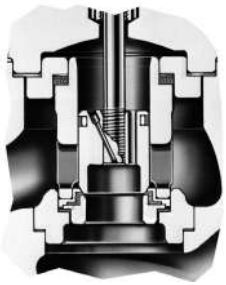

Figure 3.36 Adapter Method for Providing Reduced Flow Capacity

3.8 Actuators

Pneumatically-operated control valve actuators are the most popular type in use, but electric, hydraulic, and manual actuators are also widely used. The spring-and-diaphragm pneumatic actuator is most commonly specified due to its dependability and simplicity of design. Pneumatically-operated piston actuators provide high stem force output for demanding service conditions. Adaptations of both spring-and-diaphragm and pneumatic piston actuators are available for direct installation on rotary control valves.

3.8.1 Diaphragm Actuators

- Pneumatically-operated diaphragm actuators use air supply from controllers, positioners, or other sources.
- Various styles include: direct-acting, in which the increasing air pressure pushes the diaphragm down and extends the actuator stem (Figure 3.37); reverse-acting, in which the increasing air pressure pushes the diaphragm up and retracts the actuator stem (Figure 3.37); reversible, in which actuators can be assembled for either direct or reverse action (Figure 3.38); direct-acting unit for rotary valves, in which the increasing air pressure pushes down on the diaphragm, which, depending on orientation of the actuator lever on the valve shaft, may either open or close the valve (see Figure 3.39).
- Net output thrust is the difference between diaphragm force and opposing spring force.
- Molded diaphragms provide linear performance and increased travels.
- Output thrust required and supply

Direct-Acting **Reverse-Acting**

Figure 3.37 Diaphragm Actuators

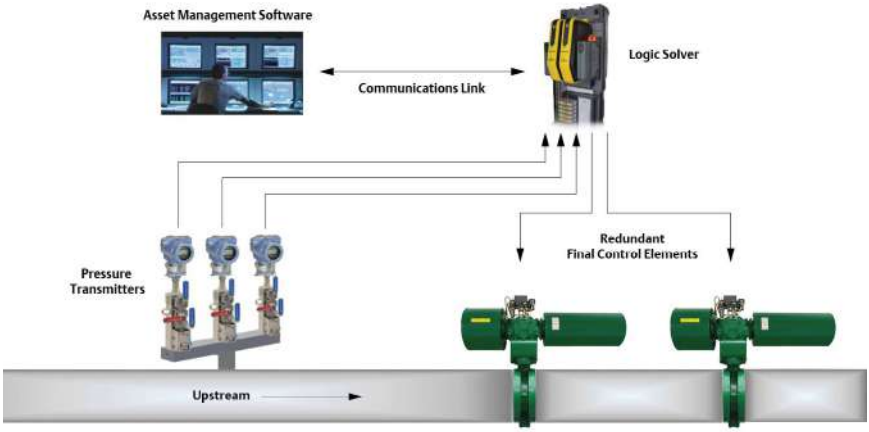

Figure 12.5 Typical HIPPS Configuration

Logic Solver: Logic solvers re often working with a dual processor and constantly running self-diagnostics. Should a failure be detected, it can be set to either shut down the final element or shift to a redundant logic solver.

Final Control Element: The governing standards for safety instrumented systems state that plant operators must determine and document that equipment is designed, maintained, inspected, tested, and operated in a safe manner. Thus it is imperative that these components of the safety instrumented system be tested frequently enough to reduce the PFD and meet the target

SIL: A full stroke or proof test will need to be done with a set of intervals, but due to the nature of the test, this will need to be done out of service. To extend the period between the proof test, online testing like partial stroke testing can be used to detect a fair amount of failures plus give predictive diagnostic, allowing an operator to take action. ■

Fisher™ FIELDVUE™ DPC2K Digital Process Controller

The Fisher FIELDVUE DPC2K digital process controller (figure 1) is an electro-pneumatic PID controller that can replace pneumatic controllers to meet your single continuous PID loop needs. The DPC2K has been designed to provide application flexibility, through simple configuration and high speed network communications, for your next expansion or modernization project.


X1903

Control at the Valve

The DPC2K may be connected directly to the process and has an integral travel sensor that provides actual feedback when mounted on a control valve. Is uses proven linkageless non-contacting technology that supports both globe and linear valve applications. Pipe stand mounting with remote position feedback is available when valve mounting is not feasible.

Features

Application Flexibility

- Control at the Valve— The DPC2K has an option for pressure control utilizing an integral pressure sensor. A 4-20 mA transmitter may also be used for other process operations such as temperature, level, and more. Remote setpoints can be entered digitally or with an analog input.
- PID Control— With both pneumatic and analog control outputs, the DPC2K is ideal for use in expansion or modernization projects, including for air/gas operated actuators or analog control for electric actuators, variable frequency drives, and pumps.
- Intuitive and Simple Configuration— Traditional controllers typically require skilled programming and can be difficult to support and maintain. The configuration software is easy to understand and navigate, using guided instructions to take the guesswork out of troubleshooting.

Safety and Reliability

- Tested in Use— The low-bleed pneumatic design has been field proven. It provides reliable control in harsh environments. Non-contact readback of the valve position ensures proper operation of the PID control algorithm.
- At a Glance Displays—User-friendly displays, both at the local user interface and the Control Dashboard of LoopConnect™ Software when network is connected, providing easy access to the information needed to keep your process running smoothly.

Specifications (continued)

Pneumatic Output Option

The Base Unit specifications also apply to the Pneumatic Output Option

The Pneumatic Output Option may also include the Process Pressure Sensor Option

Supply Pressure

Minimum Recommended: 0.3 bar (5 psig) higher than maximum actuator requirements

Maximum: 10.0 bar (145 psig) or maximum pressure rating of the actuator, whichever is lower

Medium: Air or Natural Gas
Supply medium must be clean, dry and noncorrosive

Per ISA Standard 7.0.01
A maximum 40 micrometer particle size in the air system is acceptable. Further filtration down to 5 micrometer particle size is recommended. Lubricant content is not to exceed 1 ppm weight (w/w) or volume (v/v) basis. Condensation in the air supply should be minimized

Pressure dew point: At least 10°C less than the lowest ambient temperature expected

Per ISO 8573-1

Maximum particle density size: Class 7

Oil content: Class 3

Pressure dew point: Class 3

Connections

Supply Pressure: 1/4 NPT internal

Output Pressure: 1/4 NPT internal

Tubing: 3/8-inch recommended

Vent: 3/8 NPT internal

Electrical: 1/2 NPT internal, two conduit entries

Output Signal

Pneumatic signal, up to full supply pressure

Minimum Span: 0.4 bar (6 psig)
Maximum Span: 9.5 bar (140 psig)
Action: Single Direct

Low Bleed Steady-State Air Consumption(4)(5)(6)

At 1.4 bar (20 psig) supply pressure
0.056 normal m^3/hr (2.1 scfh), average

At 5.5 bar (80 psig) supply pressure
0.184 normal m^3/hr (6.9 scfh), average

Maximum Output Capacity(4)(5)

At 1.4 bar (20 psig) supply pressure:
10.0 normal m^3/hr (375 scfh)

At 5.5 bar (80 psig) supply pressure:
29.5 normal m^3/hr (1100 scfh)

Process Pressure Sensor Option

The Process Pressure Sensor option can be used with either the Base Unit (Analog Output) or the Pneumatic Output Option

Pressure Ranges

Sealed Gauge: 2.1, 6.9, 20.7, 41.4, 103 bar (30, 100, 300, 600, 1500 psi) ranges available

Compensated Temperature range(2)

-20 to 80°C (-4 to 176°F)

Total Accuracy

Reference accuracy: ±0.25%

Temperature Sensitivity: < 0.3% per 50°C

Construction

316 stainless steel wetted parts

Pressure Port

1/4 NPT

Canadian Registration (CRN)

Pending

NOTE: Specialized instrument terms are defined in ANSI/ISA Standard 51.1 - Process Instrument Terminology.
1. NAMUR mounting is not supported on quarter-turn rotary actuators.
2. The pressure/temperature limits in this document and any other applicable code or standard should not be exceeded.
3. Temperature limits vary based on hazardous area approval.
4. Normal m^3/hour - Normal cubic meters per hour at 0°C and 1.01325 bar, absolute. Scfh - Standard cubic feet per hour at 60°F and 14.7 psia.
5. Values at 1.4 bar (20 psig) based on a single-acting direct relay.
6. The Quad O steady-state consumption requirement of 6 scfh can be met by a DPC2K. The 6 scfh requirement can be met by low bleed relay C when used with up to 5.2 bar (75 psi) supply of Natural Gas at 16°C (60°F).

Fisher™ 4196 Temperature Indicating Controllers

Fisher 4196 temperature indicating controllers show process temperature and set point on an easy-to-read process scale. The controllers are used in industries requiring accurate process monitoring and temperature control.

A temperature bulb (figure 6) measures process temperature. A 4196 controller then compares process temperature with an operator- adjusted set point. The controller delivers a pneumatic signal to a control element. The control element changes the process temperature toward the set point.

Controller types are available for proportional-only, proportional-plus-reset, proportional-plus-reset-plus-rate, and differential gap for on-off control.

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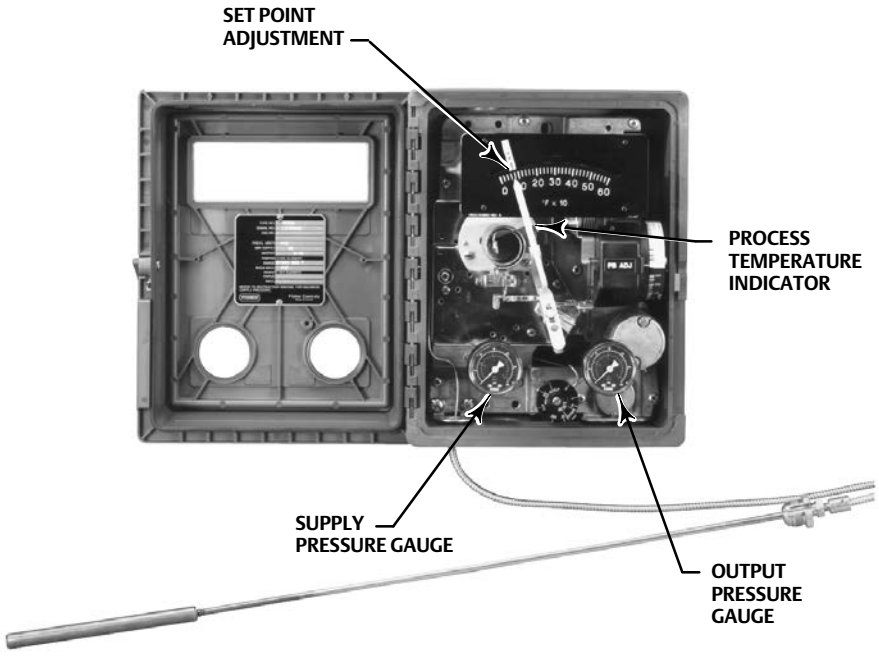
PIPESTAND-MOUNTED CONTROLLER



W5824

INTERIOR OF CONTROLLER

Specifications

Available Configurations

See table 1

Process Sensor Range (Input Signal)

Type: Temperature between -73 and 371°C (-100 and 700°F). See table 2 for available ranges
Minimum Span: 60°C or 100°F
Maximum Span: 300°C or 600°F

Output Signal

Proportional or Proportional-Plus-Reset Range: ■ 0.2 to 1.0 bar (3 to 15 psig) or ■ 0.4 to 2.0 bar (6 to 30 psig)

Differential Gap Output: ■ 0 and 1.4 bar (0 and 20 psig) or ■ 0 and 2.4 bar (0 and 35 psig)

Action: Field-reversible between ■ direct (increasing sensed temperature increases output pressure) or ■ reverse (increasing sensed temperature decreases output pressure)

Process Scale

Matched to the range of the sensing element as standard. Optional(1) scales available.

Supply and Output Connections

1/4 NPT internal

Supply Pressure Requirements(2)

See table 3

Supply Pressure Medium

Air or non-corrosive Natural Gas

Remote Set Point Pressures

■ 0.2 to 1.0 bar (3 to 15 psig) or ■ 0.4 to 2.0 bar (6 to 30 psig)

Maximum Allowable Pressure in Closed Vessel (For Temperature Element Assembly)(3)

9.7 mm (3/8-Inch) Diameter Temperature Bulb: 69 bar (1000 psig)

14.3 mm (9/16-Inch) Diameter Temperature Bulb: 34.5 bar (500 psig)

Construction Materials

See table 4

Controller Adjustments

Proportional Band: 5 to 500% of process scale range
Reset: Adjustable from 0.01 to more than 74 min per repeat (from 100 to less than 0.0135 repeats per min)
Differential Gap Controllers: Adjustable from 1 to 100% of process scale range
Set Point: Continuously adjustable from 0 to 100% of the scale range

Controller Performance

Repeatability: 0.4% of output span
Dead Band: Less than 0.4% of process scale range
Time Constant of Temperature Bulb: 6 to 12 seconds for a 93°C (200°F) span (bare bulb in agitated liquid)

Steady-State Air Consumption(4)(5)

0.2 to 1.0 Bar (3 to 15 psig) Output: 0.08 m^3/hr (2.8 scfh)
0.4 to 2.0 Bar (6 to 30 psig) Output: 0.07 m^3/hr (2.5 scfh)

Operative Ambient Temperature Limits(2)(6)

–40 to 70°C (–40 to 160°F)

-continued-

Table of Contents

Specifications (continued)

Hazardous Area Classification

Complies with the requirements of ATEX Group II Category 2 Gas and Dust

CE Ex II 2 G D — Ex h IIC Tx Gb
Ex h IIIC Tx Db

Maximum surface temperature (Tx) depends on operating conditions

Gas: T6
Dust: T70

Meets Customs Union technical regulation TP TC 012/2011 for Groups II/III Category 2 equipment

Ex — II Gb c T*X
III Db c T*X — EAC

Housing

Designed to NEMA 3 (Weatherproof) and IEC 529 IP54 specifications

Mounting

Controller can be mounted on ■ actuator, ■ panel, ■ wall, or ■ pipestand

Approximate Weight

4.5 kg (10 lb)

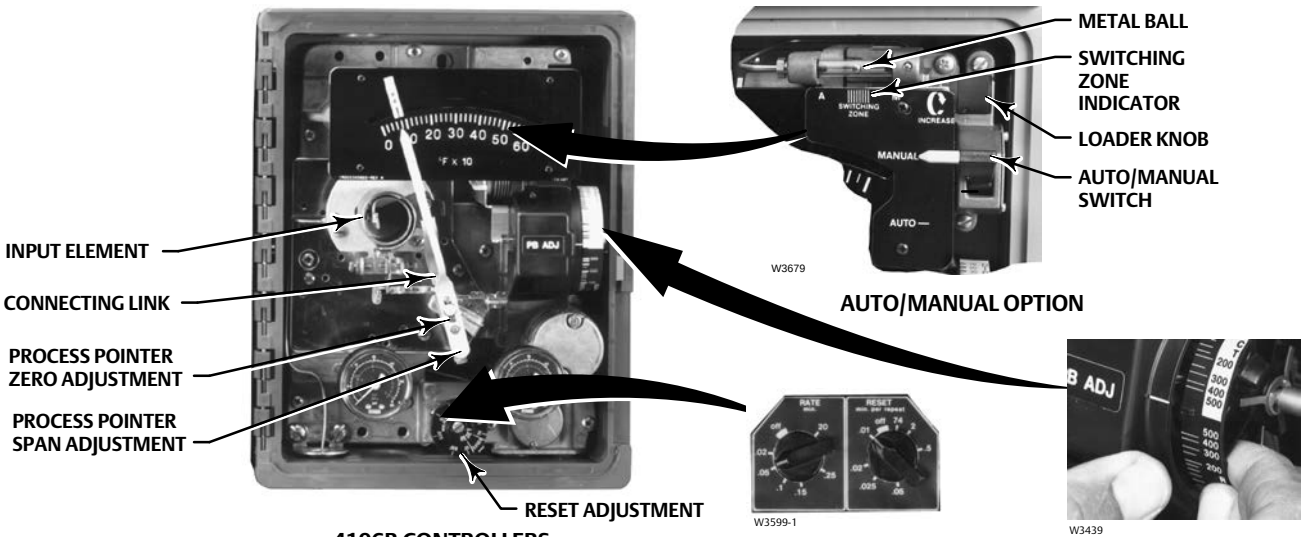
Note: Specialized instrument terms are defined in ANSI/ISA Standard 51.1 - Process Instrument Terminology.
1. Consult your Emerson sales office for additional information.
2. The pressure/temperature limits in this document and any applicable standard or code limitation should not be exceeded.
3. At 40°C (100°F)
4. Normal m^3/hr--normal cubic meters per hour (m^3/hr, 0°C and 1.01325 bar, absolute). Scfh--standard cubic feet per hour (ft^3/hr, at 60°F and 14.7 psig).
5. Without auto/manual switch. With auto/manual switch add 0.01 m^3/hr (0.5 scfh).
6. Also for transportation and storage limits.

Table 1. Available Configurations

TYPE NUMBER(1)	CONFIGURATIONS						
	Proportional-Only Suffix Letter A	Proportional-Plus Reset Suffix Letter B	Proportional-Plus Reset-Plus-Rate Suffix Letter C	Differential Gap Suffix Letter S	Anti-Reset Windup Suffix Letter F	Remote Set Point Suffix Letter M	Internal Auto/ Manual Station Suffix Letter E
4196A	X	---	---	---	---	---	---
4196AE	X	---	---	---	---	---	X
4196AM	X	---	---	---	---	X	---
4196AME	X	---	---	---	---	X	X
4196B	---	X	---	---	---	---	---
4196BE	---	X	---	---	---	---	X
4196BF	---	X	---	---	X	---	---
4196BFE	---	X	---	---	X	---	X
4196BM	---	X	---	---	---	X	---
4196BME	---	X	---	---	---	X	X
4196BFM	---	X	---	---	X	X	---
4196BFME	---	X	---	---	X	X	X
4196C	---	---	X	---	---	---	---
4196CE	---	---	X	---	---	---	X
4196CF	---	---	X	---	X	---	---
4196CFE	---	---	X	---	X	---	X
4196CM	---	---	X	---	---	X	---
4196CME	---	---	X	---	---	X	X
4196CFM	---	---	X	---	X	X	---
4196CFME	---	---	X	---	X	X	X
4196S	---	---	---	X	---	---	---
4196SE	---	---	---	X	---	---	X
4914HSM	---	---	---	X	---	X	---
4196SME	---	---	---	X	---	X	X

1. Reverse-acting constructions are designated by an R added to the type number.

Figure 1. Controller Construction Detail



Note:
1 White portion of proportional band adjustment enables direct controller action; black portion enables reverse controller action.

W5824

Construction Features

Simplified Relay Maintenance

A clean-out wire provides a fast, easy means of cleaning the relay primary orifice during service.

Pressure Protection for the Case

A rubber plug in the plastic case pops out to vent excessive pressure buildup inside the case before structural damage can occur.

Easy Direct/Reverse Switching

Controller action can be switched from direct to reverse or vice versa by simply loosening the screws on the proportional band cover and moving the cover out to rotate the proportional band knob to the desired action (see figure 1).

Easy Mode Conversion

Conversion from proportional to proportional-plus-reset control requires the addition of a reset valve and two pieces of tubing. Conversion from proportional to proportional-plus-reset-plus-rate control requires the addition of a reset/rate valve and three pieces of tubing. Conversion from proportional to differential gap control requires the addition of one piece of tubing. These conversions require removing the controller from the case.

Anti-Reset Windup

Anti-reset windup is available with proportional-plus-reset and proportional-plus-reset-plus-rate controllers. A relief valve can be adjusted to limit reset windup on either increasing or decreasing output.

Remote Set Point

The capability of adjusting the set point from a remote location is available as an option with all 4196 controllers.

Auto/Manual Capability

An optional internal auto/manual station permits smooth, bumpless transfer between automatic control and manual operation without disturbing the controller output. A positive-acting, two-position

Figure 2. Schematic of Fisher 4196 Temperature Controllers

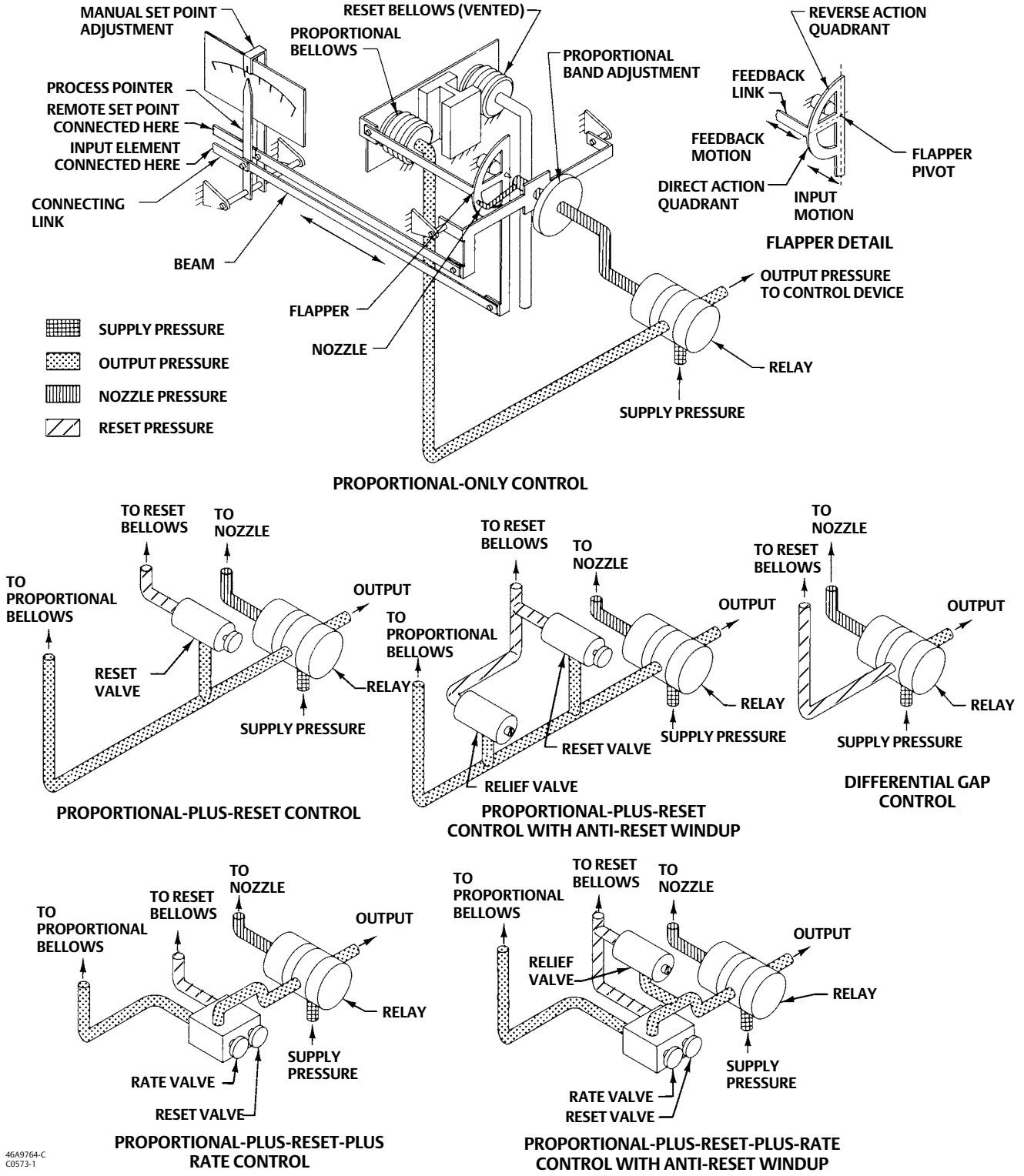
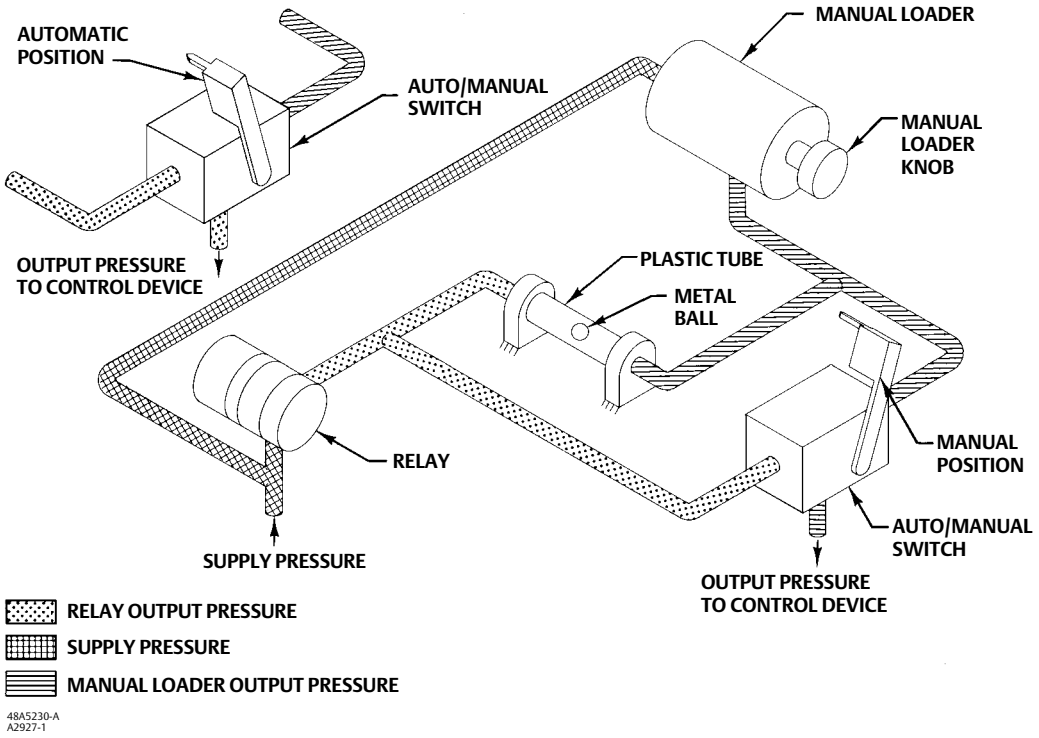


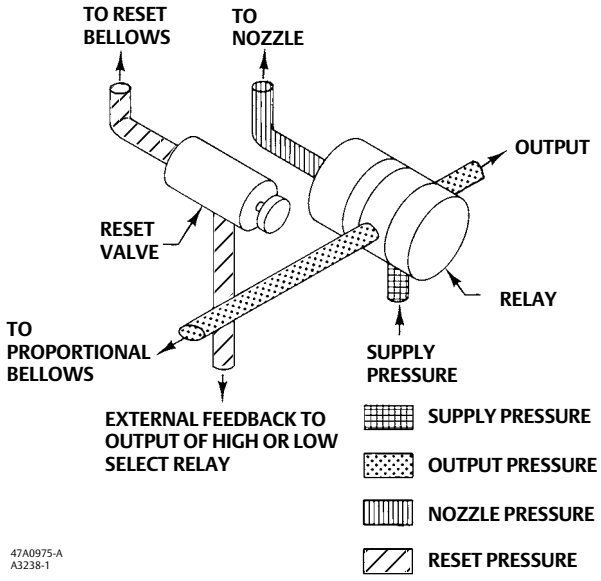
Figure 4. Schematic of Auto/Manual Option



External Feedback Option

External feedback is available with all 4196B controllers. Controllers with this option have an external process connection on the bottom of the controller case (see figure 8). This connection breaks the positive feedback (reset) loop inside the controller and brings it outside (see figure 5). The connection allows the positive feedback loops of two controllers (primary and secondary) to be tied together when the controllers are used in an override application. Thus connected, the feedback loop of the secondary controller tracks the primary controller, minimizing reset windup.

Figure 5. Schematic of External Feedback Option



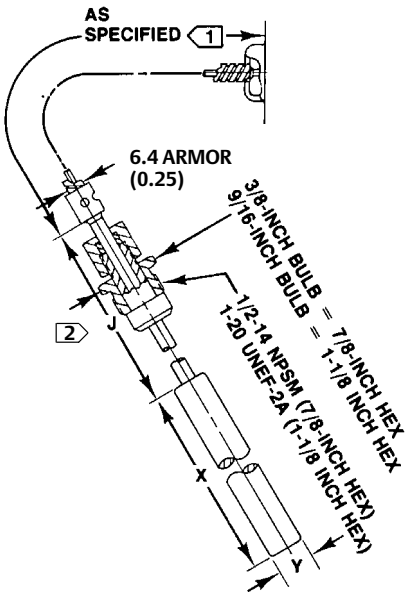
Installation

In a typical installation, a 4196 temperature controller mounts on a pipestand. The capillary tube length determines the installation site.

When installing a controller, the vent must point down. When the temperature bulb (dimensions shown in table 5 and figure 6) is used within a closed vessel, the bulb screws into a bushing (see figure 7) that penetrates the vessel. Where pressure within the closed vessel exceeds the limits of the temperature bulb or when the process fluid is corrosive, the temperature bulb screws into a thermowell (see figure 7) that penetrates the vessel. Lag type bushings and thermowells (also shown in figure 7) are used where extra length is required, such as installation in a process vessel that is coated with insulation. Dimensions for bushings and thermowells are shown in figure 7 and tables 6 and 7.

See figure 8 for basic controller dimensions. Figure 9 shows dimensions for specific mounting configurations.

Figure 6. Dimensions for Temperature Bulb with Adjustable Union (also see table 5)



mm
(INCH)

Notes:
1 Available in 4.6 and 7.6 m (15 and 25 foot) lengths. Minimum bending radius is 25 mm (1 inch).
2 Bendable extension length, Minimum bending radius is 32 mm (1-1/4 inch).
3. Temperature bulb may be used with either bushing or thermowell connection parts per SAMA RC6-10.

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A6921-1

Table 5. Dimensions for Temperature Bulb with Adjustable Union

SAMA STYLE	TEMPERATURE SPANS		DIMENSION						
	°C	°F	B(1)	J		X		Y	
				mm	Inch	mm	Inch	mm	Inch
Adjustable Union (Standard Construction)	100 and 150 60, 150 through 300	200 and 300, 100 and 150, 300 through 600	1/2-14 NPSM 1-20 UNEF-2A	445 584	17.50 23.00	145 178	5.70 7.00	10 14	0.38 0.56

1. NPSM--National Straight Pipe Threads for Mechanical Joints; UNEF--Unified Thread-Extra

Figure 8. Controller Dimensions

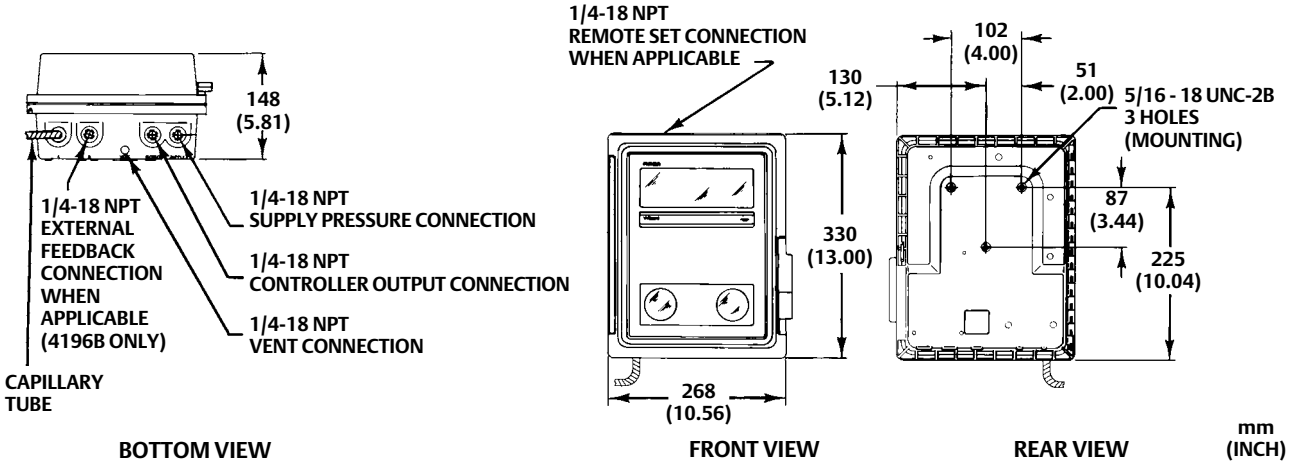

Figure 9. Mounting Dimensions