloys used to connect thermocouples to instrumentation. These alloys are selected to have similar thermal electric properties as the thermocouple alloys (however, only over a very limited temperature range).

Compensating Loop: Lead wire resistance compensation for RTD elements where an extra length of wire is run from the instrument to the RTD and back to the instrument, with no connection to the RTD.

Compensation: An addition of specific materials or devices to counteract a known error.

Complex Functions: Usually expressed in terms of both their amplitude and phase.

Complex Wave: The resultant form of a number of sinusoidal waves that are summed together forming a periodic wave. Such waves may be analyzed in the frequency domain to readily determine their component parts.



Conductance: The measure of the ability of a solution to carry an electrical current. (See Equivalent conductance.)

Conduction: The conveying of electrical energy or heat through or by means of a conductor.

Confidence Level: The range (with a specified value of uncertainty, usually expressed in percent) within which the true value of a measured quantity exists.

Connection Head: An enclosure attached to the end of a thermocouple which can be cast iron, aluminum or plastic within which the electrical connections are made.

Constantan: A copper-nickel alloy used as the negative lead in Type E, Type J, and Type T thermocouples.

Control Mode: The output form or type of control action used by a temperature controller to control temperature, i.e., on/off, time proportioning, PID.

Control Point: The temperature at which a system is to be maintained.

Convection: 1. The circulatory motion that occurs in a fluid at a non-uniform temperature owing to the variation of its density and the action of gravity. 2. The transfer of heat by this automatic circulation of fluid.

Coriolis Force: A result of centripetal force on a mass moving with a velocity radially outward in a rotating plane.

Coulomb Sensitivity: Charge/unit acceleration, expressed in Pc/g (charge sensitivity).

Coulomb: A measurement of the quantity of electrical charge, usually expressed as pico coulomb (10^{-12} coulombs).

Counter Weight: A weight added to a body so as to reduce a calculated unbalance at a desired place.

Counts: The number of time intervals counted by the dual-slope A/D converter and displayed as the reading of the panel meter, before addition of the decimal point.

CPS: Cycles per second; the rate or number of periodic events in one second, expressed in Hertz (Hz).

CPU: Central processing unit. The part of the computer that contains the circuits that control and perform the execution of computer instructions.

Critical Damping: Critical damping is the smallest amount of damping at which a given system is able to respond to a step function without overshoot.

Critical Speed: The rotational speed of the rotor or rotating element at which resonance occurs in the system. The shaft speed at which at least one of the "critical" or natural frequencies of a shaft is excited.

Cryogenics: Measurement of temperature at extremely low values, i.e., below -200°C .

CSA: Canadian Standards Administration.

Current Proportioning: An output form of a temperature controller which provides a current proportional to the amount of control required. Normally is a 4 to 20 milliamp current proportioning band.

Current: The rate of flow of electricity. The unit if the ampere (a) defined as 1 ampere = 1 coulomb per second.

Cycle Time: The time usually expressed in seconds for a controller to complete one on/off cycle.

- D -

Damping: The reduction of vibratory movement through dissipation of energy. Types include viscous, coulomb, and solid.

Data Base: A large amount of data stored in a well-organized manner. A data base management system (DBMS) is a program that allows access to the information.

dB (Decibel): 20 times the log to the base 10 of the ratio of two voltages. Every 20 dB's correspond to a voltage ratio of 10, every 10 dB's to a voltage ratio of 3.162. For instance, a CMR of 120 dB provides

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voltage noise rejection of 1,000,000/1. An NMR of 70 dB provides voltage noise rejection of 3,162/1.

DC: Direct current; an electric current flowing in one direction only and substantially constant in value.

Dead Band: 1. For chart records: the minimum change of input signal required to cause a deflection in the pen position. 2. For temperature controllers: the temperature band where heat is turned off upon rising temperature and turned on upon falling temperature expressed in degrees. The area where no heating (or cooling) takes place.

Dead Volume: The volume of the pressure port of a transducer at room temperature and ambient barometric pressure.

Debug: To find and correct mistakes in a program.

Decimal: Refers to a base ten number system using the characters 0 through 9 to represent values.

Default: The value(s) or option(s) that are assumed during operation when not specified.

Degree: An incremental value in the temperature scale, i.e., there are 100 degrees between the ice point and the boiling point of water in the Celsius scale and 180°F between the same two points in the Fahrenheit scale.

Density: Mass per unit of volume of a substance. I.E.: grams/cu.cm. or pounds/cu.ft.

Deviation: The difference between the value of the controlled variable and the value at which it is being controlled.

Diaphragm: The sensing element consisting of a membrane which is deformed by the pressure differential applied across it.

Dielectric Constant: Related to the force of attraction between two opposite charges separated by a distance in a uniform medium.

Differential Input: A signal-input circuit where SIG LO and SIG HI are electrically floating with respect to ANALOG GND (METER GND, which is normally tied to DIG GND). This allows the measurement of the voltage difference between two signals tied to the same ground and provides superior common-mode noise rejection.

Differential Pressure: The difference in static pressure between two identical pressure taps at the same elevation located in two different locations in a primary device.

Differential: For an on/off controller, it refers to the temperature difference between the temperature at which the controller turns heat off and the temperature at which the heat is turned back on. It is expressed in degrees.

Digit: A measure of the display span of a panel meter. By convention, a full digit can assume any value from 0 through 9, a ½-digit will display a 1 and overload at 2, a ¾-digit will display digits up to 3 and overload at 4, etc. For example, a meter with a display span of ±3999 counts is said to be a 3¾ digit meter.

Digital Output: An output signal which represents the size of an input in the form of a series of discrete quantities.

Digital-to-Analog Converter (D/A or DAC): A device or circuit to convert a digital value to an analog signal level.

DIN (Deutsche Industrial Norm): A set of German standards recognized throughout the world. The 1/8 DIN standard for panel meters specifies an outer bezel dimension of 96 x 48 mm and a panel cutout of 92 x 45 mm.

Discharge Time Constant: The time required for the output-voltage from a sensor or system to discharge 37% of its original value in response to a zero rise time step function input. This parameter determines a low frequency response.

Disk Operating System (DOS): Program used to control the transfer of information to and from a disk, such as MS DOS.

Displacement: The measured distance traveled by a point from its position at rest. Peak to peak displacement is the total measured movement of a vibrating point between its positive and negative extremes. Measurement units expressed as inches or millimeters.

Drift: A change of a reading or a set point value over long periods due to several factors including change in ambient temperature, time, and line voltage.

Dual Element Sensor: A sensor assembly with two independent sensing elements.

Duplex Wire: A pair of wires insulated from each other and with an outer jacket of insulation around the inner insulated pair.

Duty Cycle: The total time to one on/off cycle.

Usually refers to the on/off cycle time of a temperature controller.

Dynamic Calibration: Calibration in which the input varies over a specific length of time and the output is recorded vs. time.

Dynamic Pressure: The difference in pressure levels from static pressure to stagnation pressure caused by an increase in velocity. Dynamic pressure increases by the square of the velocity.

Dynamic Unbalance: Dynamic unbalance is that condition in which the central principal axis is not coincident with the shaft axis.

- E -

Electrical Interference: Electrical noise induced upon the signal wires that obscures the wanted information signal.

EMF: Electromotive force. A rise in (electrical) potential energy. The principal unit is the volt.

EMI: Electromagnetic interference.

Emissivity: The ratio of energy emitted by an object to the energy emitted by a blackbody at the same temperature. The emissivity of an object depends upon its material and surface texture; a polished metal surface can have an emissivity around 0.2 and a piece of wood can have an emissivity around 0.95.

End Points: The end points of a full scale calibration curve.

Endothermic: Absorbs heat. A process is said to be endothermic when it absorbs heat.

Enthalpy: The sum of the internal energy of a body and the product of its volume multiplied by the pressure.

Environmental Conditions: All conditions in which a transducer may be exposed during shipping, storage, handling, and operation.

Eprom: Erasable Programmable Read-Only Memory. The PROM can be erased by ultraviolet light or electricity.

Excitation: The external application of electrical voltage current applied to a transducer for normal operation.

Exothermic: Gives off heat. A process is said to be exothermic when it releases heat.

Expansion Factor: Correction factor for the change in density between two pressure measurement areas in a constricted flow.

Explosion-proof Enclosure: An enclosure that can withstand an explosion of gases within it and prevent the explosion of gases surrounding it due to sparks, flashes or the explosion of the container itself, and maintain an external temperature which will not ignite the surrounding gases.

Exposed Junction: A form of construction of a thermocouple probe where the hot or measuring junction protrudes beyond the sheath material so as to be fully exposed to the medium being measured. This form of construction usually gives the fastest response time.

- F -

Fahrenheit: A temperature scale defined by 32° at the ice point and 212° at the boiling point of water at sea level.

Ferrule: A compressible tubular fitting that is compressed onto a probe inside a compression fitting to form a gas-tight seal.

Floppy Disk: A small, flexible disk carrying a magnetic medium in which digital data is stored for later retrieval and use.

Flow Rate: Actual speed or velocity of fluid movement.

Flow: Travel of liquids or gases in response to a force (i.e. pressure or gravity).



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Flowmeter: A device used for measuring the flow or quantity of a moving fluid.

FM Approved: An instrument that meets a specific set of specifications established by Factory Mutual Research Corporation.

FM: Factory Mutual Research Corporation. An organization which sets industrial safety standards.

Forced Vibration: Vibration of a system caused by an imposed force. Steady-state vibration is an unchanging condition of periodic or random motion.

FPM: Flow velocity in feet per minute.

FPS: Flow velocity in feet per second.

Freezing Point: The temperature at which the substance goes from the liquid phase to the solid phase.

Frequency of Vibration: The number of cycles occurring in a given unit of time. RPM - revolutions per minute. CPM - cycles per minute.

Frequency Output: An output in the form of frequency which varies as a function of the applied input.

Frequency, Natural: The frequency of free (not forced) oscillations of the sensing element of a fully assembled transducer.

Frequency: The number of cycles over a specified time period over which an event occurs. The reciprocal is called the period.

Full Bridge: A Wheatstone bridge configuration utilizing four active elements or strain gages.

Full Scale Output: The algebraic difference between the minimum output and maximum output.

- G -

g: The force of acceleration due to gravity equal to 32.1739 ft/sec² or 386 in./sec².

Gage Factor: A measure of the ratio of the relative change of resistance to the relative change in length of a piezoresistive strain gage.

Gage Length: The distance between two points where the measurement of strain occurs.

Gage Pressure Transducer: A transducer which measures pressure in relation to the ambient pressure.

Gage pressure: Absolute pressure minus local atmospheric pressure.

Gain: The amount of amplification used in an electrical circuit.

GPH: Volumetric flow rate in gallons per hour.

GPM: Volumetric flow rate in gallons per minute.

Ground: 1. The electrical neutral line having the same potential as the surrounding earth. 2. The negative side of DC power supply. 3. Reference point for an electrical system.

Grounded Junction: A form of construction of a thermocouple probe where the hot or measuring junction is in electrical contact with the sheath material so that the sheath and thermocouple will have the same electrical potential.

- H -

Half Bridge: Two active elements or strain gages.

Handshake: An interface procedure that is based on status/data signals that assure orderly data transfer as opposed to asynchronous exchange.

Hardware: The electrical, mechanical and electromechanical equipment and parts associated with a computing system, as opposed to its firmware or software.

Head Loss: The loss of pressure in a flow system measured using a length parameter (i.e., inches of water, inches of mercury).

Head Pressure: Pressure in terms of the height of fluid, $P = \gamma y$, where $r =$ fluid density and $y =$ the fluid column heights. Expression of a pressure in terms of the height of fluid, $r = \gamma y$, where r is fluid density and $y =$ the fluid column height. $g =$ the acceleration of gravity.

Heat Sink: 1. Thermodynamic A body which can absorb thermal energy. 2. Practical. A finned piece of metal used to dissipate the heat of solid state components mounted on it.

Heat Transfer: The process of thermal energy flowing from a body of high energy to a body of low energy. Means of transfer are: conduction; the two bodies contact. Convection; a form of conduction where the two bodies in contact are of different phases, i.e. solid and gas. Radiation: all bodies emit infrared radiation.

Heat Treating: A process for treating metals where heating to a specific temperature and cooling at a specific rate changes the properties of the metal.

Heat: Thermal energy. Heat is expressed in units of calories or BTU's.

Hertz (Hz): Units in which frequency is expressed. Synonymous with cycles per second.

Hold: Meter HOLD is an external input which is used to stop the A/D process and freeze the display. BCD HOLD is an external input used to freeze the BCD output while allowing the A/D process to continue operation.

Hooke's Law: Defines the basis for the measurement of mechanical stresses via the strain measurement. The gradient of Hooke's line is defined by the ratio of which is equivalent to the Modulus of Elasticity E (Young's Modulus).

Host: The primary or controlling computer in a multiple part system.

Hysteresis: The difference in output when the measurand value is first approached with increasing and then with decreasing values. Expressed in percent of full scale during any one calibration cycle. (see Deadband)

- I -

Icon: A graphic functional symbol display. A graphic representation of a function or functions to be performed by the computer.

ICP: Integrated Circuit Piezoelectric; term sometimes used to describe an accelerometer with built-in electronics.

Impedance: The total opposition to electrical flow (resistive plus reactive).

Infrared: an area in the electromagnetic spectrum extending beyond red light from 760 nanometers to 1000 microns (106 nm). It is the form of radiation used for making non-contact temperature measurements.

Initial Unbalance: Initial unbalance is that unbalance of any kind that exists in the rotor before balancing.

Input Impedance: The resistance of a panel meter as seen from the source. In the case of a voltmeter, this resistance has to be taken into account when the source impedance is high; in the case of an ammeter, when the source impedance is low.

Input Resistance (Impedance): The input resistance of a pH meter is the resistance between the glass electrode terminal and the reference electrode terminal. The potential of a pH-measuring electrode chain is always subject to a voltage division between the total electrode resistance and the input resistance.

Insulated Junction: See ungrounded junction.

Insulation Resistance: The resistance measured between two insulated points on a transducer when a specific dc voltage is applied at room temperature.

Integral: A form of temperature control. See automatic reset, #2.

Interchangeability Error: A measurement error that can occur if two or more probes are used to make the same measurement. It is caused by a slight variation in characteristics of different probes.

Interface: The means by which two systems or devices are connected and interact with each other.

ISA: Instrument Society of America.

Isothermal: A process or area that is a constant temperature.

- J -

Joule: The basic unit of thermal energy.

Journal: A journal is that part of a rotor that is in contact with or supported by a bearing in which it revolves.

Junction: The point in a thermocouple where the two dissimilar metals are joined.

- K -

K: When referring to memory capacity, two to the tenth power (1024 in decimal notation).

Kelvin: Symbol K. The unit of absolute or thermodynamic temperature scale based upon the Celsius scale with 100 units between the ice point and boiling point of water. $0^{\circ}\text{C} = 273.15\text{K}$ (there is no degree ($^{\circ}$) symbol used with the Kelvin scale).

Kilowatt (kw): Equivalent to 1000 watts.

Kilowatt Hour (kwh): 1000 watthours. Kilovolt amperes (kva) 1000 volt amps.

Kinetic Energy: Energy associated with mass in motion, i.e., $\frac{1}{2} rV^2$ where r is the density of the moving mass and V is its velocity.

KVA: Kilovolt amperes (1000-volt amps).

- L -

Laminar Flow: Streamlined flow of a fluid where viscous forces are more significant than inertial forces, generally below a Reynolds number of 2000.

Leakage Rate: The maximum rate at which a fluid is permitted or determined to leak through a seal. The type of fluid, the differential pressure across the seal, the direction of leakage, and the location of the seal must be specified.

Least-squares Line: The straight line for which the sum of the squares of the residuals (deviations) is minimized.

Life Cycle: The minimum number of pressure cycles the transducer can endure and still remain within a specified tolerance.

Limits of Error: A tolerance band for the thermal electric response of thermocouple wire expressed in degrees or percentage defined by ANSI specification MC-96.1 (1975).

Linearity: The closeness of a calibration curve to a specified straight line. Linearity is expressed as the maximum deviation of any calibration point on a specified straight line during any one calibration cycle.

Load Impedance: The impedance presented to the output terminals of a transducer by the associated external circuitry.

Load: The electrical demand of a process expressed as power (watts), current (amps) or resistance (ohms).

Loop Resistance: The total resistance of a thermocouple circuit caused by the resistance of the thermocouple wire. Usually used in reference to analog pyrometers which have typical loop resistance requirements of 10 ohms.

LSD (Least-Significant Digit): The rightmost active (non-dummy) digit of the display.

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electrodes are especially prone to polarization errors caused by small currents flowing from the pH meter input circuit and from static electrical charges built up as the electrodes are removed from the sample solution, or when the electrodes are wiped.

Potential Energy: Energy related to the position or height above a place to which fluid could possibly flow.

Potentiometer: 1. A variable resistor often used to control a circuit. 2. A balancing bridge used to measure voltage.

Power Supply: A separate unit or part of a circuit that supplies power to the rest of the circuit or to a system.

PPM: Abbreviation for "parts per million," sometimes used to express temperature coefficients. For instance, 100 ppm is identical to 0.01%.

Primary Standard (NBS): The standard reference units and physical constants maintained by the National Bureau of Standards upon which all measurement units in the United States are based.

Primary Standards: Aqueous pH buffer solutions established by the National Bureau of Standards within the 2.5 to 11.5 pH range of ionic strength less than 0.1 and which provide stable liquid junction potential and uniformity of electrode sensitivity.

Principal Axes: The axes of maximum and minimum normal stress.

Probe: A generic term that is used to describe many types of temperature sensors.

Process Meter: A panel meter with sizeable zero and span adjustment capabilities, which can be scaled for readout in engineering units for signals such as 4–20 mA, 10–50 mA and 1–5 V.

Prom: Programmable read-only memory. A semiconductor memory whose contents cannot be changed by the computer after it has been programmed.

Proof Pressure: The specified pressure which may be applied to the sensing element of a transducer without causing a permanent change in the output characteristics.

Proportioning Band: A temperature band expressed in degrees within which a temperature controller's time proportioning function is active.

Proportioning Control Mode: A time proportioning controller where the amount of time that the relay is energized is dependent upon the system's temperature.

Proportioning Control plus Derivative Function: A time proportioning controller with a derivative function. The derivative function senses the rate at which a system's temperature is either increasing or decreasing and adjusts the cycle time of the controller to minimize overshoot or undershoot.

Proportioning Control plus Integral: A two-mode controller with time proportioning and integral (auto reset) action. The integral function automatically adjusts the temperature at which a system has stabilized back to the set point temperature, thereby eliminating droop in the system.

Proportioning Control with Integral and Derivative Functions: Three mode PID controller. A time proportioning controller with integral and derivative functions. The integral function automatically adjusts the system temperature to the set point temperature to eliminate droop due to the time proportioning function. The derivative function senses the rate of rise or fall of the system temperature and automatically adjusts the cycle time of the controller to minimize overshoot or undershoot.

Protection Head: An enclosure usually made out of metal at the end of a heater or probe where connections are made.

Protection Tube: A metal or ceramic tube, closed at one end into which a temperature sensor is inserted. The tube protects the sensor from the medium into which it is inserted.



Protocol: A formal definition that describes how data is to be exchanged.

PSIA: Pounds per square inch absolute. Pressure referenced to a vacuum.

PSID: Pounds per square inch differential. Pressure difference between two points.

PSIG: Pound per square inch gage. Pressure referenced to ambient air pressure.

PSIS: Pounds per square inch standard. Pressure referenced to a standard atmosphere.

- R -

Radiation: See Infrared.

Random Access Memory (RAM): Memory that can be both read and changed during computer operation. Unlike other semi-conductor memories, RAM is volatile—if power to the RAM is disrupted or lost, all the data stored is lost.

Range: Those values over which a transducer is intended to measure, specified by its upper and lower limits.

Rangeability: The ratio of the maximum flowrate to the minimum flowrate of a meter.

Rankine (°R): An absolute temperature scale based upon the Fahrenheit scale with 180° between the ice point and boiling point of water. 459.67°R = 0°F.

Rate Action: The derivative function of a temperature controller. Rate time: the time interval over which the system temperature is sampled for the derivative function.

Rate Time: The time interval over which the system temperature is sampled for the derivative function.

Ratiometric Measurement: A measurement technique where an external signal is used to provide the voltage reference for the dual-slope A/D converter. The external signal can be derived from the voltage excitation applied to a bridge circuit or pick-off supply, thereby eliminating errors due to power supply fluctuations.

Read Only Memory (ROM): Memory that contains fixed data. The computer can read the data, but cannot change it in any way.

Real Time: The time interval over which the system temperature is sampled for the derivative function.

Record: A collection of unrelated information that is treated as a single unit.

Recovery Time: The length of time which it takes a transducer to return to normal after applying a proof pressure.

Reference Junction: The cold junction in a thermocouple circuit which is held at a stable known temperature. The standard reference temperature is 0°C (32°F). However, other temperatures can be used.

Reference Mark. Any diagnostic point or mark which can be used to relate a position during rotation of a part to its location when stopped.

Reference Plane. Any plane perpendicular to the shaft axis to which an amount of unbalance is referred.

Relay (Mechanical): An electromechanical device that completes or interrupts a circuit by physically moving electrical contacts into contact with each other.

Relay (Solid State): A solid state switching device which completes or interrupts a circuit electrically with no moving parts.

Remote: Not hard-wired; communicating via switched lines, such as telephone lines. Usually refers to peripheral devices that are located a site away from the CPU.

Repeatability: The ability of a transducer to reproduce output readings when the same measurand value is applied to it consecutively, under the same conditions, and in the same direction. Repeatability is expressed as the maximum difference between output readings.

Resistance Temperature Characteristic: A relationship between a thermistor's resistance and the temperature.

Resistance: The resistance to the flow of electric current measured in ohms (Ω) for a conductor resistance is function of diameter, resistivity (an intrinsic property of the material) and length.

Resolution: The smallest detectable increment of measurement. Resolution is usually limited by the number of bits used to quantize the input signal. For example, a 12-bit A/D can resolve to one part in 4096 (2 to the 12 power equals 4096).

Resonant Frequency: The measurand frequency at which a transducer responds with maximum amplitude.

Response Time (time constant): The time required by a sensor to reach 63.2% of a step change in temperature under a specified set of conditions. Five time constants are required for the sensor to stabilize at 100% of the step change value.

Response Time: The length of time required for the output of a transducer to rise to a specified percentage of its final value as a result of a step change of input.

Reynolds Number: The ratio of inertial and viscous forces in a fluid defined by the formula where: r = Density of fluid, μ = Viscosity in centipoise (CP), V = Velocity, and D = Inside diameter of pipe.

RFI: Radio frequency interference.

Rheostat: A variable resistor.

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Rise Time: The time required for a sensor or system to respond to an instantaneous step function, measured from the 10% to 90% points on the response waveforms.

Room Conditions: Ambient environmental conditions under which transducers must commonly operate.

Root Mean Square (RMS): Square root of the mean of the square of the signal taken during one full cycle.

Rotor: A rotor is a rotating body whose journals are supported by bearings.

RTD: Resistance temperature detector.

- S -

SCR: Silicon controlled rectifier.

Secondary Device: A part of the flowmeter which receives a signal proportional to the flowrate, from the primary device, and displays, records and/or transmits the signal.

Secondary Standard: pH buffer solutions which do not meet the requirements of primary standard solutions but provide coverage of the pH range not covered by primary standards. Used when the pH value of the primary standard is not close to the sample pH value.

Seebeck Coefficient: The derivative (rate of change) of thermal EMF with respect to temperature normally expressed as millivolts per degree.

Seebeck Effect: When a circuit is formed by a junction of two dissimilar metals and the junctions are held at different temperatures, a current will flow in the circuit caused by the difference in temperature between the two junctions.

Seebeck EMF: The open circuit voltage caused by the difference in temperature between the hot and cold junctions of a circuit made from two dissimilar metals.

Self Heating: Internal heating of a transducer as a result of power dissipation.

Sensing Element: That part of the transducer which reacts directly in response to the input.

Sensitivity Shift: A change in slope of the calibration curve due to a change in sensitivity.

Sensitivity: The minimum change in input signal to which an instrument can respond.

Serial transmission: Sending one bit at a time on a single transmission line. Compare with parallel transmission.

Set Point: The temperature at which a controller is set to control a system.

Settling Time: The time taken for the display to settle within one digit final value when a step is applied to the meter input.

Shear Modulus: The ratio of the shear stress and the angular shear distortion.

Shear Stress: Where normal stress is perpendicular to the designated plane, shear stress is parallel to the plane.

Shearing Strain: A measure of angular distortion also directly measurable, but not as easily as axial strain.

Sheath Thermocouple: A thermocouple made out of mineral-insulated thermocouple cable which has an outer metal sheath.

SI: System Internationale. The name given to the standard metric system of units.

Signal Conditioner: A circuit module which offsets, attenuates, amplifies, linearizes and/or filters the signal for input to the A/D converter. The typical output signal conditioner is +2 V dc.

Signal Conditioning: To process the form or mode of a signal so as to make it intelligible to, or compatible with, a given device, including such

manipulation as pulse shaping, pulse clipping, compensating, digitizing, and linearizing.

Signal: An electrical transmittance (either input or output) that conveys information.

Single Precision: The degree of numeric accuracy that requires the use of one computer word. In single precision, seven digits are stored, and up to seven digits are printed. Contrast with double precision.

Single-ended Input: A signal-input circuit where SIG LO (or sometimes SIG HI) is tied to METER GND. Ground loops are normally not a problem in AC-powered meters, since METER GND is transformer-isolated from AC GND.

Smallest Bending Radius: The smallest radius that a strain gage can withstand in one direction, without special treatment, without suffering visible damage.

Software: Generally, programs loaded into a computer from external mass storage but also extended to include operating systems and documentation.

Span Adjustment: The ability to adjust the gain of a process or strain meter so that a specified display span in engineering units corresponds to a specified signal span. For instance, a display span of 200°F may correspond to the 16 mA span of a 4–20 mA transmitter signal.

Span: The difference between the upper and lower limits of a range expressed in the same units as the range.

Spare: A connector point reserved for options, specials, or other configurations. The point is identified by an (E#) for location on the electrical schematic.

Specific Gravity: The ratio of mass of any material to the mass of the same volume of pure water at 4°C.

Specific Heat: The ratio of thermal energy required to raise the temperature of a body 1° to the thermal energy required to raise an equal mass of water 1°.

Spectral Filter: A filter which allows only a specific band width of the electromagnetic spectrum to pass, i.e., 4 to 8 micron infrared radiation.

Spectrum Analysis: Utilizing frequency components of a vibration signal to determine the source and cause of vibration.

Spectrum: The resolving of overall vibration into amplitude components as a function of frequency.

Spot Size: The diameter of the circle formed by the cross section of the field of view of an optical instrument at a given distance.

SSR: Solid state relay (see relay, solid state).

Stability: The quality of an instrument or sensor to maintain a consistent output when a constant input is applied.

Stagnation Pressure: The sum of the static and dynamic pressure.

Standardization: a process of equalizing electrode potentials in one standardizing solution (buffer) so that potentials developed in unknown solutions can be converted to pH values.

Static Calibration: A calibration recording pressure versus output at fixed points at room temperature.

Static Error Band: The error band applicable at room temperature.

Static Pressure: Pressure of a fluid whether in motion or at rest. It can be sensed in a small hole drilled perpendicular to and flush with the flow boundaries so as not to disturb the fluid in any way.

Static Unbalance: Static unbalance is that condition of unbalance for which the central principal axis is displayed only parallel to the shaft axis.

Steady Flow: A flow rate in the measuring section of a flow line that does not vary significantly with time.

Steady State Vibration: That condition of vibration induced by an unchanging continuing periodic force.

Stiffness: The ratio of the force required to create a certain deflection or movement of a part expressed as (Force/deflection) lbs/in or grams/cm.

Strain Gage: A measuring element for converting force, pressure, tension, etc., into an electrical signal.

Strain: The ratio of the change in length to the initial unstressed reference length.

Super Cooling: The cooling of a liquid below its freezing temperature without the formation of the solid phase.

Super Heating: 1. The heating of a liquid above its boiling temperature without the formation of the gaseous phase. 2. The heating of the gaseous phase considerably above the boiling-point temperature to improve the thermodynamic efficiency of a system.

Surge Current: A current of short duration that occurs when power is first applied to capacitive loads or temperature dependent resistive loads such as tungsten or molybdenum heaters—usually lasting not more than several cycles.

- T -

Teflon: A fluorocarbon polymer used for insulation of electrical wires (trademark of DuPont Company).

TEMPCO: Abbreviation for "temperature coefficient": the error introduced by a change in temperature. Normally expressed in %/°C or ppm/°C.

Temperature Error: The maximum change in output, at any measurand value within the specified range, when the transducer temperature is changed from room temperature to specified temperature extremes.

Temperature Range, compensated: The range of ambient temperatures within which all tolerances specified for Thermal Zero Shift and Thermal Sensitivity Shift are applicable (temperature error).

Temperature Range, operable: The range of ambient temperatures, given by their extremes, within which the transducer may be operated. Exceeding compensated range may require recalibration.

Terminal: An input/output device used to enter data into a computer and record the output.

Thermal Coefficient of Resistance: The change in resistance of a semiconductor per unit change in temperature over a specific range of temperature.

Thermal Conductivity: The property of a material to conduct heat in the form of thermal energy.

Thermal emf: See Seebeck emf.

Thermal Expansion: An increase in size due to an increase in temperature expressed in units of an increase in length or increase in size per degree, i.e. inches/inch/degree C.

Thermal Gradient: The distribution of a differential temperature through a body or across a surface.

Thermal Sensitivity Shift: The sensitivity shift due to changes of the ambient temperature from room temperature to the specified limits of the compensated temperature range.

Thermal Sensitivity Shift: The sensitivity shift due to changes of the ambient temperature from room temperature to the specified limits of the compensated temperature range.

Thermal Zero Shift: An error due to changes in ambient temperature in which the zero pressure output shifts. Thus, the entire calibration curve moves in a parallel displacement.

Thermistor: A temperature-sensing element composed of sintered semiconductor material

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which exhibits a large change in resistance proportional to a small change in temperature. Thermistors usually have negative temperature coefficients.

Thermocouple Type (ANSI Symbol)	Material
J	Iron/Constantan
K	CHROMEAL®/ALOMEGA®
T	Copper/Constantan
E	Chromel/Constantan
R	Platinum/Platinum 13% Rhodium
S	Platinum/Platinum 10% Rhodium
B	Platinum 6% Rhodium/Platinum 30% Rhodium
G*	Tungsten/Tungsten 26% Rhenium
C*	Tungsten 5% Rhenium/Tungsten 26% Rhenium
D*	Tungsten 3% Rhenium/Tungsten 25% Rhenium

*Not ANSI symbols.

Thermocouple: The junction of two dissimilar metals which has a voltage output proportional to the difference in temperature between the hot junction and the lead wires (cold junction) (refer to Seebeck EMF).

Thermowell: A closed-end tube designed to protect temperature sensors from harsh environments, high pressure, and flows. They can be installed into a system by pipe thread or welded flange and are usually made of corrosion-resistant metal or ceramic material depending upon the application.

Transducer Vibration: Generally, any device which converts movement, either shock or steady state vibration, into an electrical signal proportional to the movement; a sensor.

Transducer: A device (or medium) that converts energy from one form to another. The term is generally applied to devices that take physical phenomenon (pressure, temperature, humidity, flow, etc.) and convert it to an electrical signal.

Transient Vibration: A temporary vibration or movement of a mechanical system.

Transitional Flow: Flow between laminar and turbulent flow, usually between a pipe Reynolds number of 2000 and 4000.

Transmitter (Two-Wire): A device which is used to transmit temperature data from either a thermocouple or RTD via a two-wire current loop. The loop has an external power supply and the transmitter acts as a variable resistor with respect to its input signal.

Transmitter: A device which is used to transmit temperature data from either a thermocouple or RTD via a two-wire current loop. The loop has an external power supply and the transmitter acts as a variable resistor with respect to its input signal.

Transmitter: A device which translates the low level output of a sensor or transducer to a higher level signal suitable for transmission to a site where it can be further processed.

Triac: A solid state switching device used to switch alternating current wave forms.

Triboelectric Noise: The generation of electrical charges caused by layers of cable insulation. This is especially troublesome in high impedance accelerometers.

Triple Point (Water): The thermodynamic state where all three phases, solid, liquid, and gas may all be present in equilibrium. The triple point of water is .01°C.

Triple Point: The temperature and pressure at which solid, liquid, and gas phases of a given substance are all present simultaneously in varying amounts.

True RMS: The true root-mean-square value of an AC or AC-plus-DC signal, often used to determine power of a signal. For a perfect sine wave, the RMS value is 1.11072 times the rectified average value,



which is utilized for low-cost metering. For significantly non-sinusoidal signals, a true RMS converter is required.

TTL Unit Load: A load with TTL voltage levels, which will draw 40 μ A for a logic 1 and -1.6 mA for a logic 0.

TTL-Compatible: For digital input circuits, a logic 1 is obtained for inputs of 2.0 to 5.5 V which can source 40 μ A, and a logic 0 is obtained for inputs of 0 to 0.8 V which can sink 1.6 mA. For digital output signals, a logic 1 is represented by 2.4 to 5.5 V with a current source capability of at least 400 μ A; and a logic 0 is represented by 0 to 0.6 V with a current sink capability of at least 16 mA.

TTL: Transistor-to-transistor logic. A form of solid state logic which uses only transistors to form the logic gates.

Turbulent Flow: When forces due to inertia are more significant than forces due to viscosity. This typically occurs with a Reynolds number in excess of 4000.

Typical: Error is within plus or minus one standard deviation ($\pm 1\%$) of the nominal specified value, as computed from the total population.

- U -

UL: Underwriters Laboratories, Inc. An independent laboratory that establishes standards for commercial and industrial products.

Ultraviolet: That portion of the electromagnetic spectrum below blue light (380 nanometers).

Unbalance: That condition which exists in a rotor when vibratory force or motion is imparted to its bearings as a result of centrifugal forces.

Undershoot: The difference in temperature between the temperature a process goes to, below the set point, after the cooling cycle is turned off and the set point temperature.

Ungrounded Junction: A form of construction of a thermocouple probe where the hot or measuring junction is fully enclosed by and insulated from the sheath material.

Union: A form of pipe fitting where two extension pipes are joined at a separable coupling.

- V -

Vacuum: Any pressure less than atmospheric pressure.

Velocity: The time rate of change of displacement; dx/dt.

Vibration Error Band: The error recorded in output of a transducer when subjected to a given set of amplitudes and frequencies.

Vibration Error: The maximum change in output of a transducer when a specific amplitude and range of frequencies are applied to a specific axis at room temperature.

Viscosity: The inherent resistance of a substance to flow.

Volt: The (electrical) potential difference between two points in a circuit. The fundamental unit is derived as work per unit charge—($V = W/Q$). One volt is the potential difference required to move one coulomb of charge between two points in a circuit while using one joule of energy.

Voltage: An electrical potential which can be measured in volts.

Voltmeter: An instrument used to measure voltage.

Volume Flow Rate: Calculated using the area of the full closed conduit and the average fluid velocity in the form, $Q = V \times A$, to arrive at the total volume quantity of flow. Q = volumetric flowrate, V = average fluid velocity, and A = cross sectional area of the pipe.

- W -

Watt Density: The watts emanating from each square inch of heated surface area of a heater. Expressed in units of watts per square inch.

Wheatstone Bridge: A network of four resistances, an emf source, and a galvanometer connected such that when the four resistances are matched, the galvanometer will show a zero deflection or "null" reading.

- Y -

Young's Modulus: Young's Modulus (the Modulus of Elasticity) is equivalent to the ratio of normal stress to strain.

- Z -

Zero Adjustment: The ability to adjust the display of a process or strain meter so that zero on the display corresponds to a non-zero signal, such as 4 mA, 10 mA, or 1 V dc. The adjustment range is normally expressed in counts.

Zero Offset: 1. The difference expressed in degrees between true zero and an indication given by a measuring instrument. 2. See zero suppression.

Zero Suppression: The span of an indicator or chart recorder may be offset from zero (zero suppressed) such that neither limit of the span will be zero. For example, a temperature recorder which records a 100° span from 400° to 500° is said to have 400° zero suppression.

