Glossary of Control Terms and Definitions

Adjustment: The procedure required to establish a controller's set point.

Ambient Temperature: The temperature of the surrounding medium.

Auxiliary Device: A component which, when added to a control system and actuated manually or by the output signal from one or more controllers, produces a desired function.

Bandwidth: The change in controlled variable that causes a full change in electronic controller output, expressed for example in say 4 K/10 Vdc.

Cavitation: The forming and imploding of vapor bubbles in a liquid due to decreased, then increased, pressure as the liquid flows through a restriction.

Closed Loop System: The arrangement of components to allow system feedback.

Control Agent: The source of energy regulated by the controlled device. The most common sources of energy are: water (hot or cold), air (hot or cold), steam, electrical current and refrigerant.

Control Loop: Chain of components which makes up a control system. If feedback is incorporated, it is a closed loop; if there is no feedback, it is an open loop system.

Control Point: The actual value of the controlled variable, which the controller is maintaining, at any given time.

Control Pressure: Pertains to pneumatic controllers only, as opposed to **Control Voltage** of electronic controllers, and is more commonly referred to as **Output Signal**.

Controlled Device: The instrument that receives the controller's output signal and regulates the flow of the control agent. It is functionally divided into two parts:

> **Actuator:** Receives the output signal and converts it into force.
>
> **Regulator** (valve body or damper)**:** Regulates the flow of the control agent.

Controlled Medium: When applied to a valve, this term refers to whatever fluid is being regulated. For heating-cooling systems, this fluid can be hot or chilled water, steam or refrigerant.

Critical Pressure Drop: This applies to gases and vapors. It is the pressure drop which causes the maximum possible velocity through the valve. Higher pressure drops will not increase the flow velocity.

Controlled Variable: In a closed loop system, the temperature, humidity or pressure which when varying causes the controller to respond and control the amount of change.

Controller: The instrument that measures the controlled variable and responds by producing an output signal which holds the controlled variable within predetermined limits.

Controller Feedback: The change in the controller's output in response to a measured change in the controlled variable transmitted back to the controller input for evaluation.

Cycling: Continuous oscillation occurring without periodic stimuli. A situation in a closed loop system where the controller's response (sensitivity) to an input change causes this instability.

Differential: The difference in values of the controlled variable that will activate a two-position controller to change an output of either maximum or zero to the opposite extreme, with no immediate steps.

Direct Acting: The output signal changing in the same direction the controlled or measured variable changes. **Example:** an increase in the controlled or measured variable results in an increased output signal.

Dynamic Pressure: The pressure of a fluid resulting from its motion. Dynamic Pressure (Pump Head) = Total Pressure – Static Pressure.

Flow Characteristic, Inherent: Flow characteristic when constant pressure drop is maintained across valve.

Flow Characteristic, Installed: Flow characteristic when pressure drop across valve varies as dictated by flow and related conditions in system in which valve is installed.

Flow Coefficient Cv: Number of U.S. gallons per minute of 60°F water that will flow through a fully

open valve with a 1 PSI drop across it.

Flow Coefficient Kv: Number of cubic metres per hour of 15°C water that will flow through a fully open valve with a 1 bar drop across it.

Gain: Controller output change per change of input to the controller.

Input: That variable signal, received by an instrument, which provides that instrument with a means of changing an output signal.

Load Change: The change in the usually uncontrollable heat gain or loss caused by lights, machinery, people, outside air temperature variations or solar effect.

Main Controller: An instrument whose variable output is used to change the set point of a receiver-controller. The main controller may be a humidistat, pressure controller, manual switch, transmitter, thermostat, etc.

Measured Variable: The uncontrolled variable, such as temperature, relative humidity or pressure, sensed by the measuring element.

Measuring Element: That part of the controller which measures a change in the temperature, relative humidity or pressure and converts this change into resistance to current flow.

Normally closed: Applies to a controlled device that closes (stops the flow of the control agent) when the signal applied to it is removed.

Normally open: Applies to a controlled device that opens (allows the flow of the control agent) when the signal applied to it is removed.

Offset: The difference between the set point of the controller and the control point of the controlled variable caused by “load changes” affecting the system. Offset is also referred to as “drift”, “deviation” and “droop”.

Open Loop System: The arrangement of components which will not allow system feedback.

Output Signal: A signal produced in response to a given input.

Overshoot: The greatest amount the controlled variable exceeds its desired value after a change of input.

Proportional Action: An output signal changing in proportion to the amount of change in the controlled or measured variable.

Proportional band: Proportional band is defined as the change in input required to produce a full-range change in output. This value is the reciprocal of the proportional coefficient. For example, if the input change required is 5 K and the total full-range output change is 10 Vdc - 0 = 10 Vdc, proportional band = 5 K.

Proportional coefficient: Proportional coefficient is defined as the ratio of actual change in input to the change in input required to produce the full-range change in output and is expressed in percentage. To convert proportional coefficient (A) to proportional band (PB), divide 1 K by the proportional coefficient. For example, if A = 20%, PB = 1/20% = 5 K.

Proportional Plus Automatic Reset Action: A combination of proportional action and a response which continually resets the control point back toward the set point to reduce the offset, and is more often referenced as **Proportional Plus Integral Action**.

Proportional Plus Rate Action: A combination of proportional action and a response that precedes the normal proportional response. The combined response is proportional to the rate of change or speed with which the controlled variable deviates from the set point.

Range: The values of a variable from a point value to a point value. (See **Span**).

Example: range 15°C to 35°C

span 20 K (C°)

Range of Remote Readjustment: The amount of set point change of the submain controller produced by a full change in output signal from the main controller.

Rate Time: The time in minutes that rate action response precedes normal proportional action response.

Rated Flow: For a coil, this is the flow through the coil which will produce the full rated heat output of the coil.

Reset Rate: The number of times per minute that the change made by the proportional action is duplicated by the reset action. It is usually expressed in “repeats per minute”.

Reverse Acting: The output signal changing in the opposite direction that the controlled or measured variable changes. **Example:** an increase in the controlled or measured variable results in a decreased output signal.

Sensitivity: The change the controller output

changes per unit change in the controlled variable. (Expressed, for example, in volts/K).

Set Point: The point at which the controller is set. This is the desired controlled variable value which can be obtained by either an integral or remote adjustment of the controller.

Span: The algebraic difference between the upper and lower fixed transmitter values. (See **Range**).

Spring Range: The range through which the signal applied must change to produce total movement of the controlled device from one extreme position to the other.

> **Nominal Spring Range:** The change in applied signal that causes total movement when there is no external force opposing the actuator.
>
> **Actual Spring Range:** The change in applied signal that operates the controlled device under actual conditions when it must overcome forces due to fluid flow, friction, etc., in addition to the nominal spring range.

Static Pressure: The pressure with respect to a surface at rest in relation to the surrounding field.

Stroke: This is synonymous to lift, travel and percent open. These are terms used when referring to the amount a valve has moved from either extreme of fully open or fully closed.

Submain Controller: A controller whose set point is automatically readjusted from a remote location. The set point is changed over a predetermined range by variations in an applied signal from a main controller.

> **Direct Readjustment:** An increase in applied signal increases the set point of the submain controller.
>
> **Reverse Readjustment:** an increase in applied signal decreases the set point of the submain controller.

Summing Point: any point at which signals are added algebraically.

Supply Pressure: The energy source (compressed air) supplied to a controlled device or auxiliary device. It is usually a constant 20 PSIG, but in special cases, may be some other value.

Supply Voltage: The energy source supplied to the controller or auxiliary device. (Usually 24 Vac, 120 Vac or 220 Vac).

System Feedback: The effect of the controller's response to a change in the controlled variable transmitted back to the controller.

Throttling Range: The change in controlled variable required to move the controlled device from one of its extreme limits of travel to the other. (See **Proportional Band**).

Timed Two-Position Action: A variation of two-position action in which the "On" or "Off" periods are prematurely shortened. This is usually accomplished in electric room thermostats by means of a heating element in the form of a resistor called **heat anticipator**, which is energized during the "On" periods in heating mode or during the "Off" periods in cooling mode.

Total Pressure: The sum of the Static Pressure and the Dynamic Pressure.

Three-Way Valve: Valve with three connections, one of which is a common and two are flow paths.

> **Bypass or Diverting Valve:** Common connection is the only inlet: fluid entering this connection is diverted to either outlet.
>
> **Mixing Valve:** Two connections are inlets and the common is the outlet. Fluid from either of both inlets is selected to go out the common connection.

Transducer: An instrument that converts an input signal usually of another form. **Example:** electrical input to pneumatic output.

Transmitter: An instrument (not a controller) that transmits a directly functional signal in proportion to the variable measured. This proportion is factory set and is not to be adjusted in the field.

Two-Position Action: The type of action in which the output signal is changed to either a maximum or minimum value with no immediate steps.

Two-Way Valve: Valve with two connections and a single flow path.

Valve Pressure Drop: Portion of the system pressure drop which appears across the valve. For valve sizing this drop is across a fully open valve.

Valve Rangeability: Ratio of maximum to minimum controllable flow passing through the valve.

Working Range: The desired controlled or measured variable values over which the system operates.