
The Automation, Systems, and Instrumentation

DICTIONARY

4th EDITION



Setting the Standard for Automation™

The Automation, Systems, and Instrumentation Dictionary

Fourth Edition

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ISA—The Instrumentation, Systems, and Automation Society



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Printed in the United States of America.

ISBN 155617-778-X

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ISA
67 Alexander Drive
P.O. Box 12277
Research Triangle Park, NC 27709

Library of Congress Cataloging-in-Publication Data

The automation, systems, and instrumentation dictionary.-- 4th ed.

p. cm.

ISBN 1-55617-778-X

1. Engineering instruments--Dictionaries. 2. Automatic control--Dictionaries. I. ISA--The Instrumentation, Systems, and Automation Society.

TA165 .I5973 2002

670.42--dc21

2002013092

Preface to the Fourth Edition

This edition of *The Automation, Systems, and Instrumentation Dictionary*, formerly entitled *Comprehensive Dictionary of Measurement and Control*, is intended as an essential reference tool for all instrumentation and control professionals. To this end, several features have been added.

Coverage of digital topics has been expanded significantly. Of the over 1000 new definitions that have been added, most are in the areas of software and digital communication. These fields make heavy use of acronyms and abbreviations, so many of these have also been added.

Almost 200 illustrations are included, all new to the dictionary. At the standard exchange rate (1 picture = 1000 words) this is a 40% increase in the information provided.

Some definitions have been classified to increase clarity. A particular term may have one meaning in the context of manufacturing, another in that of control, and yet another in that of computation. Where provided, a classification is shown in brackets (e.g., [Comp]) preceding definition(s). The following classifications are used:

- [Comm] - Communications
- [Comp] - Computers and Computation
- [Cont] - Control
- [Eng] - Engineering
- [Meas] - Measurement
- [Mfg] - Manufacturing
- [Proc] - Process
- [Safe] - Safety
- [Sci] - Science and Mathematics

Each entry consists of the defined term in **boldface**, followed by the definition(s) in regular typeface. If a term has more than one definition, each definition is preceded by a number. Terms are listed in alphabetical sequence, on a letter-by-letter basis. Hyphens, commas, word spacing, etc., within a term are ignored in constructing the sequence. The first and last term on each page are shown in large type at the top of that page.

Definitions are limited to those used in the fields of measurement and control; everyday common usages are omitted. Thus, **worm** is defined as "A shaft having at least one com-

plete spiral tooth...”, but not as a relatively small elongated soft-bodied animal.

All definitions from ISA Standards are included. Each definition from a standard is followed by the designation of that standard (e.g., [ISA-12.01.01-1999]) in brackets. A separate section contains a full numerical list of ISA Standards. ISA Standards definition may have been changed slightly for readability. Please reference the standard for full information.

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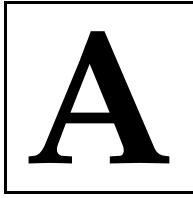
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Acknowledgements

This edition of *The Automation, Systems, and Instrumentation Dictionary* would not have been possible without the assistance of a great many people. Among those who deserve special thanks are Joice Blackson, Shandra Botts, Ann Thompson and Linda Wolffe at ISA Headquarters. Terry Blevins of Fisher-Rosemont and Kurt Zech of the Fieldbus Foundation helped with Fieldbus issues. The extensive glossary that Sam Herb compiled for his *Understanding Distributed Control Systems* was a great help, especially after the jokes were removed.

Paul G. Friedmann

Definitions



α (alpha) Average percentage change in resistance per degree of pure metal resistance of device between 0°C and 100°C. Usually designated by the Greek letter alpha, with units of W/W/°C.

aberration Deviation from ideal behavior by a lens, optical system, or optical component. Aberration exists in all optical systems, and designers must make trade-offs among the different types depending on how much aberration they will tolerate.

ABI Application Binary Interface; to run without porting.

abnormally distributed uncertainty In the ISA recommended practice ISA-RP67.04.02-2000 this term denotes uncertainties that do not have a normal distribution.

abort In data processing, to terminate a computer operation before its normal conclusion.

abrasion 1. The act of removing surface material from a substance through sliding or rolling contact with the hard particles made of the same or another substance. The particles themselves may be loose or part of another surface brought into contact with the first. 2. A surface blemish caused by roughening or scratching.

abrasive 1. Particulate matter, usually having sharp edges or points, that can be used to shape and finish workpieces in grinding, honing, lapping, polishing, blasting, or tumbling processes. Depending on the process, abrasives may be loose, formed into solid shapes, glued to paper or cloth, or suspended in a paste, slurry, or air stream. 2. Any substance capable of removing material from a surface through the act of abrasion. 3. A material formed into a solid mass, usually fired or sintered, and used to grind or polish workpieces; common forms are grinding wheels, abrasive disks, honing sticks, cones, and burrs.

ABS Acrylonitrile butadiene styrene; frequently used for enclosures; good high-temperature resistance with high impact strength and cold-temperature impact, good overall chemical resistance; can be adversely affected by ultraviolet.

absolute accuracy error The deviation of the analog value at any code from its theoretical value after the full-scale range has been calibrated. Expressed in percent, ppm, or fractions of 1 LSB.

absolute address An address that indicates the exact storage location at which the refer-

enced operand is to be found or stored in the actual machine code address numbering system. It is synonymous with *specific address* and *actual address* and related to *absolute code*.

absolute alarm An alarm caused when a system has detected a variable that has exceeded a set of prescribed high- or low-limit conditions.

absolute altimeter See *terrain clearance indicator*.

absolute altitude Distance between an aircraft or spacecraft and the actual surface of a planet or natural satellite.

absolute code Coding that uses machine instructions with absolute addresses. Synonymous with *specific code*.

absolute encoder An electronic or electromechanical device that produces a unique digital output (in coded form) for each value of an analog or digital input. In an absolute rotary encoder, for instance, you can determine directly the position following any incremental movement, without having to refer to the starting position.

absolute feedback In numerical control, the action of assigning a unique value to each possible position of a machine slide or actuating member.

absolute humidity The weight of water vapor in a gas-water vapor mixture per unit volume of space occupied, as, for example, grains or pounds per cubic foot.

absolute instrument An instrument that determines the value of a measured quantity in absolute units by making a simple physical measurement.

absolute measurement A measured value that is expressed in terms of fundamental standards of distance, mass, and time.

absolute pressure 1. The pressure measured relative to zero pressure (vacuum). 2. The combined local pressure that is induced by some source and the atmospheric pressure at the location of the measurement. 3. Gauge pressure plus barometric pressure expressed in the same units of measurement.

absolute programming In numerical control, the process of using a single point of reference to determine all positions and dimensions.

absolute stability A linear system is absolutely stable if there exists a limiting value of the open-loop gain such that the system is stable for all lower values of that gain and unstable for all higher values.

absolute value error The magnitude of the error disregarding the algebraic sign or, if a vectorial error, disregarding its direction.

absolute viscosity A measure of the internal shear properties of fluids. It is expressed as the tangential force per unit area at either of two horizontal planes separated by one unit thickness of a given fluid, with one of the planes fixed and the other moving with unit velocity.

absorbance An optical property expressed as $\log (1/T)$, where T is the transmittance.

absorptance The fraction of the incident light absorbed by something.

absorption [Sci] 1. The reduction in intensity of a beam of electromagnetic or particulate radiation as it passes through matter. This reduction is chiefly due to interactions with atoms or electrons or with their electric and magnetic fields. [Comm] 2. In fiber-optic cable, the loss of power resulting from the conversion of optical energy into heat. This loss is usually caused by impurities such as transition metals and hydroxyl ions.

absorption band A region of the electromagnetic spectrum in which a given substance exhibits a high absorption coefficient compared to adjacent regions of the spectrum.

absorption coefficient An inherent material property that is expressed as the fractional loss in radiation intensity per unit mass or per unit thickness. It is determined over an infinitesimal thickness of the given material at a fixed wavelength and bandwidth.

absorption curve A graph showing the variation of transmitted radiation through a fixed sample while the wavelength material of a given thickness is changed at a uniform rate.

absorption dynamometer A device for measuring mechanical force or power by converting the mechanical energy into heat in a friction mechanism or bank of electrical resistors.

absorption-emission pyrometer An instrument for determining gas temperature by measuring the radiation emitted by a calibrated reference source both before and after the radiation passes through the gas, where it is partly absorbed.

absorption hygrometer An instrument for determining the water vapor content of the atmosphere by measuring the amount of water absorbed by a hygroscopic chemical.

absorption meter An instrument for measuring the quantity of light transmitted through a transparent medium by means of a photocell or other light-detecting device.

absorption spectroscopy The study of the wavelengths of light that are absorbed by materials and the relative intensities at which different wavelengths are absorbed. This

technique can be used to identify materials and measure their optical densities.

AC Alternating current; electric current that reverses its direction at regularly recurring intervals, such as 60 times/second (60 Hz).

accelerated life test A method for estimating the reliability or durability of a product by subjecting it to operating conditions above its maximum ratings.

accelerating agent 1. A substance that increases a chemical reaction rate. 2. A chemical that hastens the curing of rubber, plastic, cement or adhesives, and may also improve their properties. Also known as *accelerator*.

accelerating electrode An auxiliary electrode in an electron tube that is maintained at an applied potential so as to accelerate electrons in a beam.

acceleration The time rate of change of velocity; the second derivative of a distance function with respect to time.

acceleration error The maximum difference, at any measured value within the specified range, between output readings taken with and without the application of specified constant acceleration along specified axes. Note: See *transverse sensitivity* when applied in the context of acceleration transducer.

acceleration limit The maximum vibration and shock acceleration that the transducer can accept in either direction along its sensitive axis without permanent damage. This limit is usually stated as $\pm$ ____g's. The acceleration limits are usually much wider than the acceleration range and thereby represent a measure of the overload capability of the transducer. [ISA/RP-37.2 (R1995)]

acceleration range The range of accelerations over which the transducer has the specified linearity. [ISA/RP-37.2 (R1995)]

acceleration time [Comp] 1. The amount of time it takes a mechanical component of a computer to go from rest to running speed. [Sci] 2. The measurement of the time required for any object to reach a predetermined speed.

accelerators A feature of some computer applications to create keyboard commands that provide alternatives to screen menus for selecting choices. The keystroke has special meaning within that particular application, which means more involved, but usually more "user-friendly," procedures can be saved for making requests or entries.

accelerometer 1. An instrument for measuring acceleration or an accelerating force such as gravity. If the instrument includes provisions for making a recorded output, it is

called an "accelerograph." 2. A transducer used to measure linear or angular acceleration.

acceptance angle In fiber-optic cable, the half angle of cone within which incident light is totally reflected internally by the fiber core.

acceptance test A series of tests used to demonstrate the capabilities and workability of a new system and usually conducted by the manufacturer to show the customer that the system is in working order.

access The state in which it is permissible to place information into, or retrieve information, from a storage device.

access, direct storage (DSA) The procedure whereby data are transferred to or from storage that is essentially coincident with the normal operation of a computer, without disturbing the central processing unit registers. [ISA/RP-55.1-1975 (R1983)]

access, random 1. The process of obtaining data from, or placing data into, storage such that the time required for such access is independent of the location of the data most recently obtained or stored. 2. A type of storage device in which the access time is effectively independent of the location of the data. [ISA/RP-55.1-1975 (R1983)]

access, serial The process of obtaining data from, or placing data into, storage when there is a sequential relation governing the time it takes to access successive storage locations. [ISA/RP-55.1-1975 (R1983)]

access code A group of alphanumeric characters that identifies the user to the system so information can be placed or retrieved by other devices in the system.

access line The portion of a leased communication line, such as in a telephone system, that permanently connects the user with the serving central office or wire center.

access method Any of the data-management techniques available to the user for transferring data between main storage and an input/output device.

access privilege The right or permission to access (read or write) a file that is granted by the processor after such permission has been requested.

access procedures The procedure by which the devices attached to the network gain access to the medium. The access procedure typically includes provisions for guaranteeing fairness in the sharing of the network bandwidth between attached devices. The most common access procedures for LANs are CSMA/CD, token bus, token ring, and slotted ring. See *MAC*.

access time 1. The interval between a request for stored information and the delivery of that information; often used to refer to the speed of memory. 2. The time interval that is characteristic of a storage unit. A measure of the time required to locate information in a storage position and make it available for processing or to return information from the processing unit to a storage location.

access unit interface (AUI) The optional interface between a data station that uses an IEEE 802.3 LAN and a transceiver or modem. The AUI makes it possible to transparently connect a data station to either baseband or broadband media.

accessible 1. A system feature that is viewable by and interactive with the operator, and allows the operator to perform user-permitted control actions, for example, make set point changes and auto-manual transfers or perform on-off action. 2. The capacity to be touched with a standard test finger or test pin, when used as specified in Section 6.2 of ANSI/ISA-82.02.01-1999 (IEC 1010-1 Mod). [ANSI/ISA-82.02.01-1999 (IEC 1010-1 Mod)]

accessible area An area that is routinely or periodically entered by plant personnel in their performance of routine functions during normal plant operation and in accordance with applicable health physics procedures. [ISA-67.03-1982]

accessible isolation valve The isolation valve that is nearest the measured process on an instrument-sensing line, which is available to personnel during normal plant operation. The root valve may or may not perform the function of the accessible isolation valve, depending on where it is located. [ANSI/ISA-67.02.01-1999]

accessible part A part that can be touched during normal use or operator servicing. [ANS/ISA-82.01.01-1999 (IEC 1010-1 Mod)]

accessible surface A surface to which a flammable or combustible mixture has access. [ANSI/ISA-12.01.01-1999]

accessible terminal A node in an electronic network that is configured to allow it to be connected to an external circuit.

accessory A peripheral device that supports a main system function, such as a floppy disk drive or printer.

Accredited Standard Committee A standard committee accredited to ANSI.

accumulator 1. The register and associated equipment in the arithmetic unit of the computer in which arithmetical and logical operations are performed. 2. A unit in the digital computer where numbers are totaled, that is,

accumulated. Often the accumulator stores one operand and when it receives any second operand it performs the indicated operations on them and then forms and stores the result. It is related to an *adder*. [Proc] 3. A pressure vessel containing water and steam that is used to store the heat of the steam for use at a later time and at some lower pressure. 4. A relatively large-volume chamber or other hydraulic device that receives fluid under low hydraulic power, stores it, and then discharges it at high hydraulic power, after which it is ready to repeat the cycle. 5. A chamber or vessel for storing low-side liquid refrigerant in a refrigeration system. 6. An accumulator is also referred to as a *receiver*, a "reflux receiver", or a "reflux drum."

accuracy 1. The ratio of the error to the full-scale output or the ratio of the error to the output, as specified, expressed as a percentage. Note 1: Accuracy may be expressed in terms of units of measurand or as being within $\pm$ [number] percent of full-scale output. Note 2: The term *accuracy* should be used only for generalized descriptions of characteristics. It should not be used in specifications. The term *error* is preferred in specifications and other specific descriptions of transducer performance. [ISA-37.1-1975 (R1982)] 2. In process instrumentation, the degree of conformity of an indicated value to a recognized, accepted standard value or ideal value. [ANSI/ISA-51.1-1979 (R1983); ANSI/ISA-75.05.01-2000] 3. The degree to which an indicated value matches the actual value of a measured variable. 4. Quantitatively, the difference between the measured value and the most probable value for the same quantity, when the latter is determined from all available data and critically adjusted for sources of error. 5. The deviation or error by which an actual output varies from an expected ideal or absolute output. Each element in a measurement system contributes to errors, which should be separately specified if they contribute significantly to the degradation of total system accuracy. 6. In an analog-to-digital converter, accuracy is tied to resolution. A 13-bit A/D, as used in the controller, for example, can resolve to one part in 2^{13} or 8,192, so the best accuracy as a percentage of full-scale range is theoretically $1/8192$, or about 0.0125 percent.

accuracy (data processing) The degree of freedom from error, that is, the degree of conformity to truth or to a rule. Accuracy is contrasted with precision. For example, four-place numerals are less precise than

six-place numerals; nevertheless, a properly computed four-place numeral might be more accurate than an improperly computed six-place numeral. [ANSI/ISA-51.1-1979 (R1993)]

accuracy, mean (data processing) Mean accuracy is precisely defined as $(100 - E) \% \text{ F.R.}$, where the mean error E is expressed as a percentage of full range (F.R.). It is common practice, however, to equate mean accuracy with the value of the mean error. That is, mean accuracy is commonly stated as 0.1% F.R. whereas a more precise and acceptable statement is that mean accuracy is 99.9% F.R. [ANSI/ISA-51.1-1979 (R1993)]

accuracy, measured The maximum positive and negative deviation observed when testing a device under specified conditions and by a specified procedure. Note 1: Measured accuracy is usually measured as an inaccuracy and expressed as accuracy. Note 2: Measured accuracy is typically expressed in terms of the measured variable, percentage of span, percentage of upper-range value, percentage of scale length, or percentage of actual output reading. [ANSI/ISA-51.1-1979 (R1993)]

accuracy, reference See *accuracy, rating*.

accuracy, total (data processing) Total accuracy is precisely defined as $(100 - E_{\text{max}}) \% \text{ F.S.}$ where the maximum error E_{max} is expressed as a percentage of full-scale value. Total accuracy is a measurement of the worst-case effect of all the errors present in the analog subsystem. [ISA/RP-55.1-1975 (R1983)]

accuracy measured test The procedure for this test is described in ISA Standard ANSI/ISA-51.1-1979 (R1993).

accuracy rating In process instrumentation, a number or quantity that defines a limit that errors will not exceed when a device is used under specified operating conditions. Note 1: When operating conditions are not specified, reference operating conditions shall be assumed. Note 2: As a performance specification, accuracy (or reference accuracy) shall be assumed to mean the accuracy rating of the device when used at reference operating conditions. Note 3: Accuracy rating includes the combined effects of conformity, hysteresis, dead band, and repeatability errors. The units being used should be stated explicitly. It is preferable to use a $\pm$ sign before the number or quantity. Accuracy rating can be expressed in a number of forms. The following five examples are typical: (a) Accuracy rating can be expressed in terms of the measured variable. Typical expression: The accu-

racy rating is $\pm 1^\circ\text{C}$, or $\pm 2^\circ\text{F}$. (b) Accuracy rating can be expressed in percentage of span. Typical expression: The accuracy rating is $\pm 0.5\%$ of span. (This percentage is calculated using scale units such as degrees F, psig, etc.). (c) Accuracy rating can be expressed in percentage of the upper-range value. Typical expression: The accuracy rating is $\pm 0.5\%$ of upper-range value. (This percentage is calculated using scale units such as kPa, degrees F, etc.). (d) Accuracy rating is expressed in percentage of scale length. Typical expression: The accuracy rating is $\pm 0.5\%$ of scale length. (e) Accuracy rating is expressed in percentage of actual output reading. Typical expression: The accuracy rating is $\pm 1\%$ of actual output reading. [ANSI/ISA-51.1-1979 (R1993)]

AC/DC coupling A selection on the front panel of some readout instruments. The AC-coupling position switches a capacitor into the input conductor. This is used for piezoelectric accelerometers to remove the power supply bias voltage. The DC-coupling position removes this capacitor from the input line. This is used for transducers that have an output at zero frequency (such as piezoresistive accelerometers and proximity probes), and it is desired to make measurements below 1 Hz.

ACE Advanced Computing Environment initiative; alliance of more than twenty firms who support software standards for MIP architecture based on common ABI and API. Also known as asynchronous communications elements.

achromatic Optical elements that are designed to refract light of different wavelengths at the same angle. Typically, achromatic lenses are made of two or more components of different refractive index and are designed to be used at visible wavelengths only.

acid cleaning The process of cleaning the interior surfaces of steam-generating units by using an inhibitor so as to prevent corrosion and then subsequently draining, washing, and neutralizing the acid with a further wash of alkaline water.

acid wash A chemical solution that contains phosphoric acid, which is used to neutralize residues from alkaline cleaners and to simultaneously produce a phosphate coating that protects a surface of metal from rusting and prepares it for painting.

acidity Represents the amount of free carbon-dioxide mineral acids and salts (especially sulphates of iron and aluminum) that

hydrolyze to yield hydrogen ions in water. Acidity is reported as milliequivalents per liter of acid, ppm acidity is reported as calcium carbonate, and pH is reported as the measure of hydrogen ion concentration.

acid-resistant Able to withstand chemical attack by strongly acidic solutions.

AC input module An I/O module that converts process-switched AC into logic levels for use in the PC.

ACK A transmission control character that is transmitted by a receiving device as an affirmative response to a sending device. Also see *acknowledge*.

acknowledge 1. The sequence action that indicates that a new alarm has been recognized. [ANSI/ISA-18.1-1079 (R1992)] 2. A message sent between peer entities to indicate that data was properly received.

Acme screw thread A type of power-transmission thread that is made in four series— 29° general purpose, 29° stub, 60° stub, and 10° modified square. The number of threads per inch is not standardized according to shank diameter.

acoustic Related to sound.

acoustic compliance The reciprocal of *acoustic stiffness*.

acoustic coupler A type of communications device that converts digital signals into audio tones that can be transmitted over the public telephone network through a conventional handset.

acoustic dispersion The separation of a complex sound wave into its various frequency components. Acoustic dispersion is usually caused by variation of the wave velocity in the medium that has the sound frequency. It is usually expressed in terms of the rate of change of velocity with frequency.

acoustic generator A transducer for converting electrical, mechanical, or some other form of energy into sound waves.

acoustic holography A technique for detecting flaws or regions of inhomogeneity in a part by subjecting it to ultrasonic energy. This produces an interference pattern on the free surface of water in an immersion tank. Laser holography can then read the interference pattern to produce an image of the test object.

acoustic impedance The complex quotient that is obtained by dividing the sound pressure on a surface by the flux through the surface.

acoustic inertance A property that is related to the kinetic energy of a sound medium, which equals $Z_a/2\delta f$, where Z_a is the acoustic

acoustic interferometer / activation analysis

A
B

reactance and f is sound frequency. The usual units of measure are g/cm^4 . Also known as *acoustic mass*.

acoustic interferometer An instrument for measuring either the velocity or frequency of sound pressure in a standing wave that has been established in a liquid or gas medium between a sound source and a reflector as the reflector is moved or the frequency is varied.

acoustic radiometer An instrument that measures sound intensity by determining unidirectional steady-state pressure when the sound wave is reflected or absorbed at a boundary.

acoustic reactance The imaginary component of *acoustic impedance*.

acoustic resistance The real component of *acoustic impedance*.

acoustic sensitivity The output of a transducer (not caused by rigid body motion) in response to a specified acoustical environment. This sensitivity is sometimes expressed as the acceleration in g rms that is sufficient to produce the same output that is induced by a specified sound pressure-level spectrum with an overall value of 140 dB referred to as 0.0002 dyne per sq cm rms. [ISA-RP37.2-1982 (R1995)]

acoustic signature In sonar applications, the profile that is characteristic of a particular undersea object (or class of objects), for example, the profile of a school of fish or a sea-bottom formation.

acoustic spectrometer An instrument for analyzing a complex sound wave by determining the volume (intensity) of sound-wave components that have different frequencies.

acoustic stiffness A property related to the potential energy of a medium or its boundaries that equals $2 \delta f Z_a$, where Z_a is the acoustic reactance and f is sound frequency. The usual units of measure for acoustic stiffness are dyne/cm^5 .

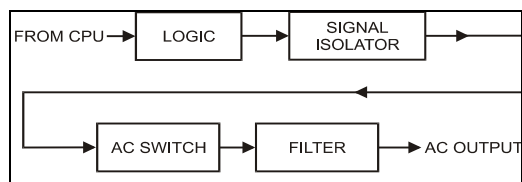
acoustical ohm The unit of measure for acoustic resistance, reactance, or impedance. It equals unity when a sound pressure of one microbar produces a volume velocity of one cubic centimeter per second.

acoustics 1. The technology associated with the production, transmission, and utilization of sound, and the science associated with sound and its effects. 2. The architectural quality of a room—especially a concert hall, theater, or auditorium—that influences the ability of a listener to hear sound clearly at any location.

acousto-optic An interaction between an acoustic wave and a lightwave passing through the same material. Acousto-optic devices can be used for the deflection or modulation of beams, for signal processing, and for Q switching.

acousto-optic glass Glass whose composition is designed to maximize the acousto-optic effect.

AC output module An I/O module that converts PC logic levels into output switch action for AC load control.



acquisition time The interval in which a sample-and-hold circuit acquires an input signal to within specification.

acronym A word formed from the initial letters of a long or complex technical term. For example, *RAM* is the acronym for "random access memory."

acrylonitrile butadiene styrene (ABS) A plastic frequently used for enclosures because it provides good high-temperature resistance with high-impact strength and cold-temperature impact as well as good overall chemical resistance. ABS can be adversely affected by ultraviolet. See *ABS*.

ACSE Association control service element; for ISO layer 7, for MAP 3.0.

ACT Acoustic charge transport; technology that processes signals in their natural analog domain, taking advantage of the 10,000-to-1 simplification that results when using analog rather than digital circuits. Converts analog input signal into discrete-time signal, sampled in time, not quantized in amplitude.

actinic The ability of radiation to induce chemical change.

actinometer 1. An instrument for measuring the actinic quality of radiation—that is, its relative ability to induce chemical change. 2. An instrument for measuring the flux density of solar radiation.

action, air-to-close See *fail-open*.

action, air-to-open See *fail-close*.

action object An object that supports the instantiation and deletion of blocks and objects within a resource. [ISA-TR50.02, Part 9-2000]

activation analysis A method for determining composition, especially the concentration

of trace elements. The composite substance is bombarded with neutrons, and the wavelengths and intensities of the characteristic gamma rays emitted from the activated nuclides are measured.

active alarm point See *alarm point*.

active application The software application on a computer that the keyboard is now focused in a Windows environment. Usually, it is the "top" window that is "open."

active device Any component, device, or circuit that introduces gain or has functional direction. The active device is usually considered to be any device except pure capacitance, inductance, resistance, or combinations of these. In current loop applications, the active device is a device capable of supplying current for the loop.

active medium The material in a laser that produces the amplified stimulated emission. The name of the laser identifies the active medium.

active transducer A transducer whose output waves are produced by power derived from a source other than any of the actuating waves, but whose output power is controlled by the actuating waves.

active window The window that appears "on top" of other windows in a Windows computer environment, thereby overlapping and obscuring from view other windows (applications) that are also open. The active window is the window that is currently in use. See *active application*.

active-matrix liquid crystal displays (AMLCDs) A liquid crystal display (LCD) technique in which the pixels on the screen are controlled by voltage signals applied in rows and columns. An array of thin film transistors (TFTs), with one transistor per pixel, keeps the pixels energized at all times so there is no need to reenergize on each scan. Thus, the pixels respond faster and are brighter than passive-matrix liquid crystal displays (PMLCDs). Compare with *passive-matrix liquid crystal displays*.

ActiveX Short for "active component extension." A binary reusable software object (COM component) that plugs into object linking and embedding (OLE) software, thereby allowing different software packages to communicate and interact with one another in a networked environment. This makes it possible to integrate plant floors using the Internet and intranets. Since the advent of Internet, Microsoft has preferred the term *ActiveX* over *OLE* because of the

former's expanded scope (and marketing appeal).

activity [Comm] 1. The presence of a signal or noise at the input terminals of a fieldbus device in which the signal or noise is higher than the receiver signal level threshold of that device. [ANSI/ISA-50.02, Part 2-1992] [Sci] 2. The ratio of the escaping tendency of the component in a solution to the escaping tendency of a standard state. The ion concentration multiplied by an activity coefficient is equal to the activity.

activity-based costing An information system that maintains and reports data on the activities, products, and processes of a plant or company.

actual address See *absolute address*.

actual flow The actual volume of liquid passing through the flowmeter in a unit time. It is computed by applying all necessary corrections for the effects of temperature, pressure, air buoyancy, and the like to the corresponding readings indicated by the calibrator. [ISA-RP31.1-1977]

actuate To put into action or motion.

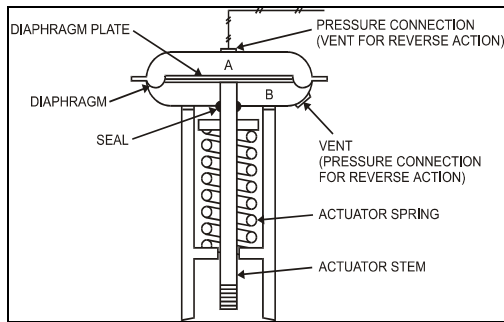
actuating error signal See *signal, actuating error*.

actuation signal The set point minus the controlled variable at a given instant. Same as *error*.

actuator 1. A pneumatic, hydraulic, or electrically powered device that supplies force and motion so as to position a valve's closure member at or between the open or closed position. [ANSI/ISA-75.05.01-2000] 2. A part of the final control element that translates the control signal into action by the final control device in the process. Typical examples are motors, solenoids, cylinders, and so on. 3. A device responsible for actuating a mechanical device such as a control valve. 4. A device that actuates.

actuator, bellows type A fluid-powered device in which the fluid acts upon a flexible convoluted member, known as the bellows, so as to provide rotary motion to the actuator stem. [ISA-75.01-1985 (R1995)]

actuator, diaphragm type A fluid-powered device in which the fluid acts upon a flexible member, termed the diaphragm, so as to provide linear motion to the actuator stem. [ANSI/ISA-75.05.01-2000]



Actuator, Diaphragm Type

actuator, double-acting An actuator in which the power supply acts both to extend and retract the actuator stem. [ISA-75.01-1985 (R1995)]

actuator, electric type A device that converts electrical energy into motion. [ANSI/ISA-75.05.01-2000]

actuator, electrohydraulic type A self-contained device that responds to an electrical signal by positioning an electrically operated hydraulic pilot valve so that it allows pressurized hydraulic fluid to move an actuating piston, bellows, diaphragm or fluid motor in order to position a valve stem. [ANSI/ISA-75.05.01-2000]

actuator, electromechanical type A device that uses an electrically operated, motor-driven gear train or screw to position the actuator stem. Such actuators may operate in response to either analog or digital electrical signals. The electromechanical actuator is also referred to as a "motor gear train actuator." [ANSI/ISA-75.05.01-2000]

actuator, fluid motor type A fluid-powered device that uses a rotary motor to move the actuator stem. [ANSI/ISA-75.05.01-2000]

actuator, hydraulic type A fluid-powered device that converts the energy of an incompressible fluid into motion.

actuator, piston type A fluid-powered device in which the fluid acts upon a movable cylindrical member, termed a piston, so as to provide linear motion to the actuator stem. [ANSI/ISA-75.05.01-2000]

actuator, pneumatic A device that converts the energy of a compressible fluid, usually air, into motion.

actuator, single-acting An actuator in which the power supply acts in only one direction. In a spring and diaphragm actuator, for example, the spring acts in a direction opposite to the diaphragm thrust. Single-acting spring and diaphragm actuators may be further classified in terms of the direction of the

stem movement on the increasing fluid pressure: (a) air to extend the actuator stem and (b) air to retract the actuator stem. [ANSI/ISA-75.05.01-2000]

actuator, vane type A fluid-powered device in which the fluid acts upon a movable pivoted member, known as the vane, so as to provide rotary motion to the actuator stem. [ANSI/ISA-75.05.01-2000]

actuator effective area The net area of a piston, bellows, vane, or diaphragm that is acted on by fluid pressure in order to generate actuator output force. [ANSI/ISA-75.05.01-2000]

actuator environment 1. The temperature, pressure, humidity, radioactivity, and corrosiveness of the atmosphere surrounding the actuator. 2. The mechanical and seismic vibration transmitted to the actuator through the piping or heat that is radiated toward the actuator from the valve body. [ANSI/ISA-75.05.01-2000]

actuator stem or actuator shaft The part that connects the actuator to the valve stem or shaft and transmits motion (force) from the actuator to the valve. Rotary-motion valves have shafts, while linear-motion valves generally have stems. [ANSI/ISA-75.05.01-2000]

actuator travel time See *stroke time*.

ACU Automatic calling unit; Dialing device that permits a business machine to automatically dial calls over a communications network (auto answer/ dial modem).

Ada A Pascal-based, real-time systems programming language developed by CII-Honeywell Bull under a contract to develop weapons system tracking for the United States Department of Defense. It has since been used throughout the federal government for applications far beyond this initial purpose.

adapter Device that makes possible compatibility between different equipment.

adapting See *self-adapting*.

adaptive control 1. A control system that uses its previous experience to adjust its response to its inputs. 2. Automatic means used to change the type or influence (or both) of control parameters in such a way as to improve the performance of the control system. [ANSI/ISA-51.1-1979 (R1993)]. See *control, adaptive*.

adaptive control, adaptive tuning 1. Continuously adjusting the gain (proportioning action) of the control loop from a signal external to that loop. Sometimes other parameters are (also) modified, particularly integral (reset action). 2. When referring to

advanced control techniques, the term has come to have the broader connotation of a system of advanced process control that is capable of automatically adjusting (adapting) itself to meet a desired output despite shifting control objectives and process conditions or unmodeled uncertainties in the process dynamics. Such control is often performed through neural networks and/or fuzzy logic coupled with traditional PID-type algorithms.

adaptive dithering A form of dithering for displaying graphics on a system that has a different-sized palette. In this form of dithering, the program looks to the overall image on the system to determine the best set of colors or shapes.

adaptive optics Optical components that can be made to change the way in which they reflect or refract light. In practice, the term usually means mirrors with adjustable surface shapes.

adaptive system A system that displays the ability to learn, change state, or otherwise react to stimuli. It is capable of adapting itself to changes in its own environment.

adaptor bushing The part that attaches a close-coupled diaphragm actuator to the bonnet of the diaphragm valve body. [ANSI/ISA-75.05.01-2000]

ADCCP Advanced Data Communications Control Procedure; bit-oriented communications protocol standard defined by ANSI.

A/D converter (ADC) A hardware device that converts analog data into digital form; also called an "encoder."

add time The time required for one addition, not including the time required to get and return the quantities from storage.

ADD 1. See *false add* and *OR*. 2. See *sum*.

adder A device that forms, as output, the sum of two or more numbers that are presented to it as inputs. Often such devices include no data-retention feature, that is, the output signal remains only as long as the input signals are present. Related to *accumulator*.

adder-subtractor A device whose output is a representation of either the arithmetic sum or difference, or both, of the quantities represented by its operand inputs.

additive primaries In color reproduction, red, green and blue. When lights of these colors are added together, they produce the sensation of white light.

add-on A component or device that is added to a system to increase storage capacity, modify architecture, or upgrade performance.

This capability is one of the powerful benefits of a good distributed control system.

address 1. An identification, represented by a name, label, or number, of a register or location in storage. Addresses also are part of an instruction word along with commands, tags, and other symbols. 2. The part of an instruction that specifies an operand for the instruction.

address bus The highway that links the sub-components of the microcomputer system along which address data are transferred.

address field That part of an instruction or word that contains an address or operand.

address format The arrangement of the address parts of an instruction.

addressing The means whereby the originator or control station selects the unit to which it is going to send a message.

addressing mode Method for addressing a location that is used for data storage.

address modification The hardware action in which an instruction's effective operand address is computed by some sequence of the following two operations (as prescribed within the instruction): (a) indexing--adding an index to the address; (b) indirect addressing--using the intermediate computed address to obtain another address from memory.

address register A register in which an address is stored.

address resolution The process of relating a logical address to a physical address.

add time The time required for one addition, not including the time required to get and return the quantities from storage.

adequately ventilated area An area that has a ventilation system (natural or artificial) that, at a minimum, prevents the accumulation of gases or vapors to an explosive level. Most standards and recommended practices recommend having systems that prevent levels in excess of 25 percent of the lower flammable (explosive) limit (LFL or LEL). Note: Adequate ventilation of an area is by itself not an effective means for preventing dust explosions. [ISA-12.01.01-1999]

adhesion 1. A bonding between two surfaces that is usually applied to localized welding at high points under substantial contact pressures. 2. Bonding between two surfaces, assisted by an adhesive substance.

adhesive Any substance capable of bonding two surfaces together.

adhesive bonding A commercial process for fastening parts together in an assembly by

using only glue, cement, resin, or other adhesive.

adhesive strength The strength of an adhesively bonded joint, usually measured in tension (perpendicular to the plane of the bonded joint) or in shear (parallel to the plane of the joint).

adiabatic Taking place without any exchange of heat between the process system and another system or its surroundings.

adiabatic temperature The theoretical temperature that would be attained by the products of combustion provided that the entire chemical energy of the fuel, the sensible heat content of the fuel, and the combustion air above the datum temperature were transferred to the products of combustion. This assumes that (a) combustion is complete, (b) there is no heat loss, (c) there is no dissociation of the gaseous compounds formed, and (d) inert gases play no part in the reaction.

adjacent channel In FM/FM telemetry, the modulated signal bandwidth immediately below or above the channel of interest. See *FM/FM*.

adjacent equipment The auxiliary equipment that may be located adjacent to the valve or actuator. [ANSI/ISA-75.05.01-2000]

adjustment The process of altering the value of some circuit element or some component of the mechanism of an instrument, controller, or auxiliary device so as to bring the indication to a desired value within a specified tolerance. This desired value usually corresponds to an independently determined value of the measured variable within a specified tolerance.

adjustment, span A means provided in an instrument to change the slope of the input-output curve. See *span shift*. [ANSI/ISA-51.1-1979 (R1993)]

adjustment, zero A means provided in an instrument to produce a parallel shift of the input-output curve. See *zero shift*. [ANSI/ISA-51.1-1979 (R1993)]

ADO Ampex Digital Optical; in video development, a traditional video editing system component that allows video frames to appear to be in motion.

ADPCM Adaptive differential pulse code modulation; encoding format for compressing and storing audio information in digital format.

ADSL Asymmetric digital subscriber line; a technique that compresses the amount of data needed to send computer, voice, and video data over normal phone lines (a compared to coaxial cable) so those three services

can function independently and simultaneously. The asymmetrical component means that the upload speeds are slower than the download speeds, but most delays occur during downloading.

adsorption The concentration of molecules of one or more specific elements or compounds at a phase boundary. The concentration usually occurs at a solid surface that bounds a liquid or gaseous medium containing the specific element or compound.

advanced process control (APC) Process control strategies beyond straightforward PID loop control, which is usually defined as "classical" advanced control. These advanced strategies involve a combination of PID loops, dead-time compensators, lead/lag feedforward function blocks, and single-variable constraint controllers.

advisory alert An alert object that has an assigned priority value of less than 8. [ISA-TR50.02, Part 9-2000]

AE Application entity; active element within an ISO layer. Also known as: architectural engineer; application enabler.

A&E Architecture and Engineering; company that designs and builds the process plant.

AEB Australian Electrotechnical Board; standards association of Australia, a member of IEC.

AECMA Association Européenne des Constructeurs de Matériel Aéronautique (also known as the European Association of Aerospace Industries). European standards group for aerospace industry.

AENOR Asociación Española de Normalización y Certificación; standards group in Spain.

aeolight A type of glow lamp whose intensity of light output varies with a signal voltage applied to it. Its construction employs a cold cathode and an envelope filled with a mixture of gases.

aerator Any device for injecting air into a material or process stream.

aerodynamics A branch of mechanics that deals with the motion of gases, such as air, and with the forces acting on solids in relative motion with respect to a gas.

aerograph Any self-recording instrument carried aloft to take meteorological data.

aerometer An instrument for determining the density of air or other gases.

aerosol A dispersion of fine liquid or solid particles in a gas. For instance, both smoke and fog are aerosols.

Aex A required prefix for apparatus that meet one or more types of protection as defined in the National Electric Code: Section 505-2(c) for installation in accordance with Article 505 of the National Electrical Code, NFPA 70: 1999. [ANSI/ISA-12.01.01-1999]

AFNOR Association Française de Normalisation; standards group in France.

afterglow Luminosity that persists in a gas after an electrical discharge passes through it. The phenomenon is sometimes utilized to measure flow.

AGA Advanced Graphics Architecture; chip set for driving high-resolution multimedia tools. Also known as: American Gas Association, a national trade association founded in 1918 in the United States, composed of about three hundred gas distribution and transmission companies to act as clearinghouse on gas energy information, and act as a catalyst in technical and energy policy matters, and as a voice for gas industry.

age hardening Raising the strength and hardness of an alloy by heating a supersaturated solid solution at a relatively low temperature so as to induce precipitation of a finely dispersed second phase. Also known as *aging* and *precipitation hardening*.

agent 1. A system that acts on behalf of another system. 2. A computing program that performs some information-gathering or processing task in the background, usually some very small, well-defined task. Some believe that the human mind consists of thousands or millions of agents working in parallel, so "true" artificial intelligence (AI) machines should also contain many agents along with some system for arbitrating among the competing results of these agents' activity.

agglomeration Any process for converting a mass of relatively fine solid material into a mass of larger lumps.

aggregate 1. Natural sand, gravel, and crushed stone that is mixed with cement to make mortar or concrete. 2. A structured collection of data elements. [ISA-TR50.02, Part 9-2000]

aging 1. The alteration of the characteristics of a device because of use. 2. Operating a product before shipping it so as to stabilize component functions or detect early failures. 3. Any time-dependent change in the properties of a material, but especially age hardening at room or slightly elevated temperatures. 4. Curing or stabilizing parts or materials

through long-term storage outdoors or under closely controlled storage conditions.

agitator A device for mixing, stirring, or shaking liquids or liquid-solid mixtures so as to keep them in motion.

AGP Accelerated graphics port; provides the capability for three-dimensional and full-motion video graphics in workstations.

AGVS Automated Guided Vehicle System; controls vehicles that proceed along predetermined routes or guide-paths, performing scheduled material-handling tasks without operators.

AHP Analytical Hierarchy Process; approach to using multiple criteria in decisions that aids in the meaningful organization of information, provides the ability to easily change weights and ratings for "what-if" analysis, and verifies that the approach to evaluation is logical and consistent.

AIA Application integration architecture; method of Digital Equipment Corporation for allowing programs to be portable between VMS and ULTRIX.

AIFF Audio Interchange File Format; method for saving digital audio in electronic memory, used for exchanging data between computers. Developed by Apple and used in Macintosh computers with a compression standard called Macintosh Audio Compression/Expansion (MACE).

air 1. The mixture of oxygen, nitrogen and other gases that, with varying amounts of water vapor, forms the atmosphere of the earth. [ISA-77.41-1992] 2. Air implies the use of any suitable and normally clean, dry, safe gas. [ISA-RP60.9-1981]

air, dry 1. Air with which no water vapor is mixed. This term is used comparatively since in nature air always has some water vapor, which, being a gas, is dry. 2. A papermaking term used to describe dry pulp that contains about 10 percent moisture.

air, saturated Air that contains the maximum amount of the vapor of water or other compound that it can hold at its temperature and pressure.

air-atomizing oil burner A burner for firing oil in which the oil is atomized by compressed air, which is forced into and through one or more streams of oil. This action breaks the oil into a fine spray.

air bearing A device that lubricates motion with flowing air. A linear air bearing floats a table on air as it travels a straight line.

air bind An air pocket in a pump, conduit, or piping system that prevents liquid from flowing past it. Also known as *liquid trap*.

air binding / air cushion

A
B

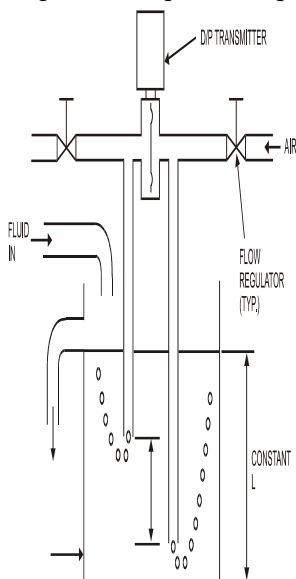
air binding The inclusion of air in a space, hindering the flow of some other gas or liquid.

air blast The flow of air at a high velocity, usually for a short period.

airborne Carried in the atmosphere either by being transported in an aircraft or by being dispersed in the atmosphere.

air-bubbler liquid-level detector A device for indirectly measuring the level of liquid in a vessel—especially a corrosive liquid, viscous liquid, or liquid containing suspended solids. This detector consists of a standpipe, open at the bottom and closed at the top, that is connected to an air supply whose pressure is maintained slightly above the maximum head of the liquid in the vessel. Air bubbles out of the bottom of the pipe, ensuring that the internal pressure is equal to the head of the liquid in the vessel (this pressure is measured by a simple gauge or transducer). Also known as *purge-type liquid-level detector*.

air-bubbler specific-gravity meter Any of several devices that measure specific gravity by determining the differential pressure between two air-purged bubbler columns. The devices ordinarily use either of two principles for determining specific gravity—comparing sample density with the density of a known liquid, or comparing the pressure between two bubbler columns immersed at different depths in the process liquid.



air buoyancy The lifting effect or buoyancy of the ambient air that acts during a weighing procedure involving open gravimetric calibrations. This effect is caused by the dis-

placement of air from the measuring vessel during the calibration run. The standard air (50% R.H.) for correcting to weights in vacuum has a density of 1.217 kg/m^3 at 288.7 K and $1.013 \text{ 250E} + 05 \text{ Pa}$. When weighings are made against weights, the buoyancy force on these weights must also be considered. For brass weights, the net effect of air buoyancy in air at standard conditions is about 0.015 percent. [ISA-RP31.1-1977]

air compressor A machine that raises the pressure of air above atmospheric pressure and normally delivers it to an accumulator or distribution system.

air condenser 1. A heat exchanger for converting steam into water in which the heat-transfer fluid is air. Also known as *air-cooled condenser*. 2. A device for removing oil or water vapors from a compressed-air line.

air-conditioned area See *area, air conditioned*.

air conditioning Controlling the atmospheric environment in a confined space by measuring and continually adjusting factors such as temperature, humidity, air motion, and concentrations of dust, gases, odors, pollen, or microorganisms.

air consumption The maximum rate at which air is consumed by a device within its operating range during steady-state signal conditions. Note: Air consumption is usually expressed in cubic feet per minute (ft^3/min) or cubic meters per hour (m^3/h) at a standard (or normal) specified temperature and pressure. [ANSI/ISA-51.1-1979 (R1993)]

air-cooled engine An engine, such as an internal combustion engine, whose waste heat is removed directly by a flowing stream of air—either a stream blown across the engine's external surfaces or one blown through internal cooling passages.

air-cooled heat exchanger A device for removing heat from a process fluid by passing it through a bank of finned tubes that are cooled by blowing or drawing a stream of air across the tube exteriors. [ANSI/ISA-51.1-1979 (R1993)]

air curtain A stream of high-velocity, conditioned air that is directed downward across an opening such as a door or window so as to exclude insects and exterior drafts, prevent heat transfer through the opening, and make it possible to air condition the interior space.

air cushion 1. A mechanical device that uses trapped air to absorb shocks or arrest motion without shock. 2. The partly confined stream of low-pressure, low-velocity air that sup-

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