Technical Information

Thermal System Glossary

A

Absolute Zero – The lowest theoretical temperature. At absolute zero, a body would have no molecular motion of heat energy. Absolute zero is the zero point on the Rankine and Kelvin scale. (-273.15˚C or-459.67˚F)

Accuracy
Calibration Accuracy – the potential error of a device compared to a physical constant or agency standard.
Control Accuracy – maintaining a process at the desired setting. The errors or combination of errors in the entire system including the sensor, control, power, load and design inefficiencies effect control accuracy.
Display Accuracy – the amount of potential error between a measured value and the control's displayed value.
Set Point Accuracy – the potential error between a measured value and the control setting.

Address – for digital communication between host computer and control, is a numerical value, typically between 1 and 255. The same address must be entered into both the computer program and the specific control to be addressed, or communicated with.

Alarm – a control condition or function, indicating that the process is at a predetermined amount above and/or below the set point.

Alarm relay options – normally energized (relay energized when not in alarm) normally de-energized (relay not energized unless in alarm). Latching means a reset button must be pushed when the temperature drops below the alarm setting plus dead band.

Alarm Type – typical choices for PID controls are: disabled, high, low, + deviation, -deviation, +/- deviation., and event (for ramp soak units.)

Algorithm – a set of rules with a finite number of steps for solving a problem.

Alternating Current (AC) – an electrical power system where the voltage reverses, alternating negative and positive. Typical frequency is 50 or 60 Hz. (cycles per second)

Ambient Compensation – the ability of an instrument to compensate for changes in the ambient temperature so that the changes do not effect control accuracy.

Ambient Temperature – the temperature of the immediate surroundings in which equipment is to operate.

AWG (American Wire Gauge) – also known as B & S wire gauge. Standard system to specify the diameter of wires for both power and control circuits. The larger the gauge number, the smaller the wire diameter.

Ampere (amp) – the rate of flow of current in a circuit.

Analog Indication – a meter with graduated scale and a pointer that moves to indicate process condition.

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

Analog Set Point – potentiometer adjustment of the control setting

Anneal - To relieve stress in a metal or glass material by heating to just below its melting point, then gradually cooling to ambient temperature. Annealing lowers tensile strength while increasing flexibility. Tubular heaters are annealed prior to forming.

ANSI – American National Standards Institute

Anti-reset Windup – a feature in 3 mode (PID) controls which prevents the integral (automatic rest) circuit from functioning when the temperature is outside the proportional band.

ASME – American Society of Mechanical Engineers.

ASTM – American Society for Testing and Materials.

Atmospheric Pressure (Standard) – Pressure exerted by the earth's atmosphere on the objects within. Measured at 60˚F (15˚C), at sea level, standard atmospheric pressure is 14.7 psia.

Automatic Reset (Integral) – the integral function of a control that automatically compensates for the difference between the set point and the actual process temperature. A signal moves the proportioning band up or down to correct for the droop or offset error.

Automatic Tuning (of control parameters) – a control that calculates the optimum PID parameters with a built-in software algorithm to eliminate manual tuning efforts.

Auxiliary Output – additional outputs for control of functions other than the primary control output, such as lights, buzzers, horns or gas purges that are triggered by the control alarm function.

Auxiliary Setpoint – an alternate set point on some PID controls, which can be selected from a button or external signal.

AWG – American Wire Gauge.

B

Band and Nozzle Heaters – component heaters designed to heat cylindrical objects such as plastic extruders. A variety of sizes and constructions are available.

Bandwidth – the total temperature variation measured at some point in the system, normally the process.

Baud Rate – In serial communications, the rate of information transfer in bits per second. Must be set for the same value in the controller and the host computer program. Typical values are 1200, 2400, 4800, 9600, and 19200. The control, computer and wiring must be able to operate at the baud rate selected.

Bend Radius (minimum) – the minimum radius for bending a wire, heating element or heat trace cable, without damage.

Blackbody – a theoretical object that radiates the maximum amount of energy at a given temperature and absorbs all energy incident upon it.

Braid – a flexible woven covering, usually of metal wire, covering an insulated wire to provide a ground path (or shield) or to protect from mechanical damage.

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Boiling Point – the temperature at which a substance in the liquid state transforms to the gaseous state. Commonly refers to the boiling point of water (100˚C or 212˚F at sea level).

BTU – British Thermal Unit; the amount of thermal energy required to raise one pound of water, 1˚F .

Bulb & Capillary – refers to thermostat construction which has a bulb filled with a fluid in the process. The increasing heat forces the fluid through a narrow tube into a bellows. The bellows actuates a snap switch, at a temperature determined by the knob setting which moves the switch toward or away from the bellows.

Bulkhead Threaded Fittings – available on tubular heaters, factory brazed, to allow heaters to be mounted through the wall of a tank or duct, etc.

Bumpless Transfer – The smooth, automatic transition from automatic control (closed loop) to manual control (open Loop). The control output is maintained during the transfer.

Burst Firing – a fast cycling control output, typically 3-32VDC, used in conjunction with a solid state relay.

C

Calibration – the process of adjusting an instrument so that the indication is accurate compared to the actual value.

Calorie – the amount of thermal energy required to raise one gram of water 1˚C at 15˚C

Cartridge and Immersion Temperature Controllers – are mechanical Thermostats with operation based on the difference of expansion of different metals.

Cartridge Heaters – cylindrical heaters with leads exiting one end. Most often inserted in drilled holes in platens and molds to heat blocks of metal. A variety of standard diameters, lengths and wattages are available, as well as special lengths, electrical ratings, and lead wire options.

Cascade – Control function where the output of one control loop provides the set point for a second loop, which determines the control action.

CE – A mark that designates compliance with European Union (EU) requirements for products sold in Europe

Celsius – (Centigrade) a temperature scale with 0˚C defined as the ice point and 100˚C as the boiling point of water at sea level.

Ceramic Beads – beads of ceramic material, with various hole sizes, intended to insulate bare high temperature wire, to prevent short circuits.

Ceramic Fiber – a light weight, low density fiber, typically used as a high temperature insulation or a refractory

Ceramic Post Terminal Insulators – used to cover the terminals of common strip heaters to prevent personnel contact with electrical hazards. Sold in pairs.

cfm – the volumetric flow rate of a liquid or gas in cubic feet per minute.

Chatter – the rapid cycling of a relay due to too narrow a bandwidth in the control.

Circuit – a complete or partial path over which current may flow.

Circulation Heaters – heaters for fluids or gasses consisting of an insulated pipe body with an immersion heater inside. Various sheath and pipe body materials are offered to heat a variety of material to a range of temperatures. Mechanical thermostats are included on some models. Options include mechanical or electrical controls, built-in sensors, baffles, and ASME design and certification. Complete skid mounted systems with panels are also available.

Closed Loop Control – a control system in which process temperature changes are detected by a sensor. The feedback from the sensor allows the control to make adjustments for accurate system regulation.

Cold Junction Compensation – a temperature sensitive device that prevents changes in the ambient temperature from affecting the cold junction of a thermocouple.

Cold Length – the distance from the end of the sheath to the heated section of a tubular or other similar heater.

Comfort Heaters – heaters, usually for the heating of areas to maintain comfort of the occupants. Generally not for use in areas above 100˚F. A wide variety of types (convection and fan forced) are available for use in ordinary, corrosive, and explosion hazard areas.

Common Mode Line Filter – a device to filter noise signals on both power lines with respect to ground.

Common Mode Rejection Ratio – the ability of an instrument to reject interference from a common voltage at the input terminals with relation to ground. Expressed in dB (decibels).

Compression Fittings – bulkhead fittings designed for customer installation on round tubular heaters, to allow heaters to be mounted through the wall of a tank, duct, etc.

Conduction – the transfer of heat from one material at a given temperature to another material at a lower temperature, while in direct contact with each other.

Conductivity – the ability of heat or electricity to flow through a material.

Constant Wattage – refers to a type of heat trace cable having a constant wattage output regardless of the surrounding temperature.

Continuity Check – A test that determines whether current can flow throughout the length of a circuit.

Control Loop – the basic control loop of any automatic control system consists of:
1) variable (process)
2) sensor
3) error detector (of control)
4) control
5) final control element (relay, SSR, SCR)
6) temperature indication

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Control Mode – the method in which the control restores the system temperature to set point. On/Off, proportioning, and PID are the most common control modes.

Control Type – options are direct acting (cooling) and reverse acting (heating).

Convection – the transfer of heat from a source or higher temperature area in a gas or liquid by the movement and mixing of the masses.

CSA – abbreviation for third party testing and approval agency, Canadian Standards Association

C-UL – this is an acceptance of UL (Underwriter's Laboratory) approval of a product. Often accepted by customers who would normally require CSA approval.

CPS – Cycles per Second (See Hertz).

Current – measured in amperes (A), is the flow of electricity. One ampere is one coulomb per second.

Current Limiting – a means to limit the current delivered to a load by a power control device, usually an SCR.

Current Proportioning – a 4-20 milliamp (typical) current output which provides a current proportional to the amount of control required.

Current Transformer – a transformer, usually toroidal (doughnut) shaped, designed to accommodate an electrical conductor, and provide a reduced, but linear output at a lower current, for instrument use. Typically specified by ratio i. e. 100:1

Cycle Rate (or Cycle Time) – in a time proportioning control, the period (usually in seconds) of time that is required to complete one on/off cycle once temperature has settled at the center of the proportioning band.

D

Data Logging – Recording a process variable over an extended period of time.

Dead Band (differential) – is the difference in degrees between temperature control turn on an turn off. This parameter is for on-off controls. It also applies to overtemperature controls.

Default Parameters – The programming instructions permanently written in microprocessor software.

Definite Purpose Magnetic Contactor – similar to a motor starter relay, for use with on-off controllers for slow processes. Available with optional enclosures for general, wet, and explosion proof areas.

Density – mass per unit of volume, such as lbs./cu.ft.

Derivative – (See Rate)

Deviation – the difference between the selected value and the actual value.

Deviation Alarm – an offset value that follows the set point. If the set point is 300˚F and the Deviation Alarm value is +20˚F (or 320˚F), then the set point is changed to 350˚F, the Deviation Value alarm would be 350˚F plus 20˚F (or 370˚F). See Process Alarm.

Deviation Meter – the display of process temperature on meter that indicates difference of or deviation of the process temperature from the set point.

di/dt – the rate of change of current vs. time. Filtering on large SCR units may be necessary to prevent damage from large current changes in small time periods

Dielectric – an electrical insulator - a material with low electrical conductivity.

Dielectric Strength – an amount of voltage that an insulating material can withstand before an electrical breakdown occurs.

Differential – in an on/off control, the temperature difference expressed in degrees between where the control switches off and the control switches on.

Differential Mode Line Filter – a device to filter noise signals between two power lines.

Digital Indication – the actual process temperature in indicated by LED or LCD display.

Digital Set Point – the desired temperature value is set by means of up-down pushbuttons or pushwheel switch.

DIN – Deutsche Industrial Norms, a German agency that sets engineering standards. Control panel hole size cutouts are typically based on DIN dimensions

Diode – A device that allows current to flow in only one direction.

Direct Current (DC) – an electric current flowing in one direction.

Disconnect – a control panel mounted main switch, which provides a means to turn off power in the panel before opening the door for servicing. Most disconnects do not provide overcurrent protection. This must be provided upstream using fuses or circuit breakers.

Dishwasher Heaters – immersion heaters with terminal housing and built-in controls, designed for use in commercial dishwashers

DOT (Demand Oriented Transfer) – an SCR power control system using the smallest time base possible. For example, 25% output would be 1 cycle on, and 3 cycles off.

Drift – a change in a value over a long period due to changes in factors such as ambient temperature, time or line voltage.

Droop – in time proportioning controls, the difference in temperature between the set point and where the system temperature stabilizes. Corrected by automatic or manual reset.

Drum Heaters – flexible heaters designed to heat or maintain the temperature of standard 5, 16, 30 and 55 gallon drums. A selection of ratings are available, some with thermostats.

Dry Well Heater – a heater designed to be installed in a dry area, usually a pipe, to heat the pipe, with the ultimate purpose of heating liquid surrounding the pipe.

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Dual Output – the primary control output will regulate the process temperature. A secondary control output will be utilized for process cooling or as an alarm.

Duty Cycle – the ratio of on time to on time plus off time, expressed as a percentage.

dv/dt transient protection – filtering to limit voltage vs. time presented to an SCR. Helps protect SCR's against transient voltages.

E

Efficiency – the amount of useful output versus energy input, expressed as a percentage.

Electric Stud Heater – a long cylindrical heater designed to be inserted into the hollow bolts of large machinery to obtain "shrink fit tightness" when the bolts cool.

Electromagnetic Interference (EMI) – electrical and magnetic "noise" than can be generated when switching AC power. EMI can interfere with the operation of microprocessor based controls.

Element Clamps – cast iron clamps are offered to clamp strip and ring heaters to surfaces for conduction heating of tanks, etc.

Emissivity – The ratio of radiant energy emitted from a surface compared to the radiant energy emitted from a black body at the same temperature.

Endothermic – a process is endothermic when it absorbs heat.

Enthalpy – the sum of the internal energy of a body and the product of its volume multiplied by the pressure used to evaluate the energy change occurring when a vapor or gas is heated. Expressed in units of Btu/lb. or Joules/gram.

Error – the difference between the correct value and the reading or display value.

Exothermic – a process is exothermic when it generates heat.

Explosion Proof Strip Heater – used to heat by conduction in areas with explosion hazards.

Explosion Proof Terminal Housing (or Enclosure) – an enclosure, housing, or panel which will contain a internal gas explosion. This prevents an explosion from setting off surrounding area. Housing contents must not produce surface temperature which would ignite flammable gases or vapors in the vicinity.

Extension Wire – wire intended to connect a sensor (typically a thermocouple or RTD) to a panel or control. Thermocouple wire must be same type as TC (J for J). RTD wire may be copper.

External Interlock – provided on most Chromalox panels, the interlock is a jumper, which turns off the load when interrupted. Typically connected to a flow or pressure switch for moving systems to protect against a no flow condition.

Event – a programmable On/Off output used to signal peripheral equipment or a process.

F

Fahrenheit – a temperature scale with 32˚F defined as the ice point and 212˚F as the boiling point of water at sea level.

Flanged Immersion Heaters – immersion heaters with mounting flanges (ANSI standard and others). Most offer a choice of terminal housings for various environments. Optional sheath thermocouples are also available.

Flexible Heaters – available in many standard sizes and ratings, most are constructed of silicone rubber, with internal winding. Specials with accessories such as thermostats, cords and plugs are available, as well as unique shapes.

Flow Rate – speed or velocity of fluid movement.

FM (Factory Mutual Research Corporation) – a third party approval agency, which tests and approves equipment for service in various areas and conditions.

Form A Relay – Single pole, single throw relay with Normally Open (NO) and common contacts. When coil is energized, the contacts will close.

Form B Relay – Single pole, single throw relay with Normally Closed (NC) and common contacts. Contacts are open when coil is energized.

Form C Relay – Single pole, double throw relay with Normally Open (NO), Normally Closed (NC) and common contacts. Can be selected as Form A or Form B contact.

fpm – flow velocity in feet per minute.

fps – flow velocity in feet per second.

Freezing Point – the temperature where a material changes from a liquid to a solid.

Frequency – the number of event occurrences or cycles over a specified period of time.

Fuse – A device that interrupts power in a circuit when an overload occurs.

Fuzzy Logic – An artificial intelligence technique that allows control decisions to be made upon approximate or incomplete information. It is a continuous decision making function that can prevent initial overshoot and set point differentials.

G

GFCI – (Ground Fault Circuit Interrupter) – an electronic circuit which monitors the current flowing from a conductor to a ground reference. When the current exceeds a predetermined value, the GFCI shuts the circuit down.

GIGA – the prefix for one billion (G).

gph – the volumetric flow rate in gallons per hour.

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gpm – the volumetric flow rate in gallons per minute.

Ground – the electrical line having the same potential as the surrounding earth; the negative side of a DC power supply; the reference point for an electrical system.

Grounded Junction – A thermocouple junction in which the sheath and conductors are welded together forming a completely sealed integrated junction.

H

Heat – thermal energy expressed in Calories, Btu's or Joules.

Heat Balance – proper sizing of the heat source to the requirements of the system (including heat losses).

Heat Exchangers – metal tubes or plastic coils designed to heat or cool solutions by immersion, with a fluid (or steam) circulating through the coil to obtain the desired effect.

Heat of Fusion – the amount of energy required to change one pound of a material from a solid to a liquid without an increase in temperature. Expressed in Btu/lb.

Heat of Vaporization – the amount of energy required to change one pound of a material from a liquid to a vapor without an increase in temperature. Expressed in Btu/lb.

Heat Offset – for some PID controllers; allows the creation of a dead area where neither heat nor cold is on, to prevent the process from oscillating between heat and cool. Saves energy.

Heat Sink – in power control, an array of plates or fins, usually aluminum, which conducts heat away from the power control devices (SCR's) and dissipates the heat by free or forced convection.

Heat Tracing – heat applied to pipes or tanks, to replace heat lost through the insulation to the ambient.

Heat Transfer – a process of thermal energy flowing from one body to another.
1) Conduction: the transfer of heat from one particle of matter to another.
2) Convection: the transfer of heat from one part of a particle to another by the mixing of the warmer particles with the cooler.
3) Radiant: the transfer of heat from one body to another as the result of the bodies emitting and absorbing radiation energy.

Heat Transfer and Release Coating – a compound designed to be applied between heaters and the surfaces being heated to improve heat transfer. Also makes cartridge heaters easier to remove from drilled holes.

Heat Transfer Fluid Vaporizer – a vaporizer for heat transfer fluids, to obtain improved process heat transfer by recovery of the heat of vaporization.

Heat Transfer Medium – a gas, liquid or solid through which heat flows from the heat source to the work.

Heat Transfer Systems – consist of circulation heater(s), pump, control panel and related items, ready to connect to your service and process. Oil and water systems are available, in many sizes with a host of features and accessories.

Helically Coiled Resistance Wire – a coil of Nichrome wire, wound in a helix, which is the resistance winding of the heater.

Hertz – units of expression for frequency, measured in cycles per second.

High Temperature Wire – special wire with high temperature insulation and nickel or nickel plated copper conductor. Can withstand higher temperatures than plastic insulated copper conductor wire used for general connections. Do not use tin plated copper lugs on high temp wire. They will oxidize and fail. High temperature terminations require special nickel or stainless steel lugs, if lugs are used.

Hi-Pot Test – the application of a high voltage to an electrical conductor to test the surrounding insulation.

Hopper Heaters – modular heaters, consisting of tubular heating elements mounted to a metal plate, for attachment to hoppers. These are used to keep the walls above a critical temperature to prevent contents from sticking to or attacking the hopper.

Humidity Transmitter – an electronic device which provides a 4-20 mA signal based on the relative humidity sensed by the probe.

Hysteresis – the temperature sensitivity designed into the on/off control action between the on and off switching points. Expressed in percentage of control range. Also known as dead band.

I

Ice Point – the temperature where pure water freezes (0˚C or 32˚F).

Immersion Heaters – heating elements designed to heat a fluid or gas by direct contact.

Impedance – the total opposition in a circuit to the flow of alternating current. Measured in ohms and represented by "Z".

Infrared – or radiation is the exchange of energy by electromagnetic waves. The infrared spectrum extends from the deep red end of the visible spectrum to the microwave region of the radio spectrum, The portion adjacent to the visible spectrum is of importance to heating. Radiant heat transfer can be very efficient in directing energy from the heat source to an object.

Insulation, Electrical – a substance which surrounds an electrical conductor, to prevent current from flowing to or leaking to ground or to other conductors.

Insulation Resistance – is the resistance of an insulator to current flow from a conductor (typically a heating element winding) to ground (the sheath). Usually measured by the application of a voltage, and measuring the resulting current. The resultant resistance, which is expressed in ohms, is calculated by the formula: R= V / I.

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Insulation, Thermal – a material which reduces heat flow from heated areas or objects to colder objects to conserve energy improve performance, or prevent operator contact with hot objects.

Input Scaling – allows PID control to be adjusted to display inputs from transmitters (i.e. humidity), in appropriate engineering units.

Integral – (See Automatic Reset).

Isothermal – a process or area that maintains a constant temperature.

J

Joule – the basic unit of thermal energy. 1 Joule equals 1 ampere passed through a resistance of 1 ohm for 1 second.

Junction – A thermocouple junction is the point at which two alloys are joined. A typical thermocouple circuit would have a measuring and a reference junction.

K

Kelvin – the unit of absolute or thermodynamic temperature scale. Zero Kelvin is absolute zero, where all molecular activity stops. No ˚ symbol is used. 0˚C = 273.15K; 100˚C = 373.15K.

Kilo – the metric prefix for one thousand (K).

Kilowatt (kw) – 1000 watts or 3412 Btu per hour.

Kilowatt Hour – electrical unit of energy expended by one kilowatt in one hour.

L

Lag – the time delay from application of heat until the process reaches temperature or the delay in a controller responding to a temperature change.

Least Significant Digit – The digit farthest to the right in a display.

Light Emitting Diode (LED) – a solid state device which produces light from the flow of electric current through a semiconductor. These are individual indicating lights or segmented readouts used to display temperature.

Linearity – the compliance of an instrument's response to a straight line.

Liquid Level Control – detects liquid level below a reference depth. Can be used for replenishment or to turn off a heater to prevent damage.

Load – the electrical demand of a process expressed as wattage, amps or resistance (ohms).

M

Manual Reset – the adjustment on a proportional control which shifts the proportioning band in relation to the set point to eliminate droop or offset errors.

Mass Flow Rate – weight of a substance flowing per unit of time past a specific cross-sectional area within a system.

Maximum Allowable Load Resistance – the maximum resistance (in ohms) into which a control can deliver specified current. Usually specified for 4–20mA outputs, and is limited by internal control supply voltage.

Mean Temperature – the maximum and minimum temperature average of a process at equilibrium.

Measuring Junction – the thermocouple junction at the point of measurement in the process.

Mechanical Relay – an electromechanical device that completes or breaks a circuit by closing or opening electrical contacts.

Mega – the metric prefix for one million (M)

Mercury Contactor (Mercury Displacement Relay) – a mechanical relay with mercury as the current carrying conductor. They are faster, quieter, and last longer than conventional mechanical contactors. Contains mercury, a hazardous substance, not permitted in some plants.

MI Cable (Mineral Insulated Cable) – refers to metal sheath heat trace cable, having internal magnesium oxide insulation between the conductor(s) and the sheath. Specially suited for high temperature operation, and is mechanically rugged. All MI cables are made to order.

Micro – The metric prefix for one millionth Microamp (one millionth of an amp).

Micron – (one millionth of a meter).

Microprocessor – The central processing unit (CPU) that performs the logic operations in a micro-computer system. The microprocessor in a process or instrument control decodes instructions from the stored program, performs algorithmic and logic functions, and produces signals and commands.

Milli – The metric prefix for one thousandth

Milliamp – (one thousandth of an amp).

Millivolt – (one thousandth of a volt)

Moisture Resistant Terminal Housing – a terminal housing designed to meet the requirements of NEMA 4. Chromalox types E2 and E4 meet these requirements.

MOV Protection – SCR protection provided by a Metal Oxide Varistor (MOV), which clamps voltages at limits to stay below critical SCR failure values.

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N

NEC (National Electrical Code) – regulations and specifications for wiring as published by the National Fire Protection Association, Inc.

NEMA – National Electrical Manufacturer's Association

Noise – undesirable electrical interference on the signal wires.

Noise Suppression – a device used to reduce electrical interference.

Normal Mode Rejection Ratio – the ability of an instrument to reject interference of the line frequency (50-60Hz) across the input terminals.

NPT – National Pipe Thread

O

OCE (Open Coil Element) – heaters designed to be installed in 2 or 3 inch customer- supplied threaded schedule 40 dry well pipes to heat liquids with the heat transferred through the pipe walls. Provides low watt density on the pipe for viscous fluids, and allows for heater replacement without draining the tank. Available terminal housings provide easy connections to heater with high temperature wire. Not for use in explosion hazard areas.

Offset – the difference in temperature between the set point and the actual process temperature.

OHM – the unit of electric resistance.

On-Off – a control whose action is full on or full off.

Open Coil Elements – elements with the Nichrome resistance wire exposed. Designed to heat by radiation and/or convection.

Open Coil Oven Elements – ribbon wound open coil elements designed specifically for use in ovens.

Open Loop Control – a control system with no sensing feedback.

Open Sensor Output Command – for some PID controls, allows selection of shut down or switch to pre-assigned power output (i.e. 30%), in the event of an open sensor.

Output Limit – for some PID controls, allows selection of a maximum percent of full power. Useful of heater is oversized, or for fast heat up followed by close control.

OSHA – US Government agency, Occupational Safety and Health Administration (or Agency). Specifies and enforces safety in the workplace.

Over-the side Immersion Heaters – immersion heaters designed for use in open top tanks. A wide variety of sheath materials and coatings are available to heat most solutions Risers to terminal housings are provided, as well as optional mechanical thermostats for some models.

Overshoot – excursion of temperature above the set point.

P

Percentage Timing Input Controllers – are motor driven adjustable duration cam devices. These provide an adjustable duty cycle, for a time base of 15 or 30 seconds. Useful for intensity (open loop) control. Not for use with tungsten quartz radiant heaters.

Phase – time based relationship between an intermittent function and a reference. Electrically, the expression is in angular degrees to describe the voltage or current relationship of two alternating waveforms.

Phase Angle Control – SCR firing mode in which the SCR's are turned on for a portion of each half cycle. Necessary for high inrush and/or inductive loads, such as tungsten (quartz lamp) heaters and transformers.

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

PID – three mode temperature control–proportional, integral (automatic reset), derivative (rate).

Polarity – having two oppositely charged poles; one positive, one negative.

Potting – The sealing of components with a compound such as epoxy to protect against moisture and other contaminants.

Process Air Heaters – component heaters or complete assemblies for heating low pressure, high volume air for processes. Single elements of 475 watts to duct heaters of 300kw are included in the selection.

Process Alarm – a fixed alarm or secondary set point value independent of the primary set point. Should a process value exceed this value, an alarm condition would register.

Process Radiant Heaters – heaters providing a variety of wave-lengths of radiant energy for heating processes, drying parts, freeze protection, etc. Many types and sizes are available.

Process Value – the indicated value of the parameter being measured/controlled.

Process Variable – the parameter being controlled or measured such as temperature, relative humidity, flow, level, pressure, etc.

Proportioning Band – (or proportional band) the temperature band in degrees within which a control's proportioning function is active. The width is usually adjustable, and is expressed in degrees or as a percent of span.

Proportioning Control Mode – when process temperature ap-proaches set point and enters the proportioning band, the output is switched on and off at the established cycle time. The change in power to the load provides a throttling action which results in less temperature overshoot. This cycling will continue until on and off times are equal.

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Protection Head – a junction box for the protection of the sensor to extension wire connection. Protection heads can provide mechanical, moisture, and explosion area protection.

psia – pounds per square inch absolute. Pressure reference to a vacuum.

psig – pound per square inch gauge. Pressure reference to ambient air pressure.

Q

Quality of Steam – the relative amount of liquid present in saturated steam as a percent of the total weight. The quality of steam is 100% less the percent liquid. Dry saturated steam has a quality of 100%.

Quartz Lamp Radiant Heater – a heater in a reflector, using a tungsten filament quartz tube heater for the radiant source. The best source when the heater must be able to be turned off quickly when the line stops. Intensity control must use phase angle fired SCR's.

R

Ramp – a programmed rise in temperature.

Range – an area between two limits in which a measurement or control action takes place. Typically expressed in upper and lower limits.

Rankine – an absolute temperature scale based upon the Fahrenheit scale with 180˚ between the ice point and boiling point of water. 0˚F = 459.67˚R.

Rate (derivative) – a control function that measures the rate of increase or decrease of the system temperature and brings the control into an accelerated proportioning action. This mode prevents an overshoot condition at initial heat-up and with system disturbances.

Rate Time – the interval over which the system temperature is sampled for the derivative function.

Remote Setpoint – on some controllers, an external 4-20 mA signal, or similar, will change the setpoint of a control. Good for remote computer system control or cascading.

Remote Shutdown – a feature on some SCR units, permitting the shutdown of output from a remote contact opening or closing.

Repeatability – the ability to give the same output or measurement under repeated identical conditions.

Repressed Bends – required when a tubular heater is bent to tighter radius than permitted for customer bending. Repress dies restore the internal compaction of the magnesium oxide to prevent voids, which may result in premature heater failure.

Resistance – the resistance to the flow of electric current measured in ohms.

Resolution Sensitivity – the amount of temperature change that must occur before the control will actuate. It may be expressed in temperature or as a percentage of the control's scale.

Response Time – In analog instruments, the time required for a change of the measured quantity to change the indication. In sensors, the time required to reach 63.2% of the step change.

Retransmit Output – analog output scaled to the process or the set point value.

Ring and Disc Heaters – component heaters which are flat and circular. They are usually used to heat by clamp on conduction. Variety of sizes offered allows for nesting.

RS232 or RS 422-485 Input/Output Signal – A serial interface suitable for connection between a digital control and a personal computer, a host computer or printer.

RTD – a temperature sensing probe of finely wound platinum wire that has a linear resistance change for a corresponding temperature change. The resistance increases as the temperature rises. A base resistance of 100 ohms at 32˚F is the industry (DIN) standard.

S

Saturation Temperature – the boiling temperature of a liquid at the existing pressure.

SCFM – Volumetric flow rate in cubic feet per minute at 60˚F (15˚C) and standard atmospheric pressure.

SCR – Silicon Controlled Rectifier

Secondary Insulating Bushings – porcelain bushings designed to allow certain strip heaters to be electrically isolated from ground, when using on higher voltages for air heating. The heater tabs must be punched at the factory to accommodate the bushings.

Self-Regulating – refers to a type of heat trace cable, which has a decreased wattage output for increasing temperature.

Self-tune – an internal program in some PID controllers, which allows the control to experience the process and internally calculate parameters to obtain good process control operation.

Serial Interface – the hardware and wiring to connect control(s) with digital communications to a computer. Typical choices are RS232 (single drop), RS 422, 458 (multi-drop).

Sensor Breakdown Protection – circuitry which ensures safe process shut down in the event of sensor failure.

Sensor Selection – a menu or hardware feature on most indicating controls which allows selection of a number of thermocouple types, RTD's and /or other sensors

Serial Communications – A method of transmitting data between devices.

Set Point – control setting to achieve or maintain temperature.

Technical Information

Thermal System Glossary *(cont'd.)*

Screw Plug Immersion Heaters – immersion heaters, which mount with a screw plug, typically with a standard NPT thread. Most have an available selection of terminal housings for various environments. Some also include built-in mechanical thermostats.

Shape Factor – in radiant applications, the amount of energy received by the target relative to heater rating and distance to the target.

Sheath – the outer shell of a heating element, usually metal. Typical materials are: copper, steel, stainless steel alloys, and others. Provides mechanical protection and a ground path.

Sheath Length – the length of the sheath measured without the terminals or protruding terminal pins. Typically held within one percent for Chromalox tubular heaters.

Shield – material surrounding a conductor(s) to prevent interference of electrostatic or EMI from external sources.

Shorted SCR Detection – circuitry in some SCR's to detect a shorted SCR in a power control module. Usually the output can be an alarm to alert operator that unit needs service.

Shunt Trip – a coil, designed to turn off the main disconnect on a panel, when energized. Typically used for large SCR panels, to drop the load if high limit is reached.

Single End Tubular Heaters – tubular heaters with both electrical connections located at one end of heater. Simplifies wiring.

Slide Wire Feedback – A potentiometer that varies resistance in response to a valve position. This provides valve position information to the valve controller.

Soak – To raise the temperature of a metal object in a heated environment to produce a metallurgical change. Also, a preprogrammed time to provide a set point to a process, as used in a ramp-soak program.

Soft Metal Melting Pot – an open top vessel designed to melt solder, tin and/or lead.

Soft Start – reduces voltage on initial start-up which reduces power to the heaters.

Solid State Relay – a solid state switching device which completes or breaks a circuit electrically with no moving parts.

Span – the difference between the upper and lower limits of a controller's range.

Specific Gravity – the ratio of mass of any material to the same volume of pure water at 4˚C.

Specific Heat – the ratio of thermal energy required to raise the temperature of a mass of material 1 degree to the thermal energy required to raise an equal mass of water 1 degree.

Speed of Response – time needed for a temperature change occurring at the sensor to be translated into a control action.

Spring Loaded – refers to sensor probes designed for use in thermowells. The probe has a spring, which forces the tip of the sensor to make good contact with the inside end of a properly chosen thermowell.

Stability – the ability of an instrument or sensor to maintain a constant output when a constant input is applied.

Standard – reference point from which references or calibrations are made.

Steam Boilers – automatically provide a source of steam for processes or other uses. Boilers are available in a wide variety of sizes and styles. Accessories include automatic blowdown, condensate return systems, steam separators and more

Strip Heaters – heating elements with a rectangular cross section, usually used to heat objects by clamp on conduction or heating air by free or forced convection.

Super Heating – the heating of a liquid above its boiling temperature without changing to a gaseous state; or the heating of a gas considerably above the boiling temperature.

Surge Current – a higher than nominal current of short duration occurring when power is initially applied to loads such as self regulating heat cable and tungsten filament quartz radiant heaters.

T

Temperature Gradient – the range of temperature variations at various physical locations throughout a thermal system.

Tera – the prefix for one trillion(T).

Terminal Pin – a pin in the end of tubular and similarly constructed heaters to which the resistance winding is attached. The pin extends out of the heater and is attached to a terminal to facilitate wiring.

Terminals – the means to attach wiring to heaters. For tubular heaters, a wide variety are available to accommodate wires, lugs, or 1/4 inch push on connectors.

Thermal Conductivity – the property of a material to conduct heat.

Thermal Expansion – an increase in size due to an increase in temperature.

Thermal Lag – the time delay in the distribution of heat throughout a thermal system.

Thermal System – a series of components arranged and designed to provide heat. The four elements or components compromising a Thermal System are:
1) work or load
2) heat source
3) heat transfer medium
4) control system

Thermistor – a temperature sensing probe manufactured of a mixture of metal oxides then encapsulated in epoxy or glass. A large

change in resistance is exhibited proportional to a change in temperature. The resistance usually decreases as temperature rises.

Thermocouple – a temperature sensing probe consisting of the junction of two dissimilar metals which has a millivolt output proportional to the difference in temperature between the "hot" junction and the lead wires (cold junction).

Thermowell – a closed-end tube into which a temperature sensor is inserted to isolate it from the environment.

Thin Blade Heaters – tubular type heaters having a 1 / 4/ by 1 inch cross section. Available in single or three phase models

Touch Safe Design – optional shields available on some SCR power control modules, reduce the possibility of personnel coming in contact with high voltage.

Transducer – a device that converts a measured variable into another form which is the transducer's output. A thermocouple transforms heat to a millivolt output.

Transmitter – a device used to transmit temperature data from the sensor.

Tubular Element – cylindrical component heating element made with a metal sheath, enclosing a magnesium oxide surrounded Nichrome resistance winding. Cross section may be round, heart shape or flat pressed.

U

Undershoot – excursion of temperature below set point.

Underwriters' Laboratories (UL) – a third party approval agency for components and finished products.

Ungrounded Junction – A thermocouple junction fully insulated from the sheath.

User Selected Security Code – a feature on some PID controls, allows the selection of an unique code, if the default codes are compromised.

V

VDE – an independent, German third party testing organization for product safety.

Viscosity – the inherent resistance of a substance to flow

Voltage – an electrical potential, which is measured in volts.

W

Wattage – a unit of measurement of electrical power. In a resistive circuit, VI = W (See Ohms Law formulas).

Watt Density – the rated wattage of an element per unit of surface area. Usually expressed in watts per square inch.

Welded – one common method of attaching sensor probe to threaded hub. Welding produces a moisture proof, mechanically strong bond.

Z

Zero Voltage (or Zero Crossover) Switching – completing or breaking of a circuit when the voltage wave form crosses zero voltage.