

**A****abrasive**

Descriptions of materials that wear, grind, or rub away by friction.

**absolute measurement**

Absolute measurement uses measurement scales based on the fundamental units of a system. It relates to the condition at which a system contains none of the variables to be measured. This is opposed to arbitrary scales that relate to a predefined numerical value. For example, when discussing temperature measurement, we use the Kelvin scale and the Celsius scale. The Kelvin scale is absolute because it relates to the condition where a substance has no temperature, but the Celsius scale is arbitrary because its zero point relates to a predefined value of temperature (the melting point of water).

**absolute pressure**

Gage pressure plus atmospheric pressure.

**absolute voltage output**

Increase in transducer voltage output (above offset) due to applied load.

**absolute zero**

Temperature at which thermal energy is at a minimum. Defined as 0 Kelvin, calculated to be -273.15 °C or -459.67°F.

**ac**

Alternating current.

**access**

To read from and possibly write to area of memory.

**accuracy**

1) The accuracy of a device or system is the extent to which any value it creates could be wrong, or the maximum error it may produce. With a sensor, it is how close the output value is to the actual value of the measurand. In practice, every device will produce an error, however small, and will have some degree of accuracy rating. It may be expressed in terms of the measurement units involved. For example, suppose we have a thermometer with an accuracy of  $\pm 0.2^\circ\text{C}$ . This means that if we take a temperature measurement with the thermometer and find it to be  $20.1^\circ\text{C}$ , then the actual temperature lies somewhere between  $19.9^\circ\text{C}$  and  $20.3^\circ\text{C}$ . Alternatively it may be expressed as a percentage error of the range of the device. 2) The combined error of non-linearity, repeatability, and hysteresis expressed as a percent of full scale output.

**accuracy/precision**

If the actual value is 4.321 and you say that it is 4.30, then you are precise to 3 places but inaccurate by .021. If a value is represented as a bull's-eye on a target, a group of guesses or measurements represented by closely grouped points have a high degree of precision. If that group is near the center, it is highly accurate as well. On a bull's-eye, think of precision as how close to the center your arrow hits, and your measurement of precision as how closely you can group your shots.

**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.

**a/d conversion**

See *analog-to-digital conversion*.

**address**

Identification, as represented by name, label, or number, for register, location, or any other data source or destination such as location of station in communications network.

**aeration**

Interspersing of air or other gases with powders or particulate material causing reduction in density and consequent increase in flowability.

**aggregate**

Dense clustering of particles into body or mass.

**agitator**

Apparatus for shaking or stirring; device used to aid in flow of bulk material to condition material to constant density.

**alarm**

Audible or visible signal that indicates abnormal or out-of-limits condition in plant or control system.

**algorithm**

Set of procedures used for solving problem in finite number of steps.

**alphanumeric**

A character set that contains both letters and digits.

**alphanumeric display**

Device capable of displaying characters (letters, numbers, and symbols) but not graphics.

**ambient conditions**

The conditions (humidity, pressure, temperature, etc.) of the medium surrounding the device.

**ambient light**

Illumination of light receiver not generated by its light source.

**ambient pressure**

Pressure of medium surrounding device.

**ambient temperature**

Temperature of medium (air, water, earth) into which heat of device is dissipated.

Note: 1) For devices that do not generate heat, this temperature is same as temperature of medium at device location when device is not present. 2) For devices that do generate heat, this temperature is temperature of medium surrounding device when it is present and dissipating heat. 3) Allowable ambient temperature limits are based on assumption that device in question is not exposed to significant radiant energy sources.

**American Wire Gauge (AWG)**

Standard system used for designating size of electrical conductors. Gauge numbers have inverse relationship to size; larger numbers have smaller cross-sectional area. However, single-strand conductor has larger cross-sectional area than multi-strand conductor of same gauge, resulting in same current-carrying specification.

**ammeter**

An instrument used to measure current.

**ampere**

Unit of electrical current intensity. One ampere of current is  $6.24 \times 10^{18}$  electrons passing point in one second; often shortened to 'amp.'

**amplifier**

Signal-gain device whose output is function of its input.

**analog**

Representation of numerical quantities by means of physical variables such as voltage, current, resistance, rotation, etc. Contrast with *digital*.

**analog backup**

Alternate method of process control by conventional analog instrumentation in event of failure in computer system.

**analog circuit**

Circuit in which signal can vary continuously between specified limits. Contrast with *digital circuit*.

**analog control**

Process regulation based on direct measurement of non-discrete quantities (e.g., voltage, rotations, etc.)

**analog gage**

Measuring device that indicates measurement result via analog signal. Contrast with *digital gage*.

**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 input module**

Device that converts analog input signals from process instrumentation into digital code for transmission or use by computer.

**analog output module**

Device that converts digital values into proportional analog dc signal output for transmission or use by other analog devices.

**analog-to-digital conversion (a/d conversion)**

Production of digital value whose magnitude is proportional to instantaneous magnitude of analog signal.

**Angstrom**

Unit of measure for wavelength of light ( $10\text{\AA} = 1\text{nm}$ ).

**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 $\pi$ f).

**angular load, concentric**

A load applied concentric with the primary axis at the point of application and at some angle with respect to the primary axis.

**angular load, eccentric**

A load applied eccentric with the primary axis at the point of application and at some angle with respect to the primary axis.

**annotation**

Descriptive comment or explanatory note.

**ANSI**

American National Standards Institute: organization that develops and publishes voluntary industry standards in U.S.

**application**

Use to which something is put, or how it is used.

**arching**

Where deaerated or agglomerated process material forms in arch-like barriers above bin or hopper discharge, preventing further flow.

**arithmetic capability**

Ability to do addition, subtraction, multiplication, division, or advanced math functions within processor.

**ASCII**

American Standard Code for Information Interchange. Eight-level code intended to provide information code compatibility between digital devices. This information code normally represents alphanumeric, punctuation marks, and control-code characters.

**aspect ratio**

Ratio of the height to the width on a storage vessel.

**asynchronous**

Recurrences or repeated operations that take place in patterns unrelated over time.

**asynchronous character**

A binary character, used in asynchronous transmission, that contains equal-length bits - including a start bit and one or more stop bits, which define the beginning and end of the character.

**asynchronous communication**

This method of transferring data does so without a specific timing mechanism between the two communicating parties. The party receiving data isn't expecting more data at any set interval.

**asynchronous modem**

A modem that uses asynchronous transmission, and therefore does not require timing synchronization with its attached DTE or the remote modem; also used to describe a modem that converts asynchronous inputs from the DTE to synchronous signals for modem-to-modem transmission.

**asynchronous transmission**

A transmission method in which time intervals between transmitted characters may be of unequal length. Transmission is controlled by start and stop bits on each character, rather than by clocking as in synchronous transmission. Contrast with synchronous transmission.

**attenuation**

1) Decrease in signal magnitude between two points or between two frequencies. 2) Reciprocal of gain, when gain is less than one.

Note: May be expressed as dimensionless ratio or scalar ratio, or in decibels as 20 times log of ratio.

Example: Total attenuation on cable is function of material and length of cable.

**attribute**

Means of characterizing data on display device (e.g. intensifying, blinking).

**auger**

Helical or closed flight screw-like device used to move or control material.

**automatic belt tension**

In weigh-belt equipment, automatic system of maintaining high and constant tension on conveyor belt to ensure accurate operations.

**auto-zero**

An automatic internal correction for offsets and/or drift at zero voltage input.

**average**

Numerical results obtained by dividing sum of two or more quantities by number of quantities; arithmetical mean.

Example: Average of 7, 9, 17 is  $(7+9+17=33 \div 3)$  or 11.

**AWG**

See *American Wire Gauge*.

**axial load**

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

**axis**

Principal direction along which movement of tool or work piece occurs.

## B

**background noise**

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

**backlash**

Relative movement between interacting mechanical parts, resulting from looseness.

**backplane**

Printed-circuit board, at back of chassis that provides electrical interconnection between modules inserted into chassis.

**backup**

1) Provision of alternate means of operation in case of failure of primary means of operation. See *analog backup*, *digital backup*, and *manual backup*. 2) To make copy of data so copy can be used if original is destroyed.

**balance beam**

Mass measuring device employing beam-mounted sliding weights to balance, and thereby determine, unknown load.

**bandwidth**

Range of frequencies over which system is designed to operate. Expressed in Hertz.

**barometric pressure effect on zero balance**

The change in zero balance due to a change in barometric pressure.

**barrier**

Partition or separation used for insulation or isolation of electric circuits or arcs (as defined in NEMA Standard Pub. No. ICS2, 1988).

**base**

Quantity of characters employed in numbering system: 2, binary; 8, octal; 10, decimal; 16, hexadecimal.

**basic**

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

**batch**

A group of commands that are executed one at a time. Same as script.

**batcher**

Device that dispenses preset amount of material by number, volume, or weight.

**batch mixer**

Device that combines discrete amounts of material into blended state prior to discharge.

**battery backup**

Battery or set of batteries that provide power to memory only when main power source is off.

**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.

**bel**

Equal to 10 decibels, see *decibel*.

**belt loading**

In weigh-belt equipment, measure of material weight per unit length of conveyor belt used to determine actual feed rate or material throughput.

**belt speed**

In weigh-belt equipment, rate of travel of conveyor belt. When combined with value of belt loading, actual feed rate and material through can be determined.

**bending strain** (moment strain)

The relationship between the force and the amount of bending that results from it.

**binary**

1) Pertaining to characteristic or property involving selection, choice, or condition in which there are two possibilities. 2) Base-2 numbering system (using only digits 0 and 1).

**binary coded decimal (BCD)**

Pertaining to decimal notation in which individual decimal digits are each represented by groups of binary digits.

Example: In 8-4-2-1 binary coded decimal notation, twenty-three is represented as 0010 0011, while in binary notation twenty-three is represented as 10111.

**binary digit**

1) Smallest unit of information in binary numbering system, represented by digits 0 and 1. 2) Smallest unit of memory.

**binary point**

Point in binary number system that separates integral and fraction portion of binary number.

**binary word**

Related group of ones and zeros that has meaning assigned by position or by weighted numerical value in natural binary system of numbers.

**bit**

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

**bit rate**

Number of bits per second.

**blending**

Prepare by thoroughly mingling different varieties or grades of materials.

**blind space**

The amount of time required for the transducer vibration to decay to a level such that ultrasonic measurement of distance is possible.

**block**

Set of things, such as words, characters, or digits, handled as a unit as with a file. Block is typically defined by number words in lengths and starting word address within file. See *I/O block*.

**block length**

Total number of words or bytes in block.

**block-transfer**

To transfer block (64 words maximum) of data to or from I/O module in one scan. Contrast with *single-transfer*.

**BNC**

A quick disconnect electrical connector used to interconnect and/or terminate coaxial cables.

**board**

1) Printed-circuit board. 2) Printed-circuit board assembly.

**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 212°F (100°C) at sea level.

**boolean algebra**

Algebraic method of manipulating logic equations.

**BPS**

Bits per second.

**break**

1) The point on a defective cable at which a signal stops, because of a damaged or severed circuit. 2) Any open-cable/circuit condition. 3) A space (or spacing) condition that exists longer than one character time (typical length is 110 milliseconds). Often used by a receiving terminal to interrupt (break) the sending device's transmission, to request disconnection, or to terminate computer output.

**breakout box (BOB)**

A testing device that permits the user to monitor the status of the various signals between two communicating devices, and to cross and tie interface leads, using jumper wires.

**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.

**bridging**

See *arching*.

**British thermal units. (BTU)**

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 BTUs.

**buffer**

1) In software terms, register or group of registers used for temporary storage of data, to compensate for transmission rate differences between transmitter and receiving device. 2) In hardware terms, isolating circuit used to avoid reaction of one circuit with another.

**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 converter.

**bug**

Error or malfunction in program or hardware.

**bulk density**

Weight-to-volume ratio used to determine dry material mass. Usually expressed in pounds per cubic foot, grams per liter, or grams per cubic centimeter.

**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.

**bus**

Single path or multiple parallel paths for power or data signals to which several devices may be connected at the same time. Bus may have several sources of supply and/or several sources of demand.

**bus structure**

Description of bus, including its size and function of each line. Some standardized bus structures: MULTIBUS I, MULTIBUS II, VAX, Q-bus, IBM PC, and STD BUS.

**byte**

Sequence of adjacent binary digits operated upon as unit and usually shorter than word.

**C****C**

A programming language developed in the late '70s. It became hugely popular due to the development of UNIX, which was written almost entirely in C. C was written by programmers for programmers and it lets you write code in sloppy ways that other, more structured languages do not. When you think of programming in C, think of driving a Delorean. It goes really fast, but it's a mess inside.

**C++**

This is an extension of the C programming language that adds object-oriented concepts.

**CAD**

Computer-Aided Design. Systems developed to facilitate design of mechanical parts using computer.

**CAE**

Computer Aided Engineering.

**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°C) and the freezing point of antimony (630.7°C) and the form  $RT = RO[1 + AT + BT^2 + C(T-100)T^2]$  between the oxygen point (-183.0°C) and the ice point (0°C).

**calibrate**

- 1) Determine, usually by comparison with standard locations at which scale/chart graduations should be placed to correspond to series of values of quantity which instrument is to measure, receive, or transmit.
- 2) Adjust device output to bring it to desired value, within specified tolerance, for particular input value.
- 3) Determine error in device output by checking it against standard.

**calibration**

1) Calibration refers to the units the scale of a sensor display or recorder is labeled in. 2) Process of presenting known quantity of material to be routinely measured to instrumentation system to determine functional relationship between device's input and output. Example: A type of sensor measuring the speed of a vehicle produces an electrical output. The size of this voltage is proportional to the speed of the vehicle. The speedometer pointer in the vehicle moves with respect to the voltage applied to it, but will be labeled in units of speed, not voltage. We therefore say the speedometer is calibrated in terms of speed.

Note: There are two steps to weight calibration: Zero Calibration (zero live load) and Scale Factor calibration (span).

**calibration curve**

A record (graph) of the comparison of load cell outputs against standard test loads.

**calorie**

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

**CAM**

Computer Aided Manufacturing.

**capacity**

Maximum attainable volumetric or gravimetric flow rate from given piece or type of material handling equipment.

**capacity, rated**

See *rated capacity*.

**card**

See *board*.

**carrier**

Continuous frequency capable of being modulated or impressed with signal.

**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.

**cascading**

Rate of slave feeder changes in direct proportion to change in master feeder.

**catch sampling**

Collecting and weighing material discharged from feeder over specified period of time to determine correction factors during calibration.

**cavitation**

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

**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.

**center rod**

Shaft that may be inserted in feed screw. Often used when feeding free-flowing materials or to add stability for heavy materials.

**central processing unit (CPU)**

1) Portion of computer or programmable controller that controls interpretation and execution of user program stored in memory. 2) KM's MVS, Weigh II, SVS 2000, Sonologic II, or other signal processor.

**CFM**

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

**channel**

1) Path along which signals can be sent; e.g., data channel, output channel. 2) Portion of storage medium that is accessible to given reading station. 3) In communication, means of one-way transmission.

**character**

One of set of elementary symbols which express information. Set usually includes decimal digits 0 through 9, letters A through Z, and special symbols used to denote functions.

**chart recorder**

Registering device used to graphically represent process variable's values through time.

**chassis**

Hardware assembly that houses devices such as I/O modules, adapter modules, processor modules, and power supplies.

**chatter**

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

**checksum**

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

**clean-out trough**

Part of automatic scavenging system used in weigh-belt equipment to convey and expel unwanted residual material for collection, disposal, or recycling.

**clear**

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

**clearance**

Shortest distance through air between conducting parts, or between conducting part and outer surface of insulating enclosure considered as though metal foil were in contact with accessible surfaces of enclosure (as defined in NEMA Standard Pub. No. ICS 2, 1988).

**clock**

1) Device that generates periodic signals used for synchronization. 2) Device that measures and indicates time.

**clock rate**

Rate at which bits or words are transferred from one internal element to another.

**coating**

Treatment applied to material contact surface of bins, conveying tubes, feed screws, etc. to eliminate sticking, avoid corrosion, etc.

**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.

**cohesive**

Material that exhibits characteristic of molecular attraction in which particles are united throughout mass.

**collecting conveyor**

Device used to gather and combine outputs of upstream equipment.

**color code**

The ANSI established color code for electronic components.

**combination feeder**

For weigh-belt equipment, any configuration involving mating of prefeeder to the weigh-belt to control flow of material to belt.

**combined error**

See *error, combined*.

**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.

**common mode interference**

Form of interference which appears between measuring circuit terminals and ground.

**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).

**communications port**

A connection on a terminal through which data is input and/or output.

**compatibility**

Ability of devices to be interconnected and used without modification.

**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.

**com port**

An abbreviation for communications port, this generally refers to a serial port.

**compensation**

The utilization of supplementary devices, materials, or processes to minimize known sources of error.

**compression**

Stress caused by forces pushing together.

**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.

**computer**

Device capable of accepting information, performing prescribed operations on information, and providing operation results. Its major elements usually include memory, control, arithmetic, logical, and input and output facilities.

**condensate**

Condensed material, e.g. liquid water or ice.

**conditioned signal**

A conditioned signal is the output from a sensor that has been modified so it can be understood by a display or recording device, a control device, or other system.

**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.

**configuration**

Arrangement and interconnection of hardware components within system, and hardware (switch and jumper) and software selections that determine system's operating characteristics.

**constant speed belt feeder**

Type of weigh-feeder that holds belt speed constant and makes flow corrections by varying inlet gate height or prefeeder.

**continuous**

Process or part of process characterized by uninterrupted flow of production materials through time.

**continuous mixer**

Device designed to combine materials as they are continuously conveyed from inlet to discharge.

**control**

1) Cause machine or process to function in predetermined manner. 2) Energize or de-energize output or set data table bit on or off, with user program.

**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.

**controller**

Unit, such as programmable controller or relay panel, that controls machine or process elements.

**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 panel**

Panel which may contain instruments, controllers, or operator interface devices that allow operator to access and control plant operations.

**control point**

The point at which a system is to be maintained.

**convertible feeder**

Volumetric feeder whose metering element can be changed to enable handling of materials of widely differing flow characteristics.

**conveyor assembly**

Part of weigh-belt equipment that transports material from inlet to discharge during which material is weighed and controlled as appropriate.

**coriolis force**

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

**correction**

Difference between true value and indication of measured quantity; Correction = True - Indication. See *Error*.

Note: Positive correction denotes that indication is less than true value.

**coulomb**

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

**counter weight**

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

**counts**

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

**cover**

Removable portion of process equipment which provides access and contains or guards material from escape, contamination, or change of condition.

**CPU**

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

**creep**

The change in load cell signal occurring with time while under load and with all environmental conditions and other variables remain constant

Note: Usually measured with rated load applied and expressed as a percent of rated output over a specific period of time.

**creep recovery**

The change in no-load signal occurring with time after removal of a load which had been applied for a specific period of time.

Note: Usually measured over a specific time period immediately following removal of rated load and expressed as a percent of rated output.

**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.

**cross-talk**

Signal on one circuit emerging on adjacent circuit as interference.

**CSA**

Canadian Standard Association.

**current**

The rate of flow of electricity. The unit of the ampere (A) defined as 1 ampere = 1 coulomb per second.

**current-to-frequency converter**

Usually used to interface two pieces of instrumentation or process equipment to transform current-based input signal to frequency-based output signal.

**cursor**

Intensified or blinking element in video display. Means for indicating where data entry or editing occurs.

**cycle**

- 1) Sequence of operations that is repeated regularly.
- 2) Time it takes for one sequence of operations to occur.

**cycle time**

- 1) Total elapsed time between identical points in two successive and identical batching operations.
- 2) In weight feeding, sum of times to empty and refill weighed hopper.

**D****D/A conversion**

See *digital-to-analog conversion*.

**D/A converter**

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**

- 1) Reduction in amplitude of oscillation.
- 2) Manner in which output settles to its steady-state value after change in measured signal value.

Note: When time response to abrupt stimulus is as fast as possible without overshoot, response is 'critically damped'; 'underdamped' when overshoot occurs; 'overdamped' when response is slower than critical.

**damping factor**

For free oscillation of second-order linear system, measure of *damping*, expressed (without sign) as quotient of greater divided by lesser of pair of consecutive swings of output (in opposite directions) about ultimate steady-state value.

**data**

Information which can be processed or produced by computer or control system.

**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 more information to be stored on a disk.

**data display module**

Device which stores computer output and translates this output into signals that are distributed to program-determined groups of lights, annunciators, and numerical indicators in operator consoles and remote stations.

**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 electrical current flowing in one direction only and substantially constant in value.

**dead band**

Range through which input can be varied without initiating response.

Note: Dead band is usually expressed in percent of span. Resolution sensitivity and ultimate sensitivity have been defined as one-half dead band. When output is at center of dead band, they denote minimum change in measured quantity required to initiate response.

**dead load**

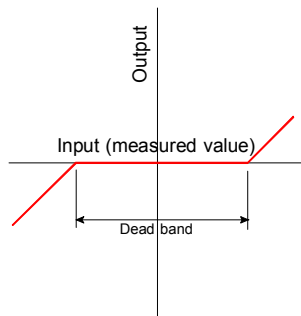
Empty weight of vessel or fixed force of platform and load-supporting structures on scale that must be cancelled out by weight measuring system.

**dead time**

Interval of time between initiation of input change or stimulus and start of resulting response.

**dead-zone or dead-band**

When a specification refers to a dead-zone or dead-band, it is referring to the largest change in the quantity to be measured to which the output does not change, or the range of input to which there is no output. Dead-zones arise as a result of static friction (stiction), or hysteresis.



The graph opposite shows dead-zone characteristics.

The dead-zone may not apply over the full operating range of the device, and sometimes, significant dead-zones only occur under certain conditions. A common example of a dead-zone is a dimmer switch on a domestic light or lamp. Often, when the dimmer switch is turned fully down, it can be turned up slowly and for a short while there will be no immediate response from the light. In this case the dead-zone of the dimmer switch is from its fully turned down position to the position it is in when the light first starts to glow.

**debug**

Detect, locate, and remove mistakes from program or malfunctions from computer. Synonymous with *troubleshoot*.

**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.

0 dB - The arbitrary value assigned the faintest audible sound that the human ear can hear.

1 dB - The smallest difference between sounds that is humanly detectable.

120 dB - The loudest sound that a human ear can tolerate.

**decimal**

Pertains to base-10 numbering system.

**default**

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

**deflection**

In weigh-equipment, total measured displacement at point of load sensing in going from zero or no-load condition to full scale or rated load condition.

**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 volume. Often approximated as weight per unit.

**density control**

Continuous proportioning of two grades of signal material, one high density and other low density grade, that results in mixture with constant and controllable density.

**deviation**

Difference between instantaneous value of controlled variable and desired value of controlled variable corresponding to set point. See *error*.

**device**

Apparatus for performing prescribed function.

**diagnostic routine**

Program designed to locate malfunctions in computer hardware or software.

**diagnostics**

Pertains to detection and isolation of error or malfunction.

**dielectric constant**

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

**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.

**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.

**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**

Pertaining to data in form of digits. Contrast with *analog*.

**digital circuit**

Switching circuit that has only two states: on and off. Contrast with *analog circuit*.

**digital control**

Type of process regulation based on calculation of numerical methods or by discrete units.

**digital filtering**

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

**digital gage**

Measuring device that indicates measurement result via digital signal. Contrast with *analog gage*.

**digital output**

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

**digital sensitivity**

1) If transducer is built with on-board analog-to-digital converter, its output is numerical value. This type of output is often described by 'count' value. Sensitivity of this type of transducer is expressed in counts per pound (counts per kilogram) rather than millivolts per pound (millivolts per kilogram). 2) Analog transducer (one that produces continuously variable signal, usually voltage or current) when connected to analog-to-digital converter may have its equivalent sensitivity expressed in terms of counts per pound. This value is found by multiplying transducer sensitivity in mV/lb by converter sensitivity in counts/mV. 3) Even though A/D converter is physically located inside signal processor enclosure, it is useful to think of combined sensitivity of transducer and A/D converter. Combined sensitivity is called digital sensitivity.

**digital-to-analog conversion (D/A conversion)**

Production of analog signal whose instantaneous magnitude is proportional to magnitude of digital value.

**dimensions**

The dimensions of a sensor or measuring system are a measurement of its physical size, and are shown on nearly every device specification.

**DIN**

Deutsche Industrie Normenausschuss. 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.

**diode**

Solid-state uni-directional conductor.

**disable**

To inhibit process or logic from being activated.

**discrete**

Having individually distinct identity. Contrast with *integrated*.

**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.

**display**

1) Image that appears on CRT screen or on other image projection systems. 2) Graphic representation of process variables or conditions.

**display menu**

List of displays from which you select specific information for viewing.

**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.

**distributed processing system**

System containing multiple hardware units located at different physical locations; individual hardware units do stand-alone processing, but can also be interconnected to share data with other locations or with central facility.

**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 converter application.

**download**

See *upload/download*.

**dribble**

In batching, reduction of rate of material flow near batch completion to avoid overshooting of desired batch weight or volume.

**drift**

1) In weighing systems a random change in *signal* under constant *load* conditions. 2) The natural tendency of a device, circuit, or system to alter its characteristics with time and environmental changes. There is a change in the output characteristics while the inputs to the device have not changed, which affects accuracy. Drift occurs over different time scales for different reasons. One of the most common and influential drift inducing effects is a change in ambient temperature. This is why the specifications of many sensors state the effect of temperature on various characteristics of the device. On an older device, drift may be caused by ageing affects on the materials it is made of, such as oxidation of metal elements. It can also be caused by the mechanical wear or self-heating of components in a system.

**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**

Pertaining to simultaneous two-way independent data communication transmission in both directions. Same as "full duplex".

**duplex wire**

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

**dust collection system**

Various equipment whose function, in aggregate, is to gather and store airborne particulate matter.

**dust-tight construction**

Classification of control and equipment construction which requires such devices be sealed sufficiently to prevent escape or intrusion of dust.

**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 gain**

Magnitude ratio of steady-state amplitude of output signal from element or system to amplitude of input signal to that element or system, for sinusoidal signal. May be expressed as ratio or in decibels as 20 time log of that ratio for specified frequency.

**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 ration, or other performance criteria.

**dynamic response**

Behavior of output of device as function of input, both with respect to time.

**E****eccentric load**

Any load applied parallel to but not concentric with the primary axis.

**echo**

To reflect received data to the sender.

**edit**

To deliberately modify program or file.

**EEPROM**

Electrically-erasable PROM. Type of PROM that can be erased and re-programmed by electrical signals. As with all PROMs, it is non-volatile random-access memory. See *PROM*.

**EIA**

Electronics Industries Association. American agency that sets electrical/electronic standards.

**electrical interference**

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

**electrical noise**

The presence of unwanted electrical signals. These can obscure or confuse the signal that carries useful information, such as the sensor output signal or the error signal.

**electromagnetic interference (emi)**

Any electromagnetic disturbance that interrupts, obstructs, or otherwise impairs performance of electronic equipment.

**electromotive force (e.m.f.)**

A source of energy in an electrical device or circuit, which can cause a current to flow. It is the rate at which this energy is drawn from the device when current flows. E.m.f. is measured in volts.

**element**

Component of device or system.

**enable**

Activate logic by removal of suppression signal.

**enclosure**

Housing in which equipment is mounted. They are available in designs for various environmental conditions. Refer to NEMA standard for specifications of different types of enclosures.

**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.

**engineering units**

Units of measure as applied to process variable. Example: PSI, Degrees F., feet, etc.

**entrain**

1) To pull or draw along after itself. 2) To carry (suspended particles, for example) along in a current.

**environment**

In systems context, environment is anything that is not part of system itself.

**environmental conditions**

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

**EPROM**

Erasable Programmable Read-only Memory. PROM that can be erased, usually with ultraviolet light, then re-programmed with electrical signals. As with all PROMs, it is non-volatile random-access memory. See *PROM*.

**error**

Error is the difference between a measured value and the actual value. For example, a ruler is used to measure the width of a page of a book, and it is found to be, say, 11 ½ inches. However, the actual size of the page measured was 11 ¼ inches, therefore there was an error in measuring the size of the book of 11 ½ inches – 11 ¼ inches = ¼ inch. Error may often be quoted as a percentage to represent the accuracy of a system.

**error, combined (non-linearity and hysteresis)**

The maximum deviation from the straight line drawn between the original no-load and rated load outputs expressed as a percentage of the rated output and measured on both increasing and decreasing loads.

**error band, static**

The band of maximum deviations of the calibration curve from a best fit line through zero including the effects of non-linearity, hysteresis, and non-repeatability, expressed as a ± percentage of rated output.

**error band, temperature**

The band of maximum deviations of the calibration curve from the static error band reference, including the effects of non-linearity, hysteresis, non-repeatability and temperature effect on output over the specified temperature range, express as a ± percentage of rated output.

**excitation**

1) The external application of electrical voltage current applied to a transducer for normal operation. 2) Voltage used to power load cells.

**explosion proof**

Term used to refer to equipment intended for use in dusty or explosive environments which is designed to contain and prevent escape of hot gases or flames.

**export**

Transfer information from one system or program to another.

## F

**factory wiring**

Wiring completed before product was shipped from factory in which it was built. Contrast with *field wiring*.

**Fahrenheit**

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

**fault**

Any malfunction that interferes with normal system operation.

**feeder**

Any of a class of process equipment whose purpose is to control flow rate of material either by weight, mass, volume, or specific gravity.

**feed rate**

In weigh or volumetric feeding, actual amount of material (expressed in appropriate engineering units) discharged per unit of time (e.g., ft<sup>3</sup>/hr, lbs/hr).

**field of view**

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

**field wiring**

Wiring connected by user after user receives product. Contrast with *factory wiring*.

**filter**

1) Device or substance that passes electric currents of certain frequencies or frequency ranges while preventing passage of others. 2) Move or pass slowly. 3) Eliminate undesirable information from data stream.

**firmware**

Logic stored in read-only memory.

**fixed point**

Pertaining to numeration system in which position of point is fixed with respect to one end of numerals according to some convention.

**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.

**flexible connection**

Pliable unions that join weigh-equipment to supply hoppers, discharge chutes, dust collection systems, etc. to contain material and prevent transmission of vibration and stress, and otherwise isolate equipment from external conditions.

**floating ground**

Electrical circuit common that is not at earth ground potential or same ground potential as circuitry with which it interfaces. Voltage difference can exist between floating ground and earth ground.

**floating point**

Pertaining to numeration system in which position of point does not remain fixed with respect to one end of numerals.

**floppy disk**

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

**flow**

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

**flow chart**

Graphical representation for definition, analysis, or solution of problem, in which symbols are used to represent operations, data, flow, and equipment.

**flowmeter**

Instrument that measures and indicates rate of flow of liquid, solid, or gas.

**flow rate**

Actual speed or velocity of fluid movement.

**fluid**

By definition a fluid is any substance, which flows. Fluids are usually gases or liquids, but sometimes a collection of solids such as powders or sand. They have no fixed shape and offer little resistance to stress.

**flush diaphragm**

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

**FM**

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

**FM approved**

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

**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.

**free flowing**

Material condition characterized by relatively uniform unaided flow without flooding, arching, ratholing, or need of external flow aid measures.

**freezing point**

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

**frequency**

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

**frequency, natural**

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

**frequency output**

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

**frequency response**

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

Note: Normally express as "within ....percent from ....to....Hertz."

**frequency-to-current converter**

Usually used to interface two pieces of instrumentation or process equipment, any class of electronic components, whose function is to transform frequency-based input signal to current-based output signal.

**friable**

Material that is easily crumbled or pulverized.

**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**

Maximum level that can be measured. For example, in analog input circuit maximum allowable voltage or current level is called full scale because any increase beyond that level cannot be measured.

**full-scale live load**

Maximum value of material that will be presented to array of weight sensor/transducers, such as contents of silo when it completely full. In most cases, rated load will exceed full-scale live load because transducers must have enough capacity to support not only full-scale live load but dead load as well. Because KM weight transducers can withstand substantial overloading without destruction, some weighing applications can have full-scale live load that is equal to or greater than rated load.

**full-scale output**

1)The algebraic difference between the minimum output (normally zero) and the rated capacity.

2)Response of instrument when it is presented with its full-scale input.

Example: When level indicator reads 100%, it is said to be at 'full scale.'

Note: 'Full scale' applies to user's maximum conditions and may differ from above 'rated' conditions.

**function keys**

Keys on keyboard labeled F1, F2, F3, etc. Function of each key is defined by software and key may have different function for each menu displayed.

**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**

Measuring device or measuring instrument.

**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.

**gaging**

The measurement between specified parallel surfaces of a hydraulic load cell which is used to determine the amount of fluid in the cell.

**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.

**gain-in-weight batching**

Device used to measure preset amount of material by discharging material into container, hopper, or vessel positioned on scale.

**galvanometer**

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

**GATT**

General Agreement on Tariffs and Trade.

**gas purging**

Slight pressurization of process equipment with inert gas to avoid explosion hazards due to concentration of airborne dust.

**glitch**

A spike caused by the skew of switches or logic. Glitches are a troublesome source of error in high-speed D/A converters and they are most prevalent at the middle scale switches.

**GPH**

Volumetric flow rate in gallons per hour.

**GPM**

Volumetric flow rate in gallons per minute.

**granular**

Materials having grainy texture.

**gravimetric**

Controlling, batching, or totalizing material flow on basis of weight or mass.

**gross weight**

Total weight of commodity, including weight of packaging or container.

**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.

**ground loop**

Errant galvanic path within system or instrument caused by unwanted circuit connections provided by earth or chassis ground.

**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**

In communications, pertaining to alternate, one way at time, independent transmission.

**handshake**

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

**hard-to-flow**

Material classification characterized by failure to achieve uniform flow unless aided by external agitation.

**hardware**

Physical equipment, e.g., mechanical, magnetic, electrical, or electronic devices. Contrast with *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 nonlinearities in the system.

**HART**

Highway Addressable Remote Transducer.

**headload**

Force or pressure exerted on process equipment by weight of material in supply hopper.

**head loss**

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

**head pressure**

Pressure in terms of the height of fluid,  $P = \gamma y$ , where  $r$  = fluid density,  $y$  = the fluid column height, and  $g$  = the acceleration of gravity.

**heat:**

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

**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.

**heel**

Portion of material which occupies inlet area of process equipment.

**helix**

Helical or closed flight screw-like device used to move or control materials.

**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.

**host**

1) Central controlling computer in network system. 2) Device on network system that provides controlling function to another device on network. 3) Intelligent device for which another device is providing communications interface to network.

**housekeeping**

Devices in weigh-equipment whose purpose is to prevent inaccuracies, damage, or premature wear due to accumulation of process material in equipment.

**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 humidity, other more specific terms tend to be used.

**hygrometer**

Any instrument for measuring humidity.

**hygrometry**

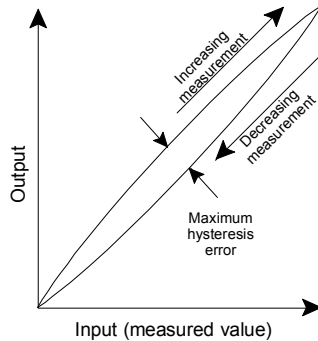
The subject of humidity measurement.

**hygroscopic**

Tending to absorb water vapor.

**hysteresis**

Hysteresis causes the difference in the output of a sensor when the direction of the input has been reversed. This produces error and so affects the accuracy of a device. This is shown here in graphical form. The input to the sensor, the measurand, is increased in set increments. Towards the end of its range, the measurand is decreased in similar sized decrements. The graph shows the difference in the output of the sensor when the measurand value is increasing to when it is decreasing. This is the hysteresis of the system.



Not all sensors or measurement systems suffer from hysteresis. It is caused by various factors, particularly mechanical strain and friction. Slack motion in gear systems and screw threads (often referred to as backlash) is also a common cause. Hence measurement systems likely to suffer significantly from hysteresis may incorporate mechanical gears or bearings, or other moving parts, and materials that tend to be elastic, such as rubber, plastics, and some metals.

Note: Measurements should be made in a manner which minimizes the effects of creep, typically done by conducting the test as rapidly as possible.

**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 other influences such as temperature, light, or polarization.

I

**icon**

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

**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.

**import**

Bring information from one system or program into another.

**indicating instrument**

Measuring instrument in which value of measured quantity is visually indicated.

**information**

Meaning assigned to data by known convention.

**initialize**

Set switches, addresses, and parameters to zero or other starting values at beginning or at prescribed points.

**inlet**

Point at which material enters process equipment.

**inlet gate**

Usually adjustable opening at inlet of weigh-belt equipment that acts to form roughly uniform material bed as conveyor belt shears material past gate.

**input**

1) Data to be processed. 2) State or sequence of states occurring on specified input channel. 3) Device or collective set of devices used for bringing data into another device. 4) Channel for impressing state on device or logic element. 5) Process of transferring data from external device to internal device.

**input-output characteristic**

Signal processor's relationship between sensor/transducer input signal and corresponding displayed value of measured variable. Signal processor stores this characteristic in the form of zero offset and slope (called scale factor). Transducer's relationship between applied loading and corresponding output voltage is another input-output characteristic. This slope is called sensitivity.

**input impedance**

1) The resistance measured across the excitation terminals of a transducer at room temperature, with no load applied, and with the output terminals open-circuited. 2) 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.

**input signal**

Signal applied to a device, element, or system.

**insulation (isolation) resistance**

1) 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.  
2) The DC resistance measured between the Load Cell circuit and the load cell structure.  
Note: Normally measured at fifty volts DC and under Standard text conditions.

**intensity of sound**

The difference in pressure between the minimum and maximum sound pressure (typically measured in decibels greater or less than some reference value).

**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**

1) The means by which two systems or devices are connected and interact with each other. 2) (verb) Logic necessary to provide electrical and communication compatibility between two devices. 3) (noun) Shared boundary. 4) A change in a transmission medium which affects the sound energy.  
*Examples:* 20 mA current loops, RS-232C, RS-422, RS-485, Allen-Bradley RIO, and Modbus RTU.

**interference (electrical)**

Spurious voltage or current arising from external sources and appearing in circuits of device. See *noise*.

**International Standards Organization (ISO)**

The standards organization that developed the Open Systems Interconnect Model and other international communications standards.

**interrupt**

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

**intrinsic safety**

Design technique applied to electrical equipment and wiring for hazardous locations. Based on limiting electrical and thermal energy to level below that required to ignite hazardous atmospheric mixtures.

**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.

**I/O**

Input(s) and/or output(s).

**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.

**J****joule**

The basic unit of thermal energy.

**jumper**

A jumper fits on two metal connectors. It provides an electrical connection between the two wires to enable a semi-permanent hardware configuration.

**junction box (J-Box)**

Box or enclosure used to join runs of cable or wiring. Contains space and terminals for connecting and branching enclosed conductors and a test point to provide strain gage troubleshooting.

**K****K**

1K =  $2^{10}$  = 1024. Prefix used as multiple for bits, bytes, or words in denoting size of block of data or memory.

**k**

Kilo. Prefix used with units of measurement to designate multiple of 1000.

**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.,  $1/2 rV^2$  where r is the density of the moving mass and V is its velocity.

**KVA**

Kilovolt amperes (1000-volt amps).

L

**lag**

Lag is the delay in the change of the output from a sensor with respect to a corresponding change in the input. It is measured in seconds (or more usually fractions of a second). In some applications, such as control, lag can seriously affect performance.

**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.

**language**

Set of symbols and rules used for representing and communicating information.

**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.

**LCD**

Liquid Crystal Display. Reflective visual readout device commonly used in digital watches and laptop computers.

**L-Cell**

KM's dual axis strain gage sensor.

**leakage rate**

The maximum rate at which a fluid is permitted or determined to leak through a seal.

**least-squares line**

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

**LED**

Light-Emitting Diode.

**level**

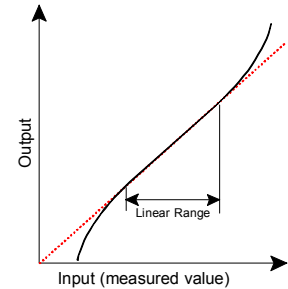
The amount of material in a vessel as measured by electrical or mechanical means.

**life cycle**

The minimum number of cycles a transducer can endure and still remain within a specified tolerance.

**linearity**

The linearity of a sensor is the amount by which the graph of its input against output is near to being a straight line. It may be quoted as being linear for a range of input values, as shown here. It may also refer to the maximum amount by which the graph deviates from being a straight line, quoted as a percentage of the operating range.



**linearity error**

For ideal A/D or D/A conversion, graph of digital values plotted against corresponding analog values form straight line. Linearity error is any deviation from straight line expressed in percentage of full scale.

**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.

**live load**

Design capacity of vessel or load applied to scale base, which is actually being measured by weighing system.

**load**

The weight or force applied to the load cell.

**load buttons**

The spherical like shape of the top surface of a load cell where the load is applied.

**load cell**

A device which produces an output signal proportional to the applied weight or force.

**Load Disc II**

KM's direct support weight transducer utilizing X-cell strain gage based technology. Designed to provide accurate weight measurement.

**load impedance**

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

**Load Link III**

KM's weight transducer utilizing foil gage technology for weighing suspended vessels.

**Load Stand II**

KM's direct support transducer utilizing Microcell strain gage technology. Designed to become part of support structure, and provides continuous weight monitoring. Field repairable.

**load voltage regulation**

Change in output voltage of power source for specified change in load.

Note: May be expressed as percentage ratio of voltage change from no load to rated load divided by no load voltage.

**local control**

In weight or volumetric feeding, where desired feed rate set point is that which is directly registered on controller. See *ratio control*.

**local display**

Electronic display located 'local to process' or 'local to signal processor/indicator.' Local display may refer to display on-board signal processor. Establish reference location when using this term.

**local reading**

A sensor, which is read locally, displays its measured values at, or very close to, the point of measurement.

**log**

Periodic hard copy summary of process operation data.

**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.

**longitudinal**

1) Of or pertaining to length. 2) Extending in direction of length; running lengthwise.

**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.

**loss-in-weight feeding**

Method of solid or liquid flow control in which desired feed rate is achieved by sensing and maintaining constant per unit time reduction in weight of entire feeding system.

**loss-of-weight batching**

Method used to measure out preset amount of material by discharging material from weighed container, hopper, or vessel.

**lvdt**

Linear variable differential transformer. Analog weight transducer that relies upon measurement of position of movable core inside induction coil to convert applied load to output voltage.

**M****1M=2<sup>20</sup>=1,048,576**

Prefix used as multiple for bits, bytes, or words in denoting size of block of data or memory.

**M**

Mega. Prefix used with units of measurement to designate multiple of 1,000,000.

**malfunction**

Incorrect function within electronic, electrical, or mechanical hardware.

**manual backup**

Alternate method of process control by manual adjustment of final control elements in event of failure in control system.

**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**

Property of material that is measure of its inertia and that causes it to have weight in gravitational field.

**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.

**master**

Device that controls secondary devices. On communication link, station that initiates communication.

**material containment**

Condition required in some processes where materials must not contaminate or be contaminated by plant environment.

**mathematical model**

Mathematical representation of process, device, or concept.

**matrix**

1) In mathematics, two-dimensional rectangular array of quantities. Matrices are manipulated in accordance with rules of matrix algebra. 2) In computers, logic network in form of array of input leads and output leads with logic elements connected at some of their intersections. 3) By extension, array of any number of dimensions.

**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 hysteresis**

Maximum difference for same input between upscale and downscale indications of measured signal during full range traverses.

Note: Difference is expressed as percent of span. Statement used in definition is common usage definition and includes hysteretic error and dead band.

**maximum load, safe**

The maximum load in percent of rated capacity which can be applied without producing a permanent shift in performance characteristics beyond those specified.

**maximum load, ultimate**

The maximum load in percent of rated capacity which can be applied without producing a structural failure.

**maximum operating temperature**

The maximum temperature at which an instrument or sensor can be safely operated.

**mean**

Average of all data values.

**mean temperature**

The average of the maximum and minimum temperature of a process equilibrium.

**measurand**

The measurand is the input to the measurement system, the quantity or parameter that is to be measured. For example, a thermometer measures temperature; therefore the measurand of a thermometer is temperature.

**measured media**

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

**measured signal**

Electrical, mechanical, pneumatic, or other variable applied to input of device. It is analog of measured variable produced by transducer (when used).

**measured variable**

Physical quantity, property, or condition which is to be measured.

**measuring instrument**

Device for ascertaining magnitude of physical quantity or condition presented to it.

**mechanical hysteresis**

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

**mechanical shock**

Momentary application of acceleration force to device. Usually expressed in units of gravity (g).

**medium**

Material through which data is transmitted or on which data is stored.

**melting point**

The temperature at which a substance transforms from a solid phase to a liquid phase.

**memory**

Group of circuit elements that can store data.

**menu**

List of options, on screen, from which user can select.

**message**

Meaningful combination of alphanumeric characters that establishes content and format of report.

**meter**

1) Basic unit of length in metric system, equal to 39.37 inches. 2) Instrument or apparatus for measuring; e.g., apparatus for measuring and recording quantity or rate of flow of gas, electricity, or water passing through it. 3) Provide in measured quantities. 4) Instrument display.

**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.

**microamp**

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

**Microcell**

KM's half bridge strain gage device used to transform mechanical deflection into electrical signal.

**microcomputer**

Small, single chip computer element comprised of microprocessor, memory, clocks, etc.

**micron**

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

**microprocessor**

Small section of electronic computer or control device implanted with relatively few large scale integrated circuits.

**microsecond**

One millionth of a second ( $10^{-6}$ ).

**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.

**millisecond**

One thousandth of a second ( $10^{-3}$ ).

**millivolt**

1) Unit of electromotive force. It is the difference in potential required to make a current of 1 milliamp flow through a resistance of 1 ohm; one thousandth of a volt, symbol mV. 2) 0.0001 volts: the unit of measure of output from strain gage sensors.

**MMI**

Man Machine Interface

**mnemonic**

Alphanumeric designation, easy to remember and commonly used, to designate location or operation.

**mode**

Selected method of operation.  
*Example:* run, test, or program.

**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.

**module**

Interchangeable plug-in item within larger (modular) assembly.

**module slot**

Location for installing module. In typical modular construction, modules plug into backplane; each module slides into slot that lines it up with its backplane connector.

**modulus**

Positive number or quantity expressing measure of function, force, or effect, as of elasticity, resistance, etc.; especially in relation to basic unit or to some other factor or factors.

**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.

**mounting position**

Position of device relative to physical surroundings.

**MR**

Magneto Resistive or Magneto-Resistance.

**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.

**multiplexing**

Time-shared scanning of number of input channels into single channel. Only one input channel is enabled at a time.

## N

**nanosecond**

One billionth of a second ( $10^{-9}$ ).

**Natural Frequency**

The frequency of free oscillations under no-load conditions.

**NEC**

National Electric Codes.

**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.

**NEMA standards**

Consensus standards in U.S. for electrical equipment approved by members of National Electrical Manufacturers Association (NEMA).

**net weight**

Weight remaining after deductions or allowances have been made for weight of container or waste materials, nonessential considerations, etc.

**network**

Series of stations (nodes) connected by some type of communications medium.

**nibble**

One half of a byte.

**NIST**

National Institute of Standards & Technology.

**node**

A terminal on a data communications network.

**noise**

Unwanted component of signal or variable that obscures its information content. See *interference*.

Note: May be expressed in units of output or in percent of output span.

**noise immunity**

Measure of product's ability to function in presence of noise.

**non-linearity**

The maximum deviation of the calibration curve from a straight line drawn between the no-load and rated output and measured on increasing load only.

**non-linear system**

System whose operation cannot be represented by a straight line.

**non-repeatability**

The maximum difference between load cell output readings for repeated loadings under identical loading and environmental conditions, expressed as a percentage of the rated output.

**normalize**

Shift representation of quantity so that representation lies in prescribed range.

**normally closed contacts**

Set of contacts on relay that are closed when relay is de-energized; they are open when relay is energized.

**normally open contacts**

Set of contacts on relay that are open when relay is de-energized; they are closed when relay is energized.

**normal mode interference (NMI)**

Form of interference which appears between measuring circuit terminals.

**normal mode rejection (NMR)**

Ability of circuit to discriminate against normal mode voltage; usually expressed as ratio or in decibels.

**normal-mode rejection ratio**

The ability of an instrument to reject interference usually of line frequency (50-60 Hz) across its input terminals.

**normal mode voltage**

Extraneous voltage induced across circuit path (transverse mode voltage).

**normal operating condition**

Range of operating conditions within which device is designed to operate and under which operating influences are usually stated.

**normal (axial) stress**

The force per unit area on a given plane within a body  $a = F/A$ .

**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****octal**

1) Pertaining to characteristic or property involving selection, choice, or condition in which there are eight possibilities. 2) Pertaining to numeration system with radix of eight.

**off line**

1) Pertaining to equipment or programs not under direct control of central processor. 2) Pertaining to computer that is not actively monitoring or controlling process or operation, or pertaining to computer operation performed with computer not monitoring or controlling process or operation.

**offset**

Steady-state deviation of controlled variable when set point is fixed. See *steady-state deviation*.  
Note: Offset resulting from no-load to full-load change (or other specified limits) is often called 'droop' or 'load regulation.'

**offset voltage**

Output of load cells when vessel is empty or at some fill level at which display is to read zero. This term is used during calibration. Offset voltage may be due to tare weight (i.e., weight on load cells when vessel is empty), relaxed transducer output voltage, and installed output voltage (Microcell sensors). It is zero point on readout scale.

Note: In most usages, 'tare' means dead load or weight of vessel. KM signal processors have Tare feature which temporarily zeros out live load of vessel.

**ohmmeter**

An instrument used to measure electrical resistance.

**on line**

1) Pertaining to equipment or programs under direct control of central processor. 2) Pertaining to computer that is actively monitoring or controlling process or operation, or pertaining to computer operation performed while computer is monitoring or controlling process or operation.

**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 conditions**

Conditions (such as ambient temperature, ambient pressure, vibration, etc.) to which device is subjected, but not including variable measured by device.

**operating influence**

Change in designated performance characteristic caused solely by prescribed change in specified operating variable from reference operating condition to another specified operating condition, all other operating variables being held within limits of reference operating conditions.

Note: Specified operating conditions are usually limits of normal operating conditions.

**operating life**

The useful operating life of a sensor is an indication of how long it can be expected to function within its specification. It is expressed in terms of time, or in the number of operations or cycles it should successfully endure.

**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.

**operator**

Person who initiates and monitors operation of computer or process.

**operator console**

Device which enables operator to communicate with computer. It can be used to enter information, request and display stored data, actuate various pre-programmed command routines, etc.

**optical isolation**

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

**optimize**

Establish control parameters to make control as effective as possible.

**optimizing control action**

Control action that automatically seeks and maintains most advantageous value of specified variable, rather than maintaining it at one set value.

**OSHA**

Occupational and Safety Hazard Organization.

**output**

1) The electrical signal measured at the output terminals which is produced by an applied input to a transducer. 2) The algebraic difference between the signal at no-load and the signal at applied load.

Note: Where output is directly proportional to excitation, it must be expressed in terms of excitation such as volts per volts, volts per ampere, etc.

**output, full scale**

See output, rated.

**output impedance**

Impedance presented by device to load.

**output noise**

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

**output, rated**

The algebraic difference between the signal at no-load and the signal at rated load.

**output signal**

Signal delivered by device, element, or system.

**overload**

To put too great a load in or on.

**overrange**

In weighing systems, exceed capacity of equipment or calibration.

**overshoot**

Amount that process output (controlled variable) exceeds its desired value after change of input.

**P****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**

Pertaining to simultaneous transfer and processing of all bits in word or other unit of information. Contrast with *serial*.

**parallel transmission**

Sending all data bits simultaneously. Commonly used for communications between computers and printer devices.

**parameter**

Controllable or variable characteristic of system or device, temporarily regarded as constant, respective values of which serve to distinguish various specific states of system or device.

**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 check**

Check that tests whether number of ones (or zeros) in array of binary digits is odd or even.

**parity error**

The effort that occurs in a DTE when the received data has the wrong parity.

**PCMCIA:**

Personal Computer Memory Card, International Association Standard.

**pellet**

Usually small and somewhat rounded form of material.

**peripheral**

Equipment used for entering data into or receiving data from computer.

**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.

**phaselocked 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 shift**

The phase angle between the output signal and the applied acceleration.

**picosecond**

One trillionth of second ( $10^{-12}$ ).

**PID**

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

**pitch**

Distance from any point on right of auger or metering screw to corresponding point on adjacent flight, measured parallel to axis.

**PLC**

Programmable Logic Controller.

**polarity**

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

**pneumatic conveying system**

Sealed solids conveying system utilizing air pressure as motive element.

**Poisson's ratio**

Ratio, in elastic body under longitudinal stress, of transverse strain to longitudinal strain. Poisson's ratio for carbon steel is 0.3.

**polling**

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

**port**

On communication link, logic circuitry or software at station that determines its communication parameters for particular communication channel.

**positive displacement**

Class of liquid or solids pumps characterized by continuous or cyclic filling and voiding of sealed space to control flow of material.

**positive temperature coefficient**

An increase in resistance due to an increase in temperature.

**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 consumption**

Maximum wattage used by device within its operating range during steady-state signal condition.

Note: For power factor other than one, power consumption is stated as maximum volt-amperes used under above stated conditions.

**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%.

**precision**

The precision of a device is the degree to which it produces similar results for the same input on a number of occasions. Precision is often used in everyday language to mean accuracy, and hence the two are sometimes confused. However, in measurement terminology a sensor can be precise, giving a very similar output a number of times when measuring a fixed quantity, but, if there is a large error in the output it is not accurate. On a specification, precision is usually quoted in general terms (such as a high precision instrument). Repeatability (reproducibility) is a quantified measure of precision, and more likely to be quoted on a specification.

It is important to note there are varying definitions of precision. We use its meaning as defined above. However, in some specifications or other texts it may be referred to as resolution.

**prefeeder**

Device used to aid in supply of material to weigh equipment.

**pressure, initial (Hydraulic or Pneumatic)**

The output pressure of the cell at zero applied load, caused by the weight of cell parts and/or the force exerted by integrally mounted preload springs.

**primary axis**

- 1) The axis along which the transducer is designed to be loaded; normally its geometric centerline.
- 2) The axis along which the load cell is designed to be loaded.

**primary element (detector)**

First system element that responds quantitatively to measured variable and performs initial measurement operation.

Note: Primary element performs initial conversion of measurement energy. For transmitters not used with external primary elements, sensing portion is primary element.

**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.

**principal axes**

The axes of maximum and minimum normal stress.

**printer**

Alphanumeric logging device to provide record of process variables or conditions.

**priority**

Level of importance of program or device.

**process**

Collective functions performed in and by equipment in which variable(s) is to be controlled.

Note: This equipment does not include any automatic control equipment. Process may also be referred to as controlled system.

**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.

**process pressure**

Pressure of process medium at sensing element.

**process temperature**

Temperature of process medium at sensing element.

**PROFIBUS**

German Token Ring Bus Standard developed by Siemens.

**program**

Series of routines which logically solve given problem.

**programmable controller**

Solid state control system that has user-programmable memory for storage of instructions to implement specific function such as I/O control, logic, timing, counting, report generation, communication, arithmetic, and data file manipulation. Controller consists of central processor, input/output interface, and memory. Controller is designed as industrial control system.

**PROM**

Programmable Read-only Memory. Type of ROM that requires electrical operation to store data. In use, bits or words are read on demand, but not changed. As with all ROMs, it is non-volatile random-access memory.

**proportioning**

In continuous feeding, term used to describe control of flow of one material in relation to another or to whole.

**protocol**

Set of conventions governing format and timing of data between communication devices.

**psi**

Pounds per square inch: unit of measurement of stress used in application of strain gage sensors.

**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**

Significant and sudden change of short duration in level of electrical variable, usually voltage.

**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****quantize**

1) To limit the possible values of (a magnitude or quantity) to a discrete set of values by quantum mechanical rules. 2) To apply quantum mechanics or the quantum theory to.

**quaternary**

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

**queue**

Logic structure that keeps track of items waiting for processing when system is unable to process each item immediately. Controls order in which items are ultimately processed.

**quiescent**

At rest; specifically, condition of circuit when no input signal is applied to it.

**R****RAM**

Random Access Memory. Type of memory in which each storage location is by X/Y coordinates, as in core or semiconductor memory.

Note: Unless stated otherwise, RAM usually implies read/write and volatile.

**range**

The operating range of a device is a statement of the limits in which it can function effectively. The operating range of a sensor is usually specified as the lowest and highest input values which it is capable of measuring. Other ranges are frequently quoted on device specifications, for example temperature range refers to the maximum and minimum temperatures in which the device will work. Humidity and pressure ranges are also commonly quoted. It is important not to exceed these ranges because not only may the device fail to operate effectively, it could also damage other components of the system or even be a risk to health and safety.

**rangeability**

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

**ranging**

Measurement of the time from the transmission of a sound pulse to the reception of its echo.

**rankine (°R)**

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

**rate action**

The derivative function of a controller.

**rated capacity (rated load)**

1) The maximum measurand that a transducer is designed to measure within its specification. 2) The maximum axial load the load cell is designed to measure within its specifications.

**rated load**

Value of load that is considered to be '100%' loading on transducer by manufacturer of measuring equipment, not user.

Note: Rated load can be made up of any combination of live and dead loads, and sum of live and dead loads can exceed rated load.

**rated output**

Output of sensor or transducer when input is at rated load specified by the manufacturer.

Note: Rated applies to manufacturer's stated capacity and may differ from *full-scale*.

**rate time**

The time interval over which the system is sampled for the derivative function.

**rating**

The rating of a device relates to the recommended conditions, electrical or mechanical, under which it will successfully or safely operate. A description of the type of rating is usually given, for example maximum temperature rating, or average load rating.

**ratio control**

Process control configuration where set point of one or more units is directly proportional to that of master unit.

**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**

Acquire data from source.

**real time**

The time interval over which the system is sampled for the derivative function.

**record**

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

**recording instrument**

Measuring instrument in which values of measured quantity are recorded.

**recovery time**

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

**reference junction**

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

**reference mark**

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

**reference operating conditions**

Range of operating conditions of device within which operating influences are negligible.

Note: Range is usually narrow. They are conditions under which reference performance is stated and base from which values or operating influences are determined.

**reference plane**

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

**reference standard**

A force measuring device whose characteristics are precisely known in relation to a primary standard.

**reflected**

Energy is reflected or returned into the medium through which it has traveled when a sound wave encounters an interface between media of differing properties.

**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.

**reliability**

The reliability of a device is similar to its operating life, and may often be quoted instead, depending on its nature. Reliability is the ability of a device to perform its function under specified conditions for a stated period of time, or a stated number of operations, whilst remaining within its specification.

**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.

**remote display**

Electronic display located elsewhere. It may be located 'remote to process' or 'remote to signal processor/indicator.' Both usages are common. Establish reference location before using this term.

**remote I/O**

I/O connected to processor across serial link. With serial link, remote I/O can be located long distance from processor.

**remote reading**

A sensor, which can be read remotely, can display its measured values away from the point of measurement.

**repeatability**

Repeatability is a numerical measurement of precision under fixed conditions. It is a measurement of the ability of a device to produce identical indications or responses, for repeated applications of the same value of the physical quantity to be measured. It may be given as  $\pm$  a maximum percentage of the reading, or within stated limits of each reading.

Note: Expressed as maximum non-repeatability in percent of span. Does not include hysteresis.

Reproducibility is another term for repeatability.

**reproducibility**

Closeness of agreement among repeated measurements of output for same value of input made under same operating conditions over period of time, approaching from either direction.

Note: 1) Expressed as maximum non-reproducibility in percent of span for specified time. Normally, this implies long period of time, but under certain conditions, may be short time during which drift may not be included. 2) Includes hysteresis, drift, repeatability, and dead band. 3) Operating conditions and input may vary between normal operating limits between measurements.

**resistance**

Property of conductor by which it opposes flow of electric current. Unit of measure is called ohm and abbreviated as W.

**resolution**

The resolution with which a device senses or displays a value relates to the smallest input or change in input it is able to detect. It is usually expressed in terms of the smallest increment, which can be measured or sensed. The higher the resolution of a display, the smaller the increment it is able to measure. For example, a five-digit display, which can measure a quantity to 0.0001 units, has a higher resolution than a four-digit display measuring to 0.001 units. It is usually expressed as a percentage.

Note: Resolution is termed fine or coarse as interval is small or large.

**resonance**

Of system or element, condition evidenced by large oscillatory amplitude, which results when small amplitude of periodic input has frequency approaching one of natural frequencies of driven system.

**resonant frequency**

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

**response**

The response of a device is the time it takes to reach its final output value for a given input. It may be quoted in terms of seconds or fractions of a second, or sometimes as a percentage of its full value. For example, if a specification states that 95% response time is 3 seconds, it means that the device takes 3 seconds to reach 95% of its final output value.

**response time**

Time required for system to readjust from one set of defined conditions to another set of defined conditions.

**restore**

1) Return a variable to its initial value. 2) Download copy of memory file to programmable device to overwrite one that had been altered.

**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. Radio-frequency energy of sufficient magnitude to have possible influence on operation of other electronic equipment. Often caused by improper grounding, plasma, and unsuppressed inductive loads switched by hard contacts.

**rheostat**

A variable resistor.

**rise time**

Time required for output of system (other than first order) to make change from small specified percentage (often 5 or 10) of steady-state increment to large specified percentage (often 90 or 95), either before over-shoot or in absence of over-shoot.

Note: If term is unqualified, response to unit step stimulus is understood; otherwise, pattern and magnitude of stimulus should be specified.

**ROM**

Read Only Memory. Type of memory with data content that cannot be changed in normal mode of operation. In use, bits and words are read on demand, but not changed.

**root mean square (RMS)**

Square root of the mean of the square of the signal taken during one full cycle.

**rotary valve**

Device used to control flowable powders and/or transfer material between areas of differing pressure.

**routine**

Series of computer instructions which performs specific task.

**RS-232-C**

EIA standard that specifies electrical, mechanical, and functional characteristics for serial binary communication circuits in point-to-point link. Limited range of few feet.

**RS-422**

EIA standard that specifies electrical characteristics of balanced-voltage digital interface circuits in point-to-point link. Range of several thousand feet.

**RS-485**

EIA standard that specifies electrical characteristics of balanced-voltage digital interface circuits in multi-point link. Range of several thousand feet.

**RTD**

Resistance Temperature Detector.

**rxid**

Received data; serialized data input to module.

**S****safe load limit**

see maximum load, safe

**sampling period**

Time interval between observations in periodic sampling control system.

**scale**

1) Change quantity by factor to bring its range within prescribed limits. 2) Device for weighing, comparing, and determining weight or mass.

**scale averaging**

Number of weight readings taken over period of time and averaged by dividing total accumulated weight by number of readings.

Note: Used when weigh vessel has mixer, blender, or some other device creating agitation during weighing process. Because center of gravity in weigh vessel is changing, displayed weight value tends to move up and down from actual weight in vessel. To dampen this effect, only average reading is displayed. This does not affect actual processing of weight signal.

**scale capacity**

Capacity of load cells only.

Example: If four 1000 lb capacity load cells are placed under vessel, scale capacity would be 4,000 lbs. This does not mean you can move 4,000 lbs of material into vessel. You must also consider weight of vessel itself and supports that rest on load cells. This tare (or dead) weight must be included when determining required scale capacity. If vessel and supports weigh 1,500 lbs, then only 2,500 lbs of material can be moved into vessel before scale capacity is reached.

**scale factor**

1) Number used as multiplier, chosen so that set of quantities will fall within given range of values. Example: To scale 856, 432, -95, and -182 between -1 and +1, scale factor of 1/1000 is suitable. 2) Adjustable parameter in signal processor that creates match between actual input and indicated output. Scale factor (also called 'span') calibration results in determination of scale factor. 3) Slope of signal processor output (indicated weight) versus signal processor input (mV or counts). Transducer output, measured in mV or counts, is signal processor input.

**scale factor counts**

Scale factor denominator, expressed in counts. Actually, change in counts that occurs because of change in load during calibration procedure. If scale factor is calculated, scale factor counts is calculated response of sensor/transducer array if given weight of material were placed in weigh vessel.

**scale factor weight**

Scale factor numerator. Typical value for scale factor weight is full-scale live load of vessel, but because scale factor is ratio of weight per counts, smaller value of weight may be used.

Example: If only 30% of full-scale live load is used for calibration, scale factor weight is 0.3 x full-scale live load. Scale factor counts is also reduced to 0.3 of change in counts expected if full-scale live load had been used.

**scan**

1) Collection of data from process sensors by computer for use in calculations, usually obtained through multiplexer. 2) Sequential interrogation of devices or lists of information under program control.

**screw**

Helical or auger type device used to control or transport material.

**screw conveyor**

Screw auger in trough or tube used to transport and partially mix materials.

**sense**

Detect presence of condition.

**sense lines**

In full bridge systems, these lines sense the excitation voltage at the load cell and return it to the power supply. The power supply then attempts to regulate the voltage to maintain a stable and accurate excitation voltage level at the load cell.

**sensing element**

Portion of device directly responsive to value of measured quantity.

Note: It may include case protecting sensitive portion.

**sensitivity**

Sensitivity is the relationship under fixed conditions between a change in the output of a device to the change in input. The sensitivity of a sensor is the difference in its output values over a given range divided by the change in the value of the measurand. That is,

$$\text{sensitivity} = \frac{\text{maximum output} - \text{minimum output}}{\text{maximum input} - \text{minimum input}}$$

The units in which sensitivity is expressed are defined by the above equation and consequently vary depending on the nature of the device and measurand. For example, there are sensors that measure the stress level in terms of psi. In this case the units of sensitivity would be millivolts per psi.

If the relationship between the measurand and the output is linear, then the sensitivity will usually be expressed over this whole range. If it is non-linear, the sensitivity characteristics of the device will vary for different values, and so the sensitivity will usually be quoted for several ranges.

Note: Expressed as numerical ratio, with units of measurement of two quantities stated.

Example: If load cell produces 360 mV when 2,000 lb load is applied, sensitivity is  $360\text{mV}/2,000\text{ lb} = 0.18\text{ mV/lb}$ .

**sensor**

Device that detects or measures something and generates corresponding electrical signal to input circuit or controller.

**sequencing**

Incorporation of time delays in starting and stopping process equipment to coordinate production operations such as material transport or resident time requirements.

**serial**

Pertaining to serial (one-at-a-time) transfer and processing of each bit in word or other unit of information. Contrast with *parallel*.

**service routine**

Routine in general support of operation of computer, e.g., input-output, diagnostic, tracing, or monitoring routine. Synonymous with *utility routine*.

**set point**

Actual or desired process-related control value.

**set point (command)**

Input variable which sets desired value of controlled variable.

Note: Input variable may be manually set, automatically set, or programmed. It is expressed in same units as controlled variable.

**settling time**

Time required, following initiation of specified stimulus to linear system, for output to enter and remain within specified narrow band centered on its steady-state value.

**shear**

Strain or distortion in shape resulting from action of shearing stress. Component of stress on horizontal beam that is measured.

**shearing strain**

1) The angular distortion of an object under stress. 2) A measure of angular distortion also directly measurable, but not as easily as axial strain.

**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.

**shield**

Conductive barrier that reduces effect of external electrostatic and electromagnetic fields.

**shielded pair**

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

**shock load**

Load seen by clutch, brake, or motor in system that transmits high peak loads. This type of load is present in crushers, separators, grinders, conveyors, winches, and cranes.

**shock mounts**

Mounting device used to aid in isolation of equipment from shock stresses or vibration.

**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.

**Shunt-to-load correlation**

The difference in output readings obtained through electrically simulated and actual applied loads.

**side load**

Load acting 90° to primary axis at point of axial load applications.

**I sigma**

Range in which 65% of all samples values will fall.

**II sigma**

Range in which 95% of all samples values will fall. This is industry standard.

**III sigma**

Range in which 99% of all samples values will fall.

**signal**

1) Event or electrical quantity that conveys information from one point to another. 2) The absolute level of measurable quantity produced at the output terminals of the load cell.

**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 lines**

The lines that return the signal from the load cell to the signal conditioner. In half bridge systems, there is only one signal line.

**signal processor**

Electronic 'box' connected to sensor/transducer array. It may be augmented with software. If so, first stage of signal processor is A/D converter. Signal processor generally has provisions for most, if not all, of following: 1) Excitation voltage applied to each of transducers in network. 2) Adjustable zero calibration. 3) Adjustable scale factor (span) calibration. 4) Interface option such as 20mA, serial communications, etc. 5) Two or three discrete thresholds used to signal alarm. 6) Local indication or display.

**signal-to-noise ratio**

Ratio of signal amplitude to noise amplitude, usually expressed in decibels.

Note: For sinusoidal signals, amplitude may be peak or rms. For non-sinusoidal signals, peak values should be used.

**signal transducer (signal converter)**

Transducer which converts one standardized transmission signal to another.

**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.

**simplex**

One-way only communications.

**simulator**

Device or computer program that performs simulation.

**SI units**

SI units are fundamental units of measurement used by international agreement, to ensure scientific and technical consistency. The 'Système International d'Unités' (international system of units, or SI) uses whole, multiples, or divisions of these units.

**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 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.

**slave**

In communication link, station that cannot initiate communication. Only master can initiate communication.

**software**

Collection of programs and routines associated with computer; all documents associated with computer. Contrast with *hardware*.

**sound**

The propagation of pressure waves through air or other media.

**source impedance**

Impedance presented to input of device by source.

**span**

Algebraic difference between upper and lower range values.

Example: range 0° to 150°F, span 150°F; range 0' to 95', span 95'; range 5' to 95', span 90'.

Note: For multi-range devices, this definition applies to particular range that device is set to measure.

**span adjustment**

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

**span stability**

The degree to which the load cell maintains its specified span, over a given time period with all environmental conditions and other variable remaining constant.

**span voltage**

Voltage change that occurs when transducer cycles from zero input (zero live load) to full-scale live load.

**specification**

The specification of a device is a technical description of its characteristics, construction, performance and any other information relevant to its use.

**specific gravity**

Ratio of density of substance to density of another substance (usually water).

**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°.

**stability**

A measurement of how much the output from a device or system varies if, under fixed conditions, a constant input is applied over a long time. For weighing equipment it is the measure of ability to operate within tolerance over time.

**stabilization period**

The time required to insure that any further change in the parameter being measured is tolerable.

**standard deviation**

Indication of how much individual sample values vary from mean (average). When standard deviation is small, most data values are near mean.

**standardized load**

Specified load rating of KM Load Disk II transducer. Standard test conditions  
The environmental conditions under which measurements should be made when measurements under any other conditions may result in disagreement between various observers at different times and places.

These conditions are as follows:

Temperature:  $23^{\circ} \pm 2^{\circ}\text{C}$ . ( $73.4^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$ )  
Relative humidity 90% or less  
Barometric pressure:  $98 \pm 10\text{kPa}$  ( $29 \pm 3$  inches Hg.)

**static error**

A constant error that occurs throughout the input range of the device. If static error is known, it can be compensated for and not significantly affect accuracy.

**steady-state deviation**

System deviation after transients have expired. See *offset*.

**stop bit**

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

**storage**

1) Device into which data can be entered, in which it can be held, and from which it can be retrieved at a later time. 2) Loosely, any device that can store data. Synonymous with *memory*.

**strain**

Deformation of body or structure as result of applied force.

**strain gage**

1) Instrumental device used to measure dimensional change within or on surface of specimen. 2) A device that converts mechanical deflection to an electrical signal.

**stress**

1) Action on body of any system of balanced forces whereby deformation results. 2) Amount of stress, usually measured in pounds per square inch or Pascal's. 3) Load, force, or system of forces producing strain. 4) Internal resistance or reaction of elastic body to external forces applied to it. 5) Ratio of force to area.

**Supply pressure (hydraulic or pneumatic)**

The pressure applied to the input port of the load cell.

**surge hopper**

Storage device designed to accommodate intermittent process flows greater than capacity of transport system.

**syntax**

1) Structure of expressions in language. 2) Rules governing structure of language.

**system**

Collection of hardware and software organized to achieve operational objective.

## T

**table**

Block of information in memory which is used as data by program.

**tag**

Information used as identifier or label for other information.

**tare**

1) Weight of empty container or vehicle. 2) Allowance or deduction from gross weight made to account for weight of empty container or vehicle.

**target**

The surface (interface) we wish to measure.

**temperature**

How hot or cold object is.

**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 effect on output**

The change in output due to a change in ambient temperature.

Note: usually expressed as the percentage change in output per °F change in ambient temperature as calculated from the change over a test interval.

**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.

**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, 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 range**

Range of temperatures over which transducer is compensated to maintain rated output and zero balance within specified limits.

**Temperature range, safe**

The extremes of temperature within which the load cell will operate without permanent adverse change to any of its performance characteristics.

**temperature scale**

Numerical scale used to quantitatively measure temperature. Most common scale is Celsius, sometimes called centigrade. In U.S., Fahrenheit scale is also common.

**temperature sensitivity shift**

Measurable effect on transducer's sensitivity caused by temperature of environment. Usually expressed as percent per degree.

Note: Since indicated value of measurement is directly proportional to transducer's sensitivity, this specification also expresses relationship between reading and changes in temperature.

**temperature zero shift**

Measurable effect on output of transducer caused by temperature of environment. Usually expressed in mV per degree. It could also be expressed in percent of rated output per degree.

**tension**

Stress on material produced by pull of forces tending to cause extension.

**terminal**

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

**terminal resistance, corner to corner**

The resistance of the load cell circuit measured at specific adjacent bridge terminals at standard temperature, with no-load applied, and with the excitation and output terminals open-circuited.

**terminal resistance, input**

The resistance of the load cell circuit measured at the excitation terminals at standard temperature, with no-load applied and with the output terminals open-circuited.

**terminal resistance symmetry**

The resistance uniformity of the load cell circuit measured from each excitation terminal to the output signal terminals connected together, at standard temperature with no-load applied and with the excitation terminals open-circuited.

**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 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 shock**

Abrupt temperature change applied to device.

**thermal stress**

Two dimensional strain caused by thermal heating (expansion) or cooling (contraction).

**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).

**time sharing**

Interleaved use of time of device.

**tolerance**

The tolerance of a device is the largest amount of error that can occur during its operation. Depending on the nature of the device, tolerance may sometimes be quoted instead of accuracy.

**torsional strain**

Strain produced by twisting.

**totalization**

In weigh-equipment, calculation and display of material throughput.

**traceability**

The step-by-step transfer process by which the load cell calibration can be related to primary standards.

**track**

Follow sequence or course of events.

**transducer**

Element or device which receives information in form of one physical quantity and converts it to information in form of same or other physical quantity.  
Note: This general definition applies to specific classes of devices such as primary element, signal transducer, and transmitter. See *primary element*, *signal transducer*, and *transmitter*.

**transmitter**

Transducer which responds to measured variable by means of sensing element and converts it to standardized transmission signal.

**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.

**troubleshoot**

See *debug*.

**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**

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

**tuning**

Adjustment of control constants in algorithms or analog controllers to produce desired control effect.

**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.

**turndown**

Measurement of range over which process or equipment control systems are capable of operating within specified performance limits. Expressed in relation to full scale or set point values.

**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.

**txd**

Transmitted data. Output that carries serialized data.

**U****UART**

Universal Asynchronous Receiver Transmitter.

**UL**

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

**ultrasonic**

Concerned with 'sound' having a frequency  $>20,000$  Hz.

**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.

**underrange**

In weigh-equipment, condition where requested or desired feed rate falls below range of operation of equipment.

**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 temperature set point is reached.

**update**

Modify program according to current information.

**utility routine**

See *service routine*.

**V****vacuum**

1) The absence of molecules in an area. 2) Any pressure less than atmospheric pressure.

**variable**

In the context of sensors and measurement systems, a variable can be considered as anything, usually a quantity or measurand that can change in value.

**variable data**

Numerical information that can be changed during application operation.

**velocity**

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

**velocity of sound**

The speed at which sound travels through a particular medium (feet/min, MPH, etc.). The speed of sound in air is 1125 ft./sec., @ 20°C, @ 50% humidity, @ 1 atmosphere.

**VHF**

Very High Frequency

**vibration**

Periodic motion of particles, elastic body, or medium in alternately opposite directions from equilibrium position when equilibrium has been disturbed.

**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.

**vibration error band**

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

**vibratory feeder**

Vibrating open receptacle with flat bottom and low rim used to convey or control flow of fibrous materials.

**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.

**volumetric**

Measurement and control on basis of volume as opposed to weight or number.

**VSWR**

Voltage Standing Wave Ratio.

**W****weight**

Force or amount of gravitational pull by which object or body is attracted toward center of earth.

**weigh transducer**

Device whose function is to convert applied force into another form for measurement purposes.

**Wheatstone bridge**

1) 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. 2) An electrical circuit used to detect small resistance changes in strain gages.

**wild flow**

Uncontrollable flow of solid or liquid material.

**word**

Sequence of bits or characters treated as unit and capable of being stored in one memory location.

**working load**

Normal operating capacity of a vessel.

**X****X-band**

A frequency band used in radar extending approximately from 5.2 to 10.9 kilomegacycles per second.

**X-ray**

Non-nuclear electromagnetic radiation of very short wavelength, lying within the interval of 0.1 to 100 angstroms (between gamma rays and ultraviolet radiation). Also called *X-radiation*, *Roentgen ray*. X-rays penetrate various thickness of all solids and they act upon photographic plates in the same manner as light. Secondary X-rays are produced whenever X-rays are absorbed by a substance; in the case of absorption by a gas, this results in ionization.

**X-radiation**

= X-ray

**Y****yard (International)**

Exactly 0.9144 meter. The U.S. yard before 1 July 1959 was 0.91440183 meter.

**year**

A period of one revolution of the earth around the sun. The period of one revolution with respect to the vernal equinox, averaging 365 days 5 hours 48 minutes 45.68 seconds in 1955, is called a tropical, astronomical, equinoctial, natural, or solar year. The period with respect to the stars, averaging 365 days 6 hours 9 minutes 9.55 seconds in 1955, is called a sidereal year. The period of revolution from perihelion to perihelion, averaging 365 days 6 hours 13 minutes 53.16 seconds in 1955, is an anomalistic year. The period between successive returns of the sun to a sidereal hour angle of 80 degrees is called a fictitious or Besselian year. A civil year is the calendar year of 365 days in common years, or 366 days in leap years. A light year is a unit of length equal to the distance light travels in one year,  $9.460 \times 10^{12}$  kilometers. The term year is occasionally applied to other intervals such as an eclipse year, the interval between two successive conjunctions of the sun with the same node of the moon's orbit, a period averaging 346 days 14 hours 52 minutes 52.23 seconds in 1955, or a great or Platonic year, the period of one complete cycle of the equinoxes around the ecliptic, about 25,800 years.

**Young modulus (symbol *E*)**

The ratio of normal stress within the proportional limit to the corresponding normal strain.

**Z****zero**

Set to zero value of word or other unit of memory.

**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 error**

Error of device operating under specified conditions of use when input is at lower range value.

**zero float**

The zero shift caused by one complete cycle of rated tensile and compressive rated loads.

**zero offset**

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

**zeroing**

Process or method to adjust output of weigh-equipment to zero when no load is applied.

**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 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 shift**

1) Any parallel shift of input-output curve. Zero Adjustments: Used when 'setting up' a transducer to adjust the output signal to zero when zero load/pressure is applied. 2) A change in zero balance.

**zero shift, permanent**

A permanent change in zero balance.

**zero stability**

The degree to which the load cell maintains its zero balance over a specified period of time with all environmental conditions and other variables remaining constant.



**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.