

## A

**Abnormal Failure:** An artificially induced failure of a component, usually as a result of "abnormals" testing for regulatory agency safety compliance.

**Absolute Pressure Transducer:** A transducer that has an internal reference chamber sealed at or close to 0 psia (full vacuum) and normally provides increasing output voltage for increases in pressure.

**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  $-273.15\text{ }^{\circ}\text{C}$  or  $-459.67^{\circ}\text{F}$ .

**Absorption(of water vapor):** retention (of water vapor) by penetration into the bulk of a material.

**A/D Converter:** (Also A/D or ADC) Short for analog-to-digital converter. Converts real-world analog signals into a digital format that can be processed by a computer.

**AC Linearity:** A dynamic measurement of how well an A/D performs. In an ideal A/D converter, a pure sine wave on the analog input appears at the digital output as a pure (sampled) sine wave. In the real world, however, spurious signals due to nonlinear distortion within the A/D appear in the digital output. These anomalies are usually combinations of harmonics of the fundamental and intermodulation products, produced when the fundamental and its harmonics beat with the sampled frequency.

**Acceleration:** The first derivative of velocity with respect to time. Units expressed in "g".

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

**Access Protocol:** A defined set of procedures that function as an interface between a user and a network and enable the user to employ the services of that network.

**Accuracy:** The combined error of nonlinearity, repeatability, and hysteresis expressed as a percent of full scale output.

**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.

**Acquisition Time:** This term relates to sampling A/Ds which utilize a track/hold amplifier on the input to acquire and hold the analog input signal. Acquisition time is the time required by the T/H amplifier to settle to its final value after it is placed in the track module.

**Active Filter:** An active filter is one that uses active devices such as operational amplifiers to synthesize the filter response function. This technique has an advantage at high speeds because the need for inductors is eliminated.

**Address:** The label or number identifying the memory location where a unit of information is stored.

**Adsorption (of water vapor):**retention (of water vapor) as a surface layer on a material .

**AIX:** Advanced Interactive Executive: IBM's version of UNIX.

**Aliasing:** In a sampled data system, the analog input must be sampled at a rate of at least twice the bandwidth of the signal in order to avoid loss of data (Nyquist Theorem). Adhering to the Nyquist Theorem prevents in-band "alias" signals, which are beat frequencies between the analog signal and the sampling clock that inherently occur.

**Aliased Imaging:** This is a technique, commonly applied to Direct Digital Synthesis, for using intentional aliasing as a source of high-frequency signals.

**Alloy 11:** A compensating alloy used in conjunction with pure copper as the negative leg to form extension wire for platinum-platinum rhodium thermocouples Types R and S.

**Alloy 200/226:** The combination of compensating alloys used with tungsten vs. tungsten 26% rhenium thermocouples as extension cable for applications under 200°C.

**Alloy 203/225:** The combination of compensating alloys used with tungsten 3% rhenium vs. tungsten 15% rhenium thermocouples as extension cable for applications under 200°C.

**Alloy 405/426:** The combination of compensating alloys used with tungsten 5% rhenium vs. tungsten 26% rhenium thermocouples as extension cable for applications under 870°C.

**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).

**AM:** Amplitude Modulation

**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 ( $6.25 \times 10^{18}$  electrons) 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.

**Analog Ground:** In high-speed acquisition applications, system ground is generally physically separated into analog and digital grounds in an attempt to suppress digital switching noise and minimize its effect on noise-sensitive analog signal processing circuitry. Input signal conditioners, amplifiers, references, and A/D converters are usually connected to analog ground.

**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.

**Angstrom:** Ten to the minus tenth meters ( $10^{-10}$ ) or one millimicron, a unit used to define the wave length of light. Designated by the symbol Å.

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

**Anion:** A negatively charged ion (Cl<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, S<sup>2-</sup> etc.)

**ANSI:** American National Standards Institute.

**Anti-reset Windup:** This is a feature in a three-mode PID controller which prevents the integral (auto reset) circuit from functioning when the temperature is outside the proportional band.

**Apparent Power:** A value of power for AC circuits that is calculated as the product of RMS current times RMS voltage, without taking the power factor into account.

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

**ARCHIE:** A system for locating files that are publicly available by anonymous FTP.

**ARP:** Address Resolution Protocol. An Internet protocol which runs on ethernets and token rings and maps Internet addresses to MAC addresses.

**ARPANET:** Advanced Research Projects Agency Network. A pioneering long haul network funded by ARPA. It served as the basis for early networking research, as well as a central backbone during the development of the Internet.

**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.

**ASIC:** Application specific integrated circuit.

**ASME:** American Society of Mechanical Engineers.

**Assembler:** A program that translates assembly language instructions into machine language instructions.

**Assembly Language:** A machine oriented language in which mnemonics are used to represent each machine language instruction. Each CPU has its own specific assembly language.

**ASTM:** American Society for Testing and Materials.

**Asymmetry Potential:** The potential developed across the glass membrane with identical solutions on both sides. Also a term used when comparing glass electrode potential in pH 7 buffer.

**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.

**Axial Load:** A load applied along or parallel to and concentric with the primary axis.

## B

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

**Backup:** A system, device, file or facility that can be used as an alternative in case of a malfunction or loss of data.

**Bandwidth:** A symmetrical region around the set point in which proportional control occurs. In analog signals, the difference between a signal's lowest frequency component and its highest component as measured in Hz. The speed of a digital communications circuit in bits per second.

**Base Station:** The central transmitter in a communications system that acts as the cell hub for communicating with handsets and/or mobile units.

**Baseband Signal** The frequency bandwidth of the fundamental signal of interest.

**Basic Transportation Reference:** The basic transportation section of the U.S. Government Test Specification MIL-STD-810D, Method 514.3, Paragraph I-3.2.1, Page 514.3-5. Basic transportation defines the test profiles that have been defined for equipment that is shipped as secured cargo; by land, by sea or by air. The test levels are based upon land transport stress levels because these are higher than stresses imposed by air or sea transportation environments.

**Basic:** A high-level programming language designed at Dartmouth College as a learning tool. Acronym for Beginner's All-purpose Symbolic Instruction Code.

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

**Baud Rate:** The speed at which data is transmitted. Measured in symbols per second. This is not the same as bits-per-second since each symbol can carry several bits of information.

**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.

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

**Beta Ratio:** The ratio of the diameter of a pipeline constriction to the unstricted pipe diameter.

**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.

**BIOS:** Acronym for basic input/output system. The commands used to tell a CPU how it will communicate with the rest of the computer.

**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.

**Bit Rate:** The rate of transfer of information necessary to ensure satisfactory reproduction of the information at the receiver.

**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.

**BPS:** Bits per second.

**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:** A Wheatstone bridge configuration utilizing four active strain gages.

**Bridge Resistance:** The nominal value of the individual legs that make up a complete Wheatstone bridge.

**Broadcast:** The process of sending a message from one station to all other stations on the network.

**Brouter:** A device that performs the functions of both a bridge and a router.

**BTU:** British thermal units. The quantity of thermal energy required to raise one pound of water at its maximum density, 1 degree F. One BTU is equivalent to .293 watt hours, or 252 calories. One kilowatt hour is equivalent to 3412 BTU.

**Buffer Amplifier:** A unity gain amplifier used to isolate the loading effect of one circuit from another. Buffer amplifiers are almost always used between the signal source and the input of a high-speed A/D convertor.

**Buffer Capacity (B):** A measure of the ability of the solution to resist pH change when a strong acid or base is added.

**Buffer:** 1. 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. 2. 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.

**Burn-In:** A long term screening test (either vibration, temperature or combined test) that is effective in weeding out infant mortalities 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.

**Bus Network:** A network topology that uses a single communications link to connect three or more terminals. Also called a Multi-Drop Network.

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

## C

**Calender-van Dusen Equation:** An equation that defines the resistance-temperature value of any pure metal that takes the form of  $RT = RO(1 + AT + BT^2)$  for values between the ice point ( $0^{\circ}\text{C}$ ) and the freezing point of antimony ( $630.7^{\circ}\text{C}$ ) and the form  $RT = RO[1 + AT + BT^2 + C(T-100)T^2]$  between the oxygen point ( $-183.0^{\circ}\text{C}$ ) and the ice point ( $0^{\circ}\text{C}$ ).

**Cable Telephony:** The practice of using digital communications techniques to provide enhanced home telephone service via the existing home cable-TV connections.

**Calibration:** The comparison of transducer voltage outputs against the outputs of a reference standard.

**CAD:** Computer Aided Design.

**CAE:** Computer Aided Engineering.

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

**Cation:** A positively charged ion (Na<sup>+</sup>, H<sup>+</sup>).

**CAM:** Computer Aided Manufacturing.

**Carrier System:** A method of obtaining communications channels over a single communications link by multiplexing the channels together at the transmitting end and demultiplexing them at the receiving end.

**Cavitation:** The boiling of a liquid caused by a decrease in pressure rather than an increase in temperature.

**CDMA:** Code Division Multiple Access. Also known as spread spectrum, allowing several users to share a channel by allocating "codes" that allow each one to distinguish between them, even though they use the same frequency bands at the same time.

**CECC:** Cenelec Electronic Components Committee.

**Cell:** An ATM packet that is 53 bytes in length with a 5 byte header and 48 byte payload.

**Celsius (centigrade):** A temperature scale defined by 0°C at the ice 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<sub>2</sub>O<sub>3</sub>), Beryllia (BeO), and Magnesia (MgO). Their application depends upon temperature and type of thermocouple. High-purity alumina is 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.).

**Clear:** To restore a device to a prescribed initial state, usually the zero state.

**Checksum:** A block check character that is formed by taking the sum of the binary data transmitted.

**Circuit Switching:** A method of establishing a dedicated communications path between two or more locations through one or more switching nodes. Data is sent in a continuous stream; the data rate is constant; the delay is constant and limited to propagation times; and a dedicated end to end path remains in effect until the communication is terminated.

**Client-Server Network:** A network that uses a central computer (server) to store data that is accessed from other computers on the network (clients).

**Clipping:** The term applied to the phenomenon which occurs when an output signal is limited in some way by the full range of an amplifier, ADC or other device. When this occurs, the signal is flattened at the peak values, the signal approaches the shape of a square wave, and high frequency components are introduced. Clipping may be hard, as is the case when the signal is strictly limited at some level; or it may be soft, in which case the clipping signal continues to follow the input at some reduced gain.

**Clock:** The device that generates periodic signals for synchronization.

**Closeness of Control:** Total temperature variation from a desired set point of system. Expressed as "closeness of control" is  $\pm 2^{\circ}\text{C}$  or a system bandwidth with  $4^{\circ}\text{C}$ , also referred to as amplitude of deviation.

**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).

**Coaxial Cable:** A tubular wire transmission medium that consists of a central conductor surrounded by a dielectric insulator that is in turn surrounded by a tubular conductor. The outer conductor is usually at ground potential and also serves as an electrical shield.

**Coherence Function.:** A frequency domain function computed to show the degree of a linear, noise-free relationship between a system's input and output. The value of the coherence function ranges between zero and one, where a value of zero indicates there is no causal relationship between the input and the output. A value of one indicates the existence of linear noise-free frequency response between the input and the output.

**Color Code:** The ANSI established color code for thermocouple wires in the negative lead is always red. Color Code for base metal thermocouples is yellow for Type K, black for Type J, purple for Type E and blue for Type T.

**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.

**Communications Port:** A connection on a terminal through which data is input and/or output.

**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).

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

**Compiler:** A program that translates a high-level language, such as Basic, into machine language.

**Complex Function:** Any mathematically defined relationship given by the following expression:

$$y(x) = a(x) + ib(x)$$

**where:**  $x$  = the real variable

$a(x)$  = the real part of  $y(x)$

$b(x)$  = the imaginary part of  $y(x)$

Complex functions are 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.

**Compression Ratio:** The ratio of the number of bits required to represent the original information to the number of bits required to represent the compressed signal.

**Condensate:** condensed material, e.g. liquid water or ice .

**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.

**Conformity Error:** For thermocouples and RTDs, the difference between the actual reading and the temperature shown in published tables for a specific voltage input.

**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.

**Contention:** A method of line control in which terminals compete with each other for permission to transmit over a common channel. If the channel is free, the

terminal transmits. If the channel is in use by another terminal, the terminal attempting to transmit waits until the channel is free.

**Control Character:** A character whose occurrence in a particular context starts, modifies or stops an operation that effects the recording, processing, transmission or interpretation of data.

**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:** A measurement of the quantity of electrical charge, usually expressed as pico coulomb (10<sup>-12</sup> 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.

**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.

**Crosstalk:** The unwanted transfer of energy from one communications circuit to another.

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

**CSA:** Canadian Standards Administration.

**Cure Point:** The temperature at which a normally magnetic material goes through a magnetic transformation and becomes non-magnetic.

**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 of the ampere (A) defined as 1 ampere = 1 coulomb per second.

**Curve Fitting:** Curve fitting is the process of computing the coefficients of a function to approximate the values of a given data set within that function. The approximation is called a "fit". A mathematical function, such as a least squares regression, is used to judge the accuracy of the fit.

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

## D

**D/A Convertor:** Short for digital-to-analog converter. This is a device that changes a digitally coded word into its equivalent quantized analog voltage or current. Just like the A/D device, there are very high-speed D/A's available, capable of converting at data rates up to 1 GHz.

**Damping:** The reduction of response at the resonant frequency through the use of a damping media such as oil. Usually specified as the ratio of critical damping.

**DARPA:** Defense Advanced Research Projects Agency. A US Dept of Defense agency that funds high-risk research projects and that funded the development of UNIX 4.2, and the TCP/IP communications protocol. One of the founders of the Internet.

**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.

**Data Compression:** A method of reducing the number of bits that are needed to represent information. Data compression allows higher communications speeds and allows more information to be stored on a disk.

**dB (Decibel):** 20 times the log to the base 10 of the ratio of two voltages. Every 20 dBs correspond to a voltage ratio of 10, every 10 dBs to a voltage ratio of 3.162. For instance, a CMR of 120 dB provides 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 inside the pressure port of a transducer at room temperature and barometric pressure.

**Debug:** To find and correct mistakes in a program.

**Decibel:** A unit (dB) for measuring the relative strength of signal power. The number of decibels equals ten times the logarithm (base 10) of the ratio of the measured signal power to a reference power. One tenth of a bell.

**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.

**Deflection:** The change in length along the primary axis or distance a diaphragm moves at the center between no-load and rated load conditions.

**Degree:** An incremental value in the temperature scale, i.e., there are 100° 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.

**Derivative:** 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.

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

**Desiccant:** Any substance which exerts a drying action by chemically absorbing water vapor .

**Desorption:** Release of adsorbed or absorbed material .

**DFT:** Discrete Fourier Transform.

**Diaphragm:** The sensing membrane which is deformed when pressure is applied.

**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 1/2-digit will display a 1 and overload at 2, a 3/4-digit will display digits up to 3 and overload at 4, etc. For example, a meter with a display span of  $\pm 3999$  counts is said to be a 3-3/4 digit meter.

**Digital Filtering:** The process of smoothing, or removing noise from a signal via mathematical functions that are performed on the digital data stream.

**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:** 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.

**DIN 43760:** The standard that defines the characteristics of a 100 ohm platinum RTD having a resistance vs. temperature curve specified by a  $\alpha = 0.00385$  ohms per degree.

**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.

**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 millinches.

**Dissipation Constant:** The ratio for a thermistor which relates a change in internal power dissipation to a resultant change of body temperature.

**Dissociation Constant (K):** A value which quantitatively expresses the extent to which a substance dissociates in solution. The smaller the value of K, the less dissociation of the species in solution. This value varies with temperature, ionic strength, and the nature of the solvent.

**Dithering:** The technique of adding controlled amounts of noise to a signal to improve overall system loop control, or to smear quantizing error in an A/D convertor application.

**DNS:** Domain Name System. A mechanism used in the Internet for translating names of host computers into addresses. The DNS also allows host computers not directly on the Internet to have registered names in the same style.

**DLL:** Dynamic Linked Library.

**DMA:** Acronym direct memory access. A high speed data storage mode of the IBM PC.

**Double Precision:** The degree of accuracy that requires two computer words to represent a number. Numbers are stored with 17 digits of accuracy and printed with up to 16 digits.

**DRAM:** Dynamic Random Access Memory.

**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.

**Drop:** A connection between a terminal and a subscriber.

**Droop:** A common occurrence in time-proportional controllers. It refers to the difference in temperature between the set point and where the system temperature actually stabilizes due to the time-proportioning action of the controller.

**Dry Bulb Temperature:** Measured air temperature, usually paired with a "wet-bulb" temperature to derive a value of relative humidity .

**DSP:** Digital signal processing or digital signal processor.

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

**Dual-slope A/D Converter:** An analog-to-digital converter which integrates the signal for a specific time, then counts time intervals for a reference voltage to bring the integrated signal back to zero. Such converters provide high resolution at low cost, excellent normal-mode noise rejection, and minimal dependence on circuit elements.

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

**Duplex:** Pertaining to simultaneous two-way independent data communication transmission in both direction. Same as "full duplex".

**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 Range:** The ratio of the maximum output signal to the smallest output signal that can be processed in a system, usually expressed logarithmically in dB. Dynamic range can be specified in terms of harmonic distortion, signal to noise ratio, or other performance criteria.

**E**

**Echo:** To reflect received data to the sender. For example, keys depressed on a keyboard are usually echoed as characters displayed on the screen.

**EEPROM:** Electrically Erasable Programmable Read Only Memory.

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

**Electrode Potential (E):** The difference in potential established between an electrode and a solution when the electrode is immersed in the solution.

**Electrolyte:** Any substance which, when in solution will conduct an electric current. Acids, bases, and salts are common electrolytes.

**Electromotive Force (emf):** The potential difference between the two electrodes in a cell. The cell emf is the cell voltage measured when no current is flowing through the cell. It can be measured by means of a pH meter with high input impedance.

**Electronic Industries Association (EIA):** A standards organization specializing in the electrical and functional characteristics of interface equipment.

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

**EMI:** Electromagnetic Interference (Emission).

**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.

**Encoding:** The process of putting information into digital format.

**Encryption:** A technique of modifying a bit stream to make it appear to be a random sequence of bits to someone who does not have access to the encryption scheme.

**End Point (Potentiometric):** The apparent equivalence point of a titration at which a relatively large potential change is observed.

**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.

**Equilibrium Constant:** The product of the concentrations (or activities) of the substances produced at equilibrium in a chemical reaction divided by the product of concentrations of the reacting substances, each concentration raised to that power which is the coefficient of the substance in the chemical equation.

**Equivalent Conductance (l):** Equivalent conductance of an electrolyte is defined as the conductance of a volume of solution containing one equivalent weight of dissolved substances when placed between two parallel electrodes 1 cm apart, and large enough to contain between them all of the solution.  $l$  is never determined directly, but is calculated from the specific conductance ( $L_s$ ). If  $C$  is the concentration of a solution in gram equivalents per liter, then the concentration of a solution in gram equivalents per liter, then the concentration per cubic centimeter is  $C/1000$ , and the volume containing one equivalent of the solute, is, therefore,  $1000/C$ .

**Equalization:** Compensation for frequency dependent attenuation in a communications circuit.

**Error Band:** The allowable deviations to output from a specific reference norm. Usually expressed as a percentage of full scale.

**Error:** The difference between the value indicated by the transducer and the true value of the measurand being sensed. Usually expressed in percent of full scale output.

**Ethernet:** A LAN standard, also known as IEE 802.3, that connects computers by means of coaxial cable or twisted pair conductors.

**Eutectic Temperature:** The lowest possible melting point of a mixture of alloys.

**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.

**FFT:** Fast Fourier Transform. A computationally efficient mathematical technique which converts digital information from the time domain to the frequency domain for rapid spectral analysis.

**Fiber Optics:** A transmission medium consisting of thin strands of glass or plastic through which data is sent by means of pulse modulated light waves.

**Field of View:** A volume in space defined by an angular cone extending from the focal plane of an instrument.

**FIFO Memory:** A type of memory with separate input and output ports. The first data to enter the input port are the first to exit the output port.

**File:** A set of related records or data treated as a unit.

**Filling Solution:** A solution of defined composition to make contact between an internal element and a membrane or sample. The solution sealed inside a pH glass bulb is called an internal filling solution. This solution normally contains a buffered chloride solution to provide a stable potential and a designated zero potential point. The solution which surrounds the reference electrode internal and periodically requires replenishing is called the reference filling solution. It

provides contact between the reference electrode internal and sample through a junction.

**Filter:** An electrical circuit that passes frequencies within a specified frequency band and attenuates signals that fall outside of that frequency band.

**Firmware:** Software instructions stored in ROMs.

**Flag:** Any of various types of indicators used for identification of a condition or event; for example, a character that signals the termination of a transmission.

**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).

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

**Flush Diaphragm:** Sensing element is located on the very tip of the transducer (NO pressure port).

**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.

**Frame:** A sequence of time slots in ISDN. A basic rate interface frame consists of 48 time slots repeated every 250 microseconds.

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

**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 Response:** The range of frequencies over which the transducer voltage output will follow the sinusoidally varying mechanical input within specified limits.

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

**FTP:** File Transfer Protocol. The Internet standard high-level protocol for transferring files from one computer to another.

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

**Full Duplex:** Communications that takes place in both directions at the same time.

**Full Scale:** See Rated Capacity.

**Full Scale Output:** The algebraic difference between the minimum output (normally zero) and the rated capacity.

**Functions:** Three mode PID controller. A timeproportioning 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.

## G

**g:** The force of acceleration due to gravity equal to 32.1739 ft/sec<sup>2</sup> or 386 in./sec<sup>2</sup>.

**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:** The pressure above (or below) atmospheric. Represents positive difference between measured pressure and existing atmospheric

pressure. Can be converted to absolute by adding actual atmospheric pressure value.

**Gage Pressure Transducer:** A transducer which measures pressure in relation to atmospheric pressure.

**Gain:** The amount of amplification used in an electrical circuit. Gain is usually measured in decibels, but it can also be expressed as the ratio of output power to input power.

**Galvanometer:** An instrument that measures small electrical currents by means of deflecting magnetic coils.

**GATT:** General Agreement on Tariffs and Trade.

**Gateway:** A special dedicated computer that attaches to two or more networks and routes packets from one network to the other.

**General Communications Interface:** An ISDN interchip standard interface for both basic rate and primary rate equipment.

**Glitch:** A spike caused by the skew of switches or logic. Glitches are a troublesome source of error in high-speed D/A convertors and they are most prevalent at the mid scale switching location.

**Gopher:** A menu based system for exploring Internet resources.

**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.

**GUI:** Graphical user interface.

## H

**Half Bridge:** Two active elements or strain gages.

**Half-Duplex:** One way at a time data communication; both devices can transmit and receive data, but only one at a time.

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

**Hardcopy:** Output in a permanent form (usually a printout) rather than in temporary form, as on disk or display terminal.

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

**Harmonic:** A frequency that is a multiple of the fundamental. See also Distortion and Non-Linearity.

**Harmonic Distortion:** A type of communications line interface that is caused by erroneous frequencies that are generated by non-linearities in the system.

**HART:** Highway Addressable Remote Transducer.

**HDTV:** High Definition Television.

**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,  $P = \rho y g$ , where  $\rho$  = fluid density and  $y$  = the fluid column heights. Expression of a pressure in terms of the height of fluid,  $\rho = \frac{P}{y g}$ , where  $\rho$  is fluid density and  $y$  = the fluid column height.  $g$  = the acceleration of gravity.

**Header:** The portion of a packet, preceding the actual data, containing source and destination addresses and error-checking fields.

**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.

**Hexadecimal:** Refers to a base sixteen number system using the characters 0 through 9 and A through F to represent the values. Machine language programs are often written in hexadecimal notation.

**Hit:** For Internet sites, this is the common term for the numbers of times a site (or page) is accessed.

**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.

**Host Number:** The part of an Internet address that designates which node on the (sub)network is being addressed.

**Hub:** A central node in a star network to which all other nodes are connected by means of point-to-point communications links.

**Humidity:** The presence of water vapor in air or other gases. Some people use "humidity" to mean relative humidity only. Strictly speaking, "humidity" also refers to all kinds of absolute indications of humidity. For very low humidities, other more specific terms tend to be used.

**Hydrogen Ion Activity (aH<sup>+</sup>):** Activity of the hydrogen ion in solution. Related to hydrogen ion concentration (CH<sup>+</sup>) by the activity coefficient for hydrogen (f H<sup>+</sup>).

**Hygrometer:** Any instrument for measuring humidity.

**Hygrometry:** The subject of humidity measurement.

**Hygroscopic:** Tending to absorb water vapor.

**Hysteresis (Electrode Memory):** When an electrode system is returned to a solution, equilibrium is usually not immediate. This phenomenon is often

observed in electrodes that have been exposed to the other influences such as temperature, light, or polarization.

**Hysteresis:** The maximum difference between output readings for the same measured point, one point obtained while increasing from zero and the other while decreasing from full scale. The points are taken on the same continuous cycle. The deviation is expressed as a percent of full scale.

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 measured across the excitation terminals of a transducer at room temperature, with no load applied, and with the output terminals open-circuited.

**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 (Isolation) Resistance:** The DC resistance expressed in ohms measured between any electrical connector pin or lead wire and the transducer body or case. Normally measured at 50 VDC.

**Integral Nonlinearity:** This term describes the absolute accuracy of a converter. It is the maximum deviation, at any point in the transfer function, of the converter's output from its ideal value.

**Integrated Services Digital Network (ISDN):** A telephone service that brings a digital loop to the telephone subscriber's premises and integrates all forms of information (voice, computer data, facsimile, etc.) onto a single communications network.

**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.

**Internal Reference electrode (Element):** The reference electrode placed internally in a glass electrode.

**International Standards Organization (ISO):** The standards organization that developed the Open Systems Interconnect Model and other international communications standards.

**Internet:** The global collection of interconnected regional and wide-area networks which use IP as the network layer protocol.

**Internet Address:** An assigned number which identifies a host in an Internet. It has two or three parts: network number, optional subnet number, and host number.

**Internet Protocol (IP):** The network layer protocol for the Internet. It is the datagram protocol defined by RFC 791.

**Interpreter:** A system program that converts and executes each instruction of a high-level language program into machine code as it runs, before going onto the next instruction.

**Interrupt:** To stop a process in such a way that it can be resumed.

**Intrinsically Safe:** An instrument which will not produce any spark or thermal effects under normal or abnormal conditions that will ignite a specified gas mixture.

**IOBASE-T Ethernet:** A version of Ethernet that operates over twisted-pair wire at a speed of 10 Mb/s. IOBASE-T networks with more than two terminals must use an Ethernet hub and a star topology.

**Ionic Mobility:** Defined similarly to the mobility of nonelectrolytic particles, viz., as the speed that the ion obtains in a given solvent when influenced by unit power.

**Ionic Strength:** The weight concentration of ions in solution, computed by multiplying the concentration of each ion in solution (C) by the corresponding square of the charge on the ion (Z) summing this product for all ions in solution and dividing by 2: ionic strength =  $\frac{1}{2} \sum Z^2 C$ .

**IPTS-48:** International Practical Temperature Scale of 1948. Fixed points in thermometry as specified by the Ninth General Conference of Weights and Measures which was held in 1948.

**IPTS-68:** International Practical Temperature Scale of 1968. Fixed points in thermometry set by the 1968 General Conference of Weights and Measures.

**ISA:** Industry Standard Architecture (PC-AT Bus) or Instrument Society of America.

**ISO:** International Standards Organization.

**Isolation:** The reduction of the capacity of a system to respond to an external force by use of resilient isolating materials.

**Isopotential Point:** A potential which is not affected by temperature changes. It is the pH value at which  $dE/dt$  for a given electrode pair is zero. Normally, for a glass electrode and SCE reference, this potential is obtained approximately when immersed in pH 7 buffer.

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

## J

**Joule:** The basic unit of thermal energy.

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

## K

**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

**Lag:** 1. A time delay between the output of a signal and the response of the instrument to which the signal is sent. 2. A time relationship between two waveforms where a fixed reference point on one wave occurs after the same point of the reference wave.

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

**LAN:** Local Area Network. A network that takes advantage of the proximity of computers to offer relatively efficient, higher-speed communications than long-haul or wide-area networks.

**LAP:** Link Access Protocol.

**Latent Heat:** Expressed in BTU per pound. The amount of heat needed (absorbed) to convert a pound of boiling water to a pound of steam.

**Leakage Rate:** The maximum rate at which a fluid is permitted or determined to leak through a seal. The type of fluid, the differential  
**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).

**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 maximum deviation of the calibration curve from a straight line between zero and full scale, expressed as a percent of full scale output and measured on increasing measured only.

**Line Pressure:** The maximum pressure in the pressure vessel or pipe for differential pressure measurement.

**Line Protocol:** A control program used to perform data communication functions over network lines which consists of handshaking and line-control functions that move the data between the transmit and receive terminals.

**LISP:** List Processing Language.

**Load Buttons:** The spherical like shape of the top surface of a load cell where the load is applied.

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

**Logarithmic Scale:** A method of displaying data (in powers of ten) to yield maximum range while keeping resolution at the low end of the scale.

**Loopback:** Directing signals back toward the transmitting terminal at some point along the communications path. Used as a method of troubleshooting.

**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.

**LS-TTL Compatible:** For digital input circuits, a logic 1 is obtained for inputs of 2.0 to 5.5 V which can source 20  $\mu$ A, and a logic 0 is obtained for inputs of 0 to

0.8 V which can sink 400  $\mu\text{A}$ . 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  $\mu\text{A}$ ; and a logic 0 is represented by 0 to 0.6 V with a current sink capability of at least 16 MA. "LS" stands for low-power Schottky.

**LS-TTL Unit Load:** A load with LS-TTL voltage levels, which will draw 20  $\mu\text{A}$  for a logic 1 and -400  $\mu\text{A}$  for a logic 0.

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

**LVDT - Linear Variable Differential Transformer**

## M

**Manual Reset (Adjustment):** The adjustment on a proportioning controller which shifts the proportioning band in relationship to the set point to eliminate droop or offset errors.

**Manual Reset (Switch):** The switch in a limit controller that manually resets the controller after the limit has been exceeded.

**Mass Flow Rate:** Volumetric flowrate times density, i.e. pounds per hour or kilograms per minute.

**Mass Storage:** A device like a disk or magtape that can store large amounts of data readily accessible to the central processing unit.

**Maximum Excitation:** The maximum value of excitation voltage or current that can be applied to the transducer at room conditions without causing damage or performance degradation beyond specified tolerances.

**Maximum Operating Temperature:** The maximum temperature at which an instrument or sensor can be safely operated.

**Mean Temperature:** The average of the maximum and minimum temperature of a process equilibrium.

**Measurand:** A physical quantity, property, or condition which is measured.

**Measured Media:** The physical quantity, property, or condition which is measured. (eg: pressure, load, weight, acceleration)

**Measuring Junction:** The thermocouple junction referred to as the hot junction that is used to measure an unknown temperature.

**Mechanical Hysteresis:** The difference of the indication with increasing and decreasing strain loading, at identical strain values of the specimen.

**Melting Point:** The temperature at which a substance transforms from a solid phase to a liquid phase.

**Membrane:** The pH-sensitive glass bulb is the membrane across which the potential difference due to the formation of double layers with ion-exchange properties on the two swollen glass surfaces is developed. The membrane makes contact with and separates the internal element and filling solution from the sample solution.

**Method of Correction:** A procedure whereby the mass distribution of a rotor is adjusted to reduce unbalance, or vibration due to unbalance, to an acceptable value. Corrections are usually made by adding material to, or removing it from, the rotor.

**MFLOPS:** Million Floating Point Instructions Per Second.

**Mica:** A transparent mineral used as window material in high-temperature ovens.

**Microamp:** One millionth of an ampere,  $10^{-6}$  amps,  $\mu\text{A}$ .

**Micron:** One millionth of a meter,  $10^{-6}$  meters.

**Microvolt:** One millionth of a volt,  $10^{-6}$  volts.

**Mil:** One thousandth of an inch (.001").

**Milliamp:** One thousandth of an amp,  $10^{-3}$  amps, symbol mA.

**Millimeter:** One thousandth of a meter, symbol mm.

**Millivolt:** Unit of electromotive force. It is the difference in potential required to make a current of 1 millampere flow through a resistance of 1 ohm; one thousandth of a volt, symbol mV.

**Mineral-insulated Thermocouple:** A type of thermocouple cable which has an outer metal sheath and mineral (magnesium oxide) insulation inside separating a pair of thermocouple wires from themselves and from the outer sheath. This cable is usually drawn down to compact the mineral insulation and is available in diameters from .375 to .010 inches. It is ideally suited for high-temperature and severe-duty applications.

**MIPS:** Million Instructions Per Second.

**Modem:** Modulator/Demodulator. A device that transforms digital signals into audio tones for transmission over telephone lines, and does the reverse for reception.

**Modulation:** The process by which some characteristic of a higher frequency wave is varied in accordance with the amplitude of a lower frequency wave.

**Molality:** A measure of concentration expressed in mols per kilogram of solvent.

**Monovalent Ion:** An ion with a single positive or negative charge ( $H^+$ ,  $Cl^-$ ).

**Motherboard:** The pc board of a computer that contains the bus lines and edge connectors to accommodate other boards in the system. In a microcomputer, the motherboard contains the microprocessor and connectors for expansion boards.

**Mounted Resonant Frequency:** The frequency at which the internal spring/mass system of an accelerometer resonates, producing a 90 degree phase shift in output signal vs. applied acceleration.

**Mounting Error:** The error resultant from installing the transducer, both electrical and mechanical.

**MR:** Magneto Resitive or Magneto-Resistance.

**MRI:** Magnetic Resonance Imaging.

**MSD (Most-Significant Digit):** The leftmost digit of the display.

**MTBF:** Mean Time Between Failures.

**Mueller Bridge:** A high-accuracy bridge configuration used to measure three-wire RTD thermometers.

**Multiplex:** A technique which allows different input (or output) signals to use the same lines at different times, controlled by an external signal. Multiplexing is used to save on wiring and I/O ports.

## N

**NEC:** National Electric Codes.

**NCSA:** National Center for Supercomputing Applications.

**Negative Temperature Coefficient:** A decrease in resistance with an increase in temperature.

**NEMA-4:** A standard from the National Electrical Manufacturers Association, which defines enclosures intended for indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water, and hose-directed water.

**NEMA-7:** A standard from the National Electrical Manufacturers Association, which defines explosion-proof enclosures for use in locations classified as Class I, Groups A, B, C or D, as specified in the National Electrical Code.

**NEMA-12:** A standard from the National Electrical Manufacturers Association, which defines enclosures with protection against dirt, dust, splashes by non-corrosive liquids, and salt spray.

**NEMA-Size Case:** An older US case standard for panel meters, which requires a panel cutout of 3.93 x 1.69 inches.

**Nernst Equation:** A mathematical description of electrode behavior: E is the total potential, in millivolts, developed between the sensing and reference electrodes;  $E_x$  varies with the choice of electrodes, temperature, and pressure:  $2.3RT/nF$  is the Nernst factor (R and F are constants, n is the charge on the ion, including sign, T is the temperature in degrees Kelvin), and  $a_i$  is the activity of the ion to which the electrode is responding.

**Nernst Factor (S, Slope):** The term  $2.3RT/nF$  is the Nernst equation, which is equal (at  $T = 25^\circ\text{C}$ ) to 59.16 mV when  $n = 1$  and 29.58 mV when  $n = 2$ , and which includes the sign of the charge on the ion in the term n. The Nernst factor varies with temperature.

**Network:** A group of computers that are connected to each other by communications lines to share information and resources.

**Nibble:** One half of a byte.

**NIC:** Network Information Center. An organization which provides network users with information about services provided by the network.

**Nicrosil/Nisil:** A nickel chrome/nickel silicone thermal alloy used to measure high temperatures. Inconsistencies in thermoelectric voltages exist in these alloys with respect to the wire gage.

**NIST:** National Institute of Standards & Technology.

**NMR (Normal-Mode Rejection):** The ability of a panel meter to filter out noise superimposed on the signal and applied across the SIG HI to SIG LO input terminals. Normally expressed in dB at 50/60 Hz.

**Node:** A terminal on a data communications network.

**Noise:** An unwanted electrical interference on the signal wires.

**Normal (axial) Stress:** The force per unit area on a given plane within a body  $a = F/A$

**Normal Hydrogen Electrode:** A reversible hydrogen electrode (Pt) in contact with hydrogen gas at 1 atmosphere partial pressure and immersed in a solution containing hydrogen ions at unit activity.

**Normal-mode Rejection Ratio:** The ability of an instrument to reject interference usually of line frequency (50-60 Hz) across its input terminals.

**NPT:** National Pipe Thread.

**Null:** A condition, such as balance, which results in a minimum absolute value of output.

**Nyquist Theorem:** This theorem says that if a continuous bandwidth-limited signal contains no frequency components higher than  $f_C$  then the original signal can be recovered without distortion if it is sampled at a rate of at least  $2 f_C$ . This theorem applies to A/D converter applications as well as data transmission density over limited-bandwidth channels.

## O

**OCR:** Optical Character Recognition.

**Octal:** Pertaining to a base 8 number system.

**Offset:** The difference in temperature between the set point and the actual process temperature. Also, referred to as droop.

**Ohmmeter:** An instrument used to measure electrical resistance.

**On/off Controller:** A controller whose action is fully on or fully off.

**Open Circuit:** The lack of electrical contact in any part of the measuring circuit. An open circuit is usually characterized by rapid large jumps in displayed potential, followed by an off-scale reading.

**Operating System:** A collection of programs that controls the overall operation of a computer and performs such tasks as assigning places in memory to programs and data, processing interrupts, scheduling jobs and controlling the overall input/output of the system.

**Optical Isolation:** Two networks which are connected only through an LED transmitter and photoelectric receiver with no electrical continuity between the two networks.

**OSHA:** Occupational and Safety Hazard Organization.

**Output:** The electrical signal measured at the output terminals which is produced by an applied input to a transducer.

**Output Impedance:** The resistance as measured on the output terminals of a pressure transducer at standard temperature, with no measured applied, and with the excitation terminals open-circuited.

**Output Noise:** The RMS, peak-to-peak (as specified) AC component of a transducer's DC output in the absence of a measurand variation.

**Overrange, Safe:** The maximum pressure or load which may be applied to the transducer without causing a permanent change in the performance specifications.

**Overshoot:** The number of degrees that a process exceeds the set point temperature when coming up to the set point temperature.

## P

**Packet:** The unit of data sent across a packet switching network. The term is used loosely.

**Packet Switching:** A method of transmitting units of data (called packets) through a mesh network. There is no physical circuit established between end points; instead, each packet is individually relayed from one switching node to the next, and individual packets may take different routes through the switching node.

**Parallax:** An optical illusion which occurs in analog meters and causes reading errors. It occurs when the viewing eye is not in the same plane, perpendicular to the meter face, as the indicating needle.

**Parallel Transmission:** Sending all data bits simultaneously. Commonly used for communications between computers and printer devices.

**Parity:** A technique for testing transmitting data. Typically, a binary digit is added to the data to make the sum of all the digits of the binary data either always even (even parity) or always odd (odd parity).

**Parity Error:** The error that occurs in a DTE when the received data has the wrong parity.

**PCMCIA:** Personal Computer Memory Card, International Association Standard.

**Peltier Effect:** When a current flows through a thermocouple junction, heat will either be absorbed or evolved depending on the direction of current flow. This effect is independent of joule  $I^2 R$  heating.

**Peripheral:** A device that is external to the CPU and main memory, i.e., printer, modem or terminal, but is connected by the appropriate electrical connections.

**pH Junctions:** The Junction of a reference electrode or combination electrode is a permeable membrane through which the fill solution escapes (called the liquid junction).

**pH(S) (Standard pH Scale):** The conventional standard pH scale established on the basis that an individual ionic activity coefficient can be calculated from the Debye-Hückel law for primary buffers.

**Phase:** A time based relationship between a periodic function and a reference. In electricity, it is expressed in angular degrees to describe the voltage or current relationship of two alternating waveforms.

**Phase Difference:** The time expressed in degrees between the same reference point on two periodic waveforms.

**Phase Locked Loop:** A circuit containing a voltage-controlled oscillator whose phase or frequency can be "steered" to keep it in sync with a reference source. A PLL circuit is generally used to lock onto and "up-convert" the frequency of a stable source.

**Phase-Locked Loop (PLL):** An electronic circuit that consists of a phase detector, low pass filter and voltage-controlled oscillator. A PLL can be used as an FSK demodulator or to synchronize a terminal's internal clock to the received bit stream.

**Phase Proportioning:** A form of temperature control where the power supplied to the process is controlled by limiting the phase angle of the line voltage.

**Phase Shift:** The phase angle between the output signal and the applied acceleration.

**PID:** Proportional, integral, derivative. A three mode control action where the controller has time proportioning, integral (auto reset) and derivative rate action.

**Piezoelectric Accelerometer:** A transducer that produces an electrical charge in direct proportion to the vibratory acceleration.

**Piezoresistance:** Resistance that changes with stress.

**Pixel:** Picture element. Definable locations on a display screen that are used to form images on the screen. For graphic displays, screens with more pixels provide higher resolution.

**Plane Separation:** Of a balancing machine, is the operation of reducing the correction plane interference ratio for a particular rotor.

**Platinel:** A non-standard, high temperature platinum thermocouple alloy whose thermoelectric voltage nearly matches a Type K thermocouple (Trademark of Englehard Industries).

**Platinum 6% Rhodium:** The platinum-rhodium alloy used as the negative wire in conjunction with platinum-30% rhodium to form a Type B thermocouple.

**Platinum 10% Rhodium:** The platinum-rhodium alloy used as the positive wire in conjunction with pure platinum to form a Type S thermocouple.

**Platinum 13% Rhodium:** The platinum-rhodium alloy used as the positive wire in conjunction with pure platinum to form a Type R thermocouple.

**Platinum 30% Rhodium:** The platinum-rhodium alloy used as the positive wire in conjunction with platinum 6% rhodium to form a Type B thermocouple.

**Platinum:** A noble metal which in its pure form is the negative wire of Type R and Type S thermocouples.

**PLC:** Programmable Logic Controller.

**Polarity:** In electricity, the quality of having two oppositely charged poles, one positive one negative.

**Polarization:** The inability of an electrode to reproduce a reading after a small electrical current has been passed through the membrane. Glass pH 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.

**Polling:** A control message sent from a master terminal to a slave terminal as an invitation for the slave to transmit.

**Port:** A signal input (access) or output point on a computer.

**Positive Temperature Coefficient:** An increase in resistance due to an increase in temperature.

**POSIX:** Portable Operating System Interface. Operating system based on Unix.

**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%.

**PRI:** See Primary Rate Interface.

**Primary Axis:** The axis along which the transducer is designed to be loaded; normally its geometric centerline.

**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.

**PROFIBUS:** German Token Ring Bus Standard Developed By Siemens.

**Program:** A list of instructions that a computer follows to perform a task.

**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 setpoint 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.

**PSI:** Pounds per square inch.

**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.

**Pull Plate:** Load cell attachment which allows tension or compression force to be directed at the center line of a load cell through a threaded center hole.

**Pulse Code Modulation:** A method of quantizing audio-range analog signals into a digital form for transmission in digital communications systems, or for processing in DSP. Effectively the same as analog-to-digital conversion.

**Pulse Width Modulation:** An output in the form of duty cycle which varies as a function of the applied measurand.

## Q

**Quaternary:** A coding scheme that uses four different voltage levels to represent information, used over the local loop with basic ISDN.

## R

**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:** The measured values, over which a transducer is intended to measure, specified by their 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.  $459.67^{\circ}\text{R} = 0^{\circ}\text{F}$ .

**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.

**Rated Capacity:** The maximum measurand that a transducer is designed to measure within its specification.

**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.

**Redox Potential:** The potential developed by a metallic electrode when placed in a solution containing a species in two different oxidation states.

**Reference Junction:** The cold junction in a thermocouple circuit which is held at a stable known temperature. The standard reference temperature is  $0^{\circ}\text{C}$  ( $32^{\circ}\text{F}$ ). 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.

**Refractory Metal Thermocouple:** A class of thermocouples with melting points above  $3600^{\circ}\text{F}$ . The most common are made from tungsten and tungsten/rhenium alloys Types G and C. They can be used for measuring high temperatures up to  $4000^{\circ}\text{F}$  ( $2200^{\circ}\text{C}$ ) in non-oxidizing, inert, or vacuum environments.

**Register:** A storage device with a specific capacity, such as a bit, byte or word.

**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 as a percent of full scale.

**Resistance:** The resistance to the flow of electric current measured in ohms (1/2) for a conductor. Resistance is function of diameter, resistivity (an intrinsic property of the material) and length.

**Resolution:** The smallest change in mechanical input which produces a detectable change in the output signal.

**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 600 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  $Re = rVD/\mu$ , where:  $r$  = Density of fluid,  $\mu$  = Viscosity in centipoise (CP),  $V$  = Velocity, and  $D$  = Inside diameter of pipe.

**RFI:** Radio frequency interference.

**Rheostat:** A variable resistor.

**Rigid Rotor:** A rotor is considered rigid when it can be corrected in any two (arbitrarily selected) planes [see "Correction (Balancing) Plane"] and after that correction, its unbalance does not significantly exceed the balancing tolerances

(relative to the shaft axis) at any speed up to maximum operating speed and when running under conditions which approximate closely to those of the final supporting system.

**Ring Network:** A network topology that connects its terminals in a loop or ring.

**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.

**RISC:** Reduced Instruction Set Computing.

**ROM:** Read Only Memory.

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

**Router:** A device that connects two or more LANs and operates at OSI Model layers one through three. A router is able to select from among multiple paths to route a data packet through the network based on an address sent with the data.

**RS-232:** A recommended serial standard that is frequently used to interface a DTE and a DCE.

**RS-422:** A recommended standard published by the EIA to specify electrical signal levels of a serial interface. RS-422 uses balanced circuits and is designed to be used with the RS-499 mechanical specifications.

**RS-423:** A recommended standard published by the EIA to specify electrical signal levels of a serial interface. RS-423 uses unbalanced circuits and is designed to be used with the RS-499 mechanical specifications.

**RTD:** Resistance Temperature Detector.

## S

**Salt Bridge:** The salt bridge of a reference electrode is that part of the electrode which contains the filling solution to establish the electrolytic connection between reference internal cell and the test solution. **Auxiliary Salt Bridge:** A glass tube open at one end to receive intermediate electrolyte filling solution, and the reference electrode tip and a junction at the other end to make contact with the sample.

**Salt Effect (fx):** The effect on the activity coefficient due to salts in the solution.

**SAMA:** Scientific Apparatus Makers Association. An association that has issued standards covering platinum, nickel, and copper resistance elements (RTDs).

**SCR:** Silicone controlled rectifier.

**Scroll:** To move all or part of the screen material up to down, left or right, to allow new information to appear.

**SCSI:** Small Computer System Interface.

**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:** The part of the transducer which reacts directly in response to the measurand.

**Sensitivity:** The ratio of change in transducer output to a change in the value of the measurand.

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

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

**Server:** A computer on a network that serves as a central repository for data and programs and which can be accessed over the network by other computers, which are called clients.

**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.

**Shielded Pair:** A pair of conductors that are wrapped with metallic foil to isolate the pair from electrical interference.

**SHTTP:** Secure-Hypertext Transfer Protocol, Security Protocols For The Internet.

**Shunt Cal (R-Cal):** The change in electrical output caused by placing a fixed resistor between the appropriate transducer terminals. Used "in the field" for quick calibration.

**Sign Bit:** The first bit in a dibit (group of two bits) in 2 binary, 1 quaternary (2B1Q) modulation. The sign bit determines if the voltage of the transmitted signal is positive or negative. The second bit is the magnitude bit, and it determines whether the voltage is positive or negative.

**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.

**SIMM:** Single In Line Memory Module.

**Simplex:** One-way only communications.

**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.

**Single-Plane (Static) Balancing Machine:** A single plane balancing machine is a gravitational or centrifugal balancing machine that provides information for accomplishing single plane balancing.

**SLIP:** Serial Line Internet Protocol. SLIP is currently a de facto standard, commonly used for point-to-point serial communications.

**Slope (Electrode Sensitivity, Span):** See Nernst factor.

**SMBus:** Smart Management Bus.

**SMT:** Surface Mount Technology.

**SMTP:** Simple Mail Transfer Protocol. The Internet standard protocol for transferring electronic mail messages from one computer to another.

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

**Solvation:** Ions in solution are normally combined with at least one molecule of solvent. This phenomenon is termed solvation.

**Source Code:** A non-executable program written in a high-level language. A compiler or assembler must translate the source code into object code (machine language) that the computer can understand and process.

**SP50:** Standard Project (Committee #50).

**Span:** The algebraic difference between the limits of the range from zero to full scale.

**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.

**Specifications:** The group of error limits within which each device will operate.

**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°.

**Spread Spectrum:** This communications technique has been used in secure military systems for a number of years and is now becoming popular in commercial systems. This format involves transmitting information which has been multiplied by a pseudo-random noise (PN) sequence which essentially "spreads" it over a relatively wide frequency bandwidth. The receiver detects and uses the same PN sequence to "despread" the frequency bandwidth and decode the transmitted information. This communications technique allows greater signal density within a given transmission bandwidth and provides a high degree of signal encryption and security in the process.

**Spurious Error:** Random or erratic malfunction.

**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.

**Standard Electrode Potential (E<sub>0</sub>):** The standard potential E<sub>0</sub> of an electrode is the reversible emf between the normal hydrogen electrode and the electrode with all components at unit activity.

**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.

**Star Network:** A network topology with a central hub and a number of remote terminals. Each remote is connected to the hub by a point-to-point network.

**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 Router:** A router whose routing table must be reprogrammed by the network manager every time there is a change made to the internet work.

**Static Unbalance:** Static unbalance is that condition of unbalance for which the central principal axis is displaced 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.

**Stop Bit:** A signal following a character or block that prepares the receiving device to receive the next character or block.

**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.

**Subscriber:** A customer of a telephone company or other communications carrier.

**Subscriber Line:** Data transmission capacity over conventional twisted pair telephone lines. ADSL is a contender for a major piece of the "information highway" pie and it promises to deliver telephone, television, and data services to your home over the existing telephone line.

**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.

**Supervisory Information:** Signaling information used to connect, maintain, and disconnect a telephone circuit.

**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 no more than several cycles.

**Suspension Effect:** The source of error due to varied reference liquid junction potential depending upon whether the electrodes are immersed in the supernatant fluid or deeper in the sediment. Normally encountered with solutions containing resins or charged colloids.

**Syntax:** The rules governing the structure of a language.

**T**

**T1 (Carrier System):** A digital communications link that operates at 1.544 Mb/s in North America and Japan. The European version is called E1 and operates at 2.048 Mb/s.

**T2 Carrier System:** A North American digital communications link that is formed by multiplexing three T1 systems and operates at 6.312 Mb/s. The European version is E2.

**T3 Carrier System:** A North American digital communications link that is formed by multiplexing seven T2 systems and operates at 47.736 Mb/s. The European version is E3.

**TCP:** Transmission Control Protocol. A transport layer protocol for the Internet.

**TCP/IP:** Transmission Control Protocol/Internet Protocol. This is a common shorthand which refers to the suite of application and transport protocols which run over IP. These include FTP, Telnet, SMTP, and UDP (a transport layer protocol).

**TDM:** Time Division Multiplexing.

**Telemetry:** Transmission and collection of data obtained by sensing conditions in a realtime environment.

**TELNET:** The Internet standard protocol for remote terminal connection service. Telnet allows a user at one site to interact with a remote timesharing system at another site as if the user's terminal was connected directly to the remote computer.

**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, Compensated:** The range of temperature over which a transducer can operate up to full scale and still meet all specifications.

**Temperature Compensation:** The utilization of supplementary devices, materials, or components within the bridge to minimize sources of error caused by changing temperature.

**Temperature, Operating:** The range of temperature over which a transducer may be safely operated up to full scale without causing failure, but specifications may not be met.

**Temperature Effect On Span:** The change in rated output due to a change in ambient temperature. Usually expressed as +/- a percentage change in rated output per degree F change in ambient temperature over the compensated temperature range.

**Temperature Effect On Zero:** The change in zero balance due to a change in ambient temperature. Usually expressed as +/- a percentage change in rated output per degree F change in ambient temperature over the compensated temperature range.

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

**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).

**Thermopile:** An arrangement of thermocouples in series such that alternate junctions are at the measuring temperature and the reference temperature. This arrangement amplifies the thermoelectric voltage. Thermopiles are usually used as infrared detectors in radiation pyrometry.

**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.

**Thomson Effect:** When current flows through a conductor within a thermal gradient, a reversible absorption or evolution of heat will occur in the conductor at the gradient boundaries.

**Token Passing:** A protocol that gives a terminal permission to transmit on a Token Ring LAN. A unique bit pattern, called a token, circulates around the ring from terminal to terminal. The terminal that possesses the token has permission to transmit.

**Token Ring:** A LAN standard, also known as IEEE 802.5, that connects a ring topology. Token Ring LANs operate at 4 Mb/s or 16 Mb/s.

**TQM:** Total Quality Management.

**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:** A transducer that has a 4-20 mA two wire output.

**Transverse Sensitivity:** Signal output as a result of acceleration perpendicular to the sensitive axis. Specified as a percentage of sensitive axis output for equivalent right angle acceleration or as a decimal fraction.

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

**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  $\mu$ 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  $\mu$ 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  $\mu$ 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.

**Twisted Pair:** Two insulated wires, usually made from copper, that are twisted in a regular, six turns per inch spiral pattern used to connect most telephones. Also used as a medium by several local area networks.

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

## U

**UART:** Universal Asynchronous Receiver Transmitter.

**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.

**Unbalance Tolerance:** The unbalance tolerance with respect to a radial plane (measuring plane or correction plane) is that amount of unbalance which is specified as the maximum below which the state of unbalance is considered acceptable.

**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.

**UPS:** Uninterruptible Power Supply.

**UTC:** Universal Time Code.

## V

**Vacuum:** Any pressure less than atmospheric pressure.

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

**VHF:** Very High Frequency

**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.

**VSWR:** Voltage Standing Wave Ratio.

## 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.

**Wet/Dry Differential:** A differential pressure transducer or transmitter that uses a metal diaphragm at the wet port where fluids can be applied, and no diaphragm at the dry port. The dry port exposes the internal circuitry to the medium, so only clean dry gas can be applied to this port.

**Wet/Wet Differential:** A differential pressure transducer or transmitter that has a metal diaphragm in each pressure port to permit fluid into both parts.

**Wetted Parts:** The diaphragm and pressure port material that comes in direct contact with the medium (gas, liquid).

**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.

**WHOIS:** An Internet program which allows users to query a database of people and other Internet entities.

**Window:** In computer graphics, a defined area in a system not bounded by any limits; unlimited "space" in graphics.

**Word:** Number of bits treated as a single unit by the CPU. In an 8-bit machine, the word length is 8 bits; in a sixteen bit machine, it is 16 bits.

**Working Standard:** A standard of unit measurement calibrated from either a primary or secondary standard which is used to calibrate other devices or make comparison measurements.

**Write:** To record data in a storage device or on a data medium.

**WWW:** World Wide Web.

**WYSIWYG:** What You See Is What You Get.

## X

## Y

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

## Z

**Zero Adjustments:** Used when 'setting up' a transducer to adjust the output signal to zero when zero load/pressure is applied.

**Zero Balance:** The output signal of the transducer with rated excitation and with no-load applied, usually expressed as a percent of rated output.

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

**Zero Point:** The electrical zero point where zero millivolts would be displayed. Used in conjunction with the slope control to provide a narrower range calibration.

**Zero Power Resistance:** The resistance of a thermistor or RTD element with no power being dissipated.

**Zero Return:** The difference in zero balance measured immediately before rated load application of specified duration and measured after removal of the load, and when the output has stabilized.

**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.

**Zero Voltage Switching:** The making or breaking of circuit timed such that the transition occurs when the voltage wave form crosses zero voltage; typically only found in solid state switching devices.