4150K and 4160K Series Wizard® II Pressure Controllers and Transmitters

Contents

Figure 1. Wizard® II Controller Yoke-Mounted on Control Valve Actuator

4150K and 4160K Controllers and Transmitters

Contents (Continued)

Introduction

Scope of Manual

This instruction manual provides installation, operating, maintenance, and parts information for the 4150K and 4160K Series Wizard® II pressure controllers and transmitters shown in figure 1. Refer to separate instruction manuals for information regarding the control valve, actuator, and accessories.

No person may install, operate, or maintain 4150K and 4160K Series Wizard II pressure controllers and transmitters without first ● being fully trained and qualified in valve, actuator and accessory installation, operation and maintenance, and ● carefully reading and understanding the contents of this manual. If you have any questions about these instructions, contact your Emerson Process Management™ sales office.

Description

The 4150K and 4160K Series pneumatic pressure controllers and transmitters use a bellows or Bourdon tube sensing element to sense the gauge pressure, vacuum, compound pressure, or differential pressure of a liquid or gas. The controller or transmitter output is a pneumatic pressure signal that can be used to operate a final control element, indicating device, or recording device.

Unless otherwise noted, all NACE references are to NACE MR0175-2002.

Specifications

Specifications for the 4150K and 4160K Series controllers and transmitters are listed in table 1. Table 2 explains available configurations and options.

Educational Services

For information on available courses for 1450K and 4160K Series controllers and transmitters, as well as a variety of other products, contact:

Emerson Process Management
Educational Services, Registration
P.O. Box 190; 301 S. 1st Ave.
Marshalltown, IA 50158-2823
Phone: 800-338-8158 or
Phone: 641-754-3771
FAX: 641-754-3431
e-mail: education@emersonprocess.com

Note

Neither Emerson®, Emerson Process Management, Fisher®, nor any of their affiliated entities assumes responsibility for the selection, use, and maintenance of any product. Responsibility for the selection, use, and maintenance of any product remains with the purchaser and end-user.

Installation

⚠ WARNING

To avoid personal injury or property damage resulting from the sudden release of pressure:

● Always wear protective clothing, gloves, and eyewear when performing any installation operations.

● Personal injury or property damage may result from fire or explosion if natural gas is used as the supply medium and preventative measures are not taken. Preventative measures may include: Remote venting of the unit, re-evaluating the hazardous area classification, ensuring adequate ventilation, and the removal of any nearby ignition sources. For information on remote venting of this controller/transmitter, refer to page 9.

(Installation Warning continued on page 5)

Table 1. Specifications

Available Configurations

See table 2

Input Signal(1)

Type: ■ Gauge pressure, ■ vacuum, ■ compound pressure, or ■ differential pressure of a liquid or gas
Limits: See table 3 or 4

Output Signal(1)

Proportional-Only or Proportional-Plus-Reset Controllers and Transmitters:
■ 0.2 to 1.0 bar (3 to 15 psig) or
■ 0.4 to 2.0 bar (6 to 30 psig) pneumatic pressure signal
Differential Gap Controllers:
■ 0 and 1.4 bar (0 and 20 psig) or
■ 0 and 2.4 bar (0 and 35 psig) pneumatic pressure signal
Action: Control action is field reversible between ■ direct (increasing sensed pressure produces increasing output signal) and ■ reverse (increasing sensed pressure produces decreasing output signal). The suffix R is added to the type number of a construction specified for reverse action.

Supply Pressure Requirements(2)

See table 5

Supply Pressure Medium

Air or natural gas(3)

Steady-State Air Consumption(1)

See figure 2

Supply and Output Connections

1/4-inch NPT female

Common Signal Pressure Conversions

See table 6

Proportional Band(1) Adjustment

For Proportional-Only and Proportional-Plus-Reset Controllers: Full output pressure change adjustable from 3 to 100% for a 0.2 to 1.0 bar (3 to 15 psig), or 6 to 100% for a 0.4 to 2.0 bar (6 to 30 psig) of the sensing element range.

Differential Gap Adjustment

For Differential Gap Controllers: Full output pressure change adjustable from 15% to 100% of sensing element range

Reset(1) Adjustment

For Proportional-Plus-Reset Controllers: Adjustable from 0.01 to 74 minutes per repeat (100 to 0.01 repeats per minute)

Zero(1) Adjustment (Transmitters Only)

Continuously adjustable to position span of less than 100% anywhere within the sensing element range

Span(1) Adjustment (Transmitters Only)

Full output pressure change adjustable from 6 to 100% of sensing element range

Performance

Repeatability(1): 0.5% of sensing element range
Deadband(1) (Except Differential Gap Controllers(4): 0.1% of output span
Typical Frequency Response at 100% Proportional Band
Output to Actuator: 0.7 Hz and 110 degree phase shift with 1850 cm^3 (113 $inches^3$) volume, actuator at mid-stroke
Output to Positioner Bellows: 9 Hz and 130 degree phase shift with 0.2 to 1.0 bar (3 to 15 psig) output to 33 cm^3 (2 $inches^3$) bellows

Ambient Operating Temperature Limits(2)

■ **Standard Construction:** −40 to 93°C (−40 to 200°F)
■ **4160KF (w/Reset Relief):** −40 to 71°C (−40 to 160°F)

Typical Ambient Temperature Operating Influence

Proportional Control only: Output pressure changes ±3.0% of sensing element range for each 28°C (50°F) change in temperature between −40 and 71°C (−40 and 160°F) for a controller set at 100% proportional band
Reset Control only: Output pressure changes ±2.0% of sensing element range for each 28°C (50°F) change in temperature between −40 and 71°C (−40 and 160°F) for a controller set at 100% proportional band

−Continued−

Table 1. Specifications (continued)

Typical Ambient Temperature Operating Influence (continued)

Transmitters only: Output pressure changes ±3.0% of sensing element range for each 28°C (50°F) change in temperature between –40 and 71°C (–40 and 160°F) for a transmitter set at 100% span

Hazardous Area Classification

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

CE ⟨Ex⟩ II 2 G D

Refer to figure 22 for location of ATEX label

Approximate Weight

8.2 kg (18 pounds)

Options

Case pressure tested to 0.14 bar (2 psig)

Declaration of SEP

Fisher Controls International LLC declares this product to be in compliance with Article 3 paragraph 3 of the Pressure Equipment Directive (PED) 97 / 23 / EC. It was designed and manufactured in accordance with Sound Engineering Practice (SEP) and cannot bear the CE marking related to PED compliance.

However, the product *may* bear the CE marking to indicate compliance with *other* applicable EC Directives.

1. This term is defined in ISA Standard S51.1.
2. The pressure/temperature limits in this document and any applicable standard or code limitation should not be exceeded.
3. This product can be used with natural gas. Natural gas should not contain more than 20 ppm of H_2S.
4. An adjustable differential gap (differential gap controllers) is equivalent to an adjustable deadband.

Table 2. Available Configurations

DESCRIPTION		TYPE NUMBER(1)		
		Bourdon Tube Sensing Element (Gauge Pressure Only)	Bellows Sensing Element	
			Gauge Pressure	Differential Pressure
Proportional-only controller		4150K	4152K	4154K
Proportional-plus-reset controller	Without anti-reset windup	4160K	4162K	4164K
	With anti-reset windup	4160KF	4162KF	- - -
Differential gap controller		4150KS	4152KS	- - -
Transmitter		4157K	4158K	4155K

1. The suffix R is added to the type number of a construction specified for reverse action.

Table 3. Bourdon Tube Pressure Ranges and Materials

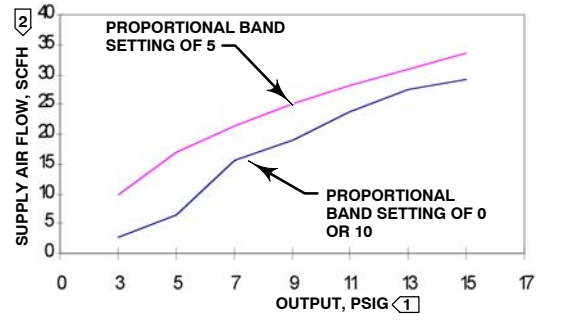
PRESSURE RANGES(1)		MAXIMUM ALLOWABLE STATIC PRESSURE(2) LIMITS(3)				MATERIAL
		Standard		With Optional Travel Stop(4)		
Bar	Psig	Bar	Psig	Bar	Psig	
0 to 2.0	0 to 30	2.0	30	3.3	48	316 stainless steel
0 to 4.0	0 to 60	4.0	60	6.6	96	
0 to 7.0	0 to 100	7.0	100	11	160	
0 to 14	0 to 200	14	200	19	280	
0 to 20	0 to 300	20	300	29	420	
0 to 40	0 to 600(5)	40	600	50	720	
0 to 70	0 to 1000(5)	70	1000	83	1200	
0 to 100	0 to 1500(5)	100	1500	115	1650	
0 to 200	0 to 3000	200	3000	230	3300	
0 to 350	0 to 5000	350	5000	380	5500	
0 to 550	0 to 8000	550	8000	550	8000	
0 to 700	0 to 10.000	700	10,000	700	10,000	

1. Range marked on Bourdon tube may be in kPa (1 bar = 100 kPa)
2. This term is defined in ISA Standard S51.1.
3. Bourdon tube may be pressurized to limit shown without permanent zero shift.
4. With travel stop set at 110% of the range.
5. These Bourdon tubes are also available in N05500 for sour service.

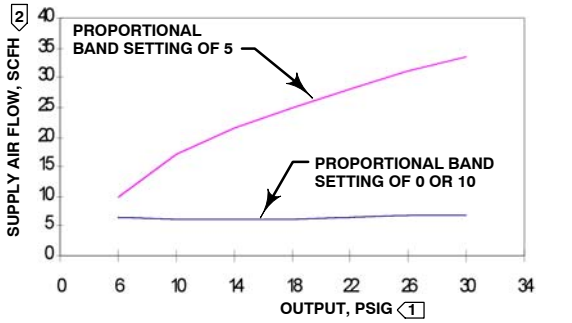
Table 4. Bellows Pressure Ranges and Materials

PRESSURE RANGES			MAXIMUM ALLOWABLE STATIC PRESSURE(1) LIMITS(2)			
			Brass Construction		Stainless Steel Construction	
			Bar	Psig	Bar	Psig
Gauge Pressure	Vacuum	0 to 150 mbar (0 to 60 inch wc)	1.6	20	---	---
		0 to 340 mbar (0 to 10 inch Hg)	2.8	40	---	---
		0 to 1.0 bar (0 to 30 inch Hg)	2.8	40	6.9	100
	Compound Pressure	75 mbar vac. to 75 mbar (30 inch wc vac. to 30 inch wc)	1.4	20	---	---
		500 mbar vac. to 500 mbar (15 inch Hg vac. to 7.5 psig)	2.8	40	6.9	100
		1.0 bar vac. to 1.0 bar (30 inch Hg vac. to 15 psig)	2.8	40	6.9	100
	Positive pressure	0 to 150 mbar (0 to 60 inch wc)	1.4	20	---	---
		0 to 250 mbar(3) (0 to 100 inch wc)	1.4	20	---	---
		0 to 350 mbar(4) (0 to 140 inch wc)	2.8	40	---	---
		0 to 0.35 bar (0 to 5 psig)	2.8	40	---	---
		0 to 0.5 bar (0 to 7.5 psig)	2.8	40	---	---
		0 to 0.7 bar (0 to 10 psig)	2.8	40	---	---
		0 to 1.0 bar (0 to 15 psig)	2.8	40	6.9	100
		0 to 1.4 bar (0 to 20 psig)	2.8	40	---	---
		0 to 2.0 bar (0 to 30 psig)	2.8	40	6.9	100
Differential Pressure(5)		0 to 300 mbar (0 to 80 inch wc)	1.4	20	---	---
		0 to 0.7 bar (0 to 10 psi)	2.8	40	---	---
		0 to 1.4 bar (0 to 20 psi)	2.8	40	---	---
		0 to 2.0 bar (0 to 30 psi)	---	---	6.9	100

1. This term is defined in ISA Standard S51.1.
2. Bellows may be pressured to limit shown without permanent zero shift.
3. Type 4158K transmitter only.
4. Except Type 4158K transmitter.
5. The overrange limit for these sensing elements is a differential pressure equal to the maximum allowable static pressure limit.



3 TO 15 PSIG (0.2 TO 1.0 BAR) OUTPUT SIGNAL RANGE



6 TO 30 (0.4 TO 2.0 BAR) OUTPUT SIGNAL RANGE

NOTES
1 TO CONVERT PSIG TO BAR, MULTIPLY BY 0.06895.
2 SCFH—STANDARD CUBIC FEET PER HOUR (60°F AND 14.7 PSIA). TO CONVERT TO NORMAL M^3/HR—NORMAL CUBIC METERS PER HOUR (0°C AND 1.01325 BAR, ABSOLUTE), MULTIPLY BY 0.0268

Figure 2. Steady-State Air Consumption

A7242 / IL

WARNING

(Installation Warning, continued from page 2)

- **If installing into an existing application, also refer to the WARNING at the beginning of the Maintenance section in this instruction manual.**
- **Check with your process or safety engineer for any additional measures that must be taken to protect against process media.**

Standard Installation

The instruments are normally mounted vertical with the case/cover as shown in figure 1. If installing the instrument in any other position, be sure that the vent opening shown in figure 3 is facing downward.

Panel Mounting

Refer to figure 3.

Cut a hole in the panel surface according to the dimensions shown in figure 3. Remove the cap screws (key 252), brackets (key 251), and vent assembly (key 15). Slide the controller or transmitter

into the cutout and reattach the brackets. Tighten the cap screw located in the center of each bracket to draw the case snugly and evenly against the panel. Reinstall the vent unless a remote vent will be used.

Wall Mounting

Refer to figure 3.

Drill four holes in the wall using the dimensions shown in figure 3. In the bracket (key 251) are 8.7 mm (0.3438 inch) diameter holes. Back out the cap screw located in the center of each bracket. (The screws are used for panel mounting but are not required for wall mounting.) If tubing runs through the wall, drill holes in the wall to accommodate the tubings. Figure 3 shows the pressure connection locations in the back of the case.

Mount the controller to the bracket using the four cap screws (key 252) provided. Attach the bracket to the wall, using suitable screws or bolts.

Pipestand Mounting

Refer to figure 3.

Attach the spacer spools (key 228) and the mounting plate (key 213) to the controller with cap screws, lock washers, and nuts (keys 215, 221, and 216). Attach the controller to a 2-inch (nominal) pipe with pipe clamps (key 250).

Actuator Mounting

Refer to figure 4.

Controllers specified for mounting on a control valve actuator are mounted at the factory. If the instrument is ordered separately for installation on a control valve actuator, mount the instrument according to the following instructions.

Mounting parts for the different actuator types and sizes vary. Two typical actuator-mounting installations are shown in figure 4; see the parts list for parts required for the specific actuator type and size involved. Attach the spacer spools (key 228) and the mounting plate (key 213) to the controller with machine screws, lock washers, and nuts (keys 215, 221, and 216).

Attach the mounting bracket to the actuator yoke with cap screws (key 222) and, if needed, spacer spools. On some designs, the mounting bracket is attached to the actuator diaphragm casing rather than to the yoke.

Pressure Connections

WARNING

To avoid personal injury or property damage resulting from the sudden release of pressure, do not install any system component where service conditions could exceed the limits given in this manual. Use pressure-relieving devices as required by government or accepted industry codes and good engineering practices.

All pressure connections on 4150K and 4160K Series instruments are 1/4-inch NPT female. Use 6 mm (1/4-inch) or 10 mm (3/8-inch) pipe or tubing for supply and output piping. The pressure connection locations are shown in figure 3.

Supply Pressure

WARNING

Severe personal injury or property damage may occur from an uncontrolled process if the instrument supply medium is not clean, dry, oil-free and noncorrosive. While use and regular maintenance of a filter that removes particles larger than 40 microns in diameter will suffice in most applications, check with an Emerson Process Management field office and industry instrument supply medium quality standards for use with hazardous gas or if you are unsure about the proper amount or method of air filtration or filter maintenance.

Supply pressure must be clean, dry air or noncorrosive gas that meets the requirements of ISA Standard S7.3. Use a suitable supply pressure regulator to reduce the supply pressure source to the normal operating supply pressure shown in table 5. Connect supply pressure to the SUPPLY connection at the back of the case.

If operating the controller or transmitter from a high pressure source [up to 138 bar (2000 psig)], use a high pressure regulator system, such as the Type 1367 High Pressure Instrument Supply System. For Type 1367 system installation, adjustment, and maintenance information, see the separate instruction manual.

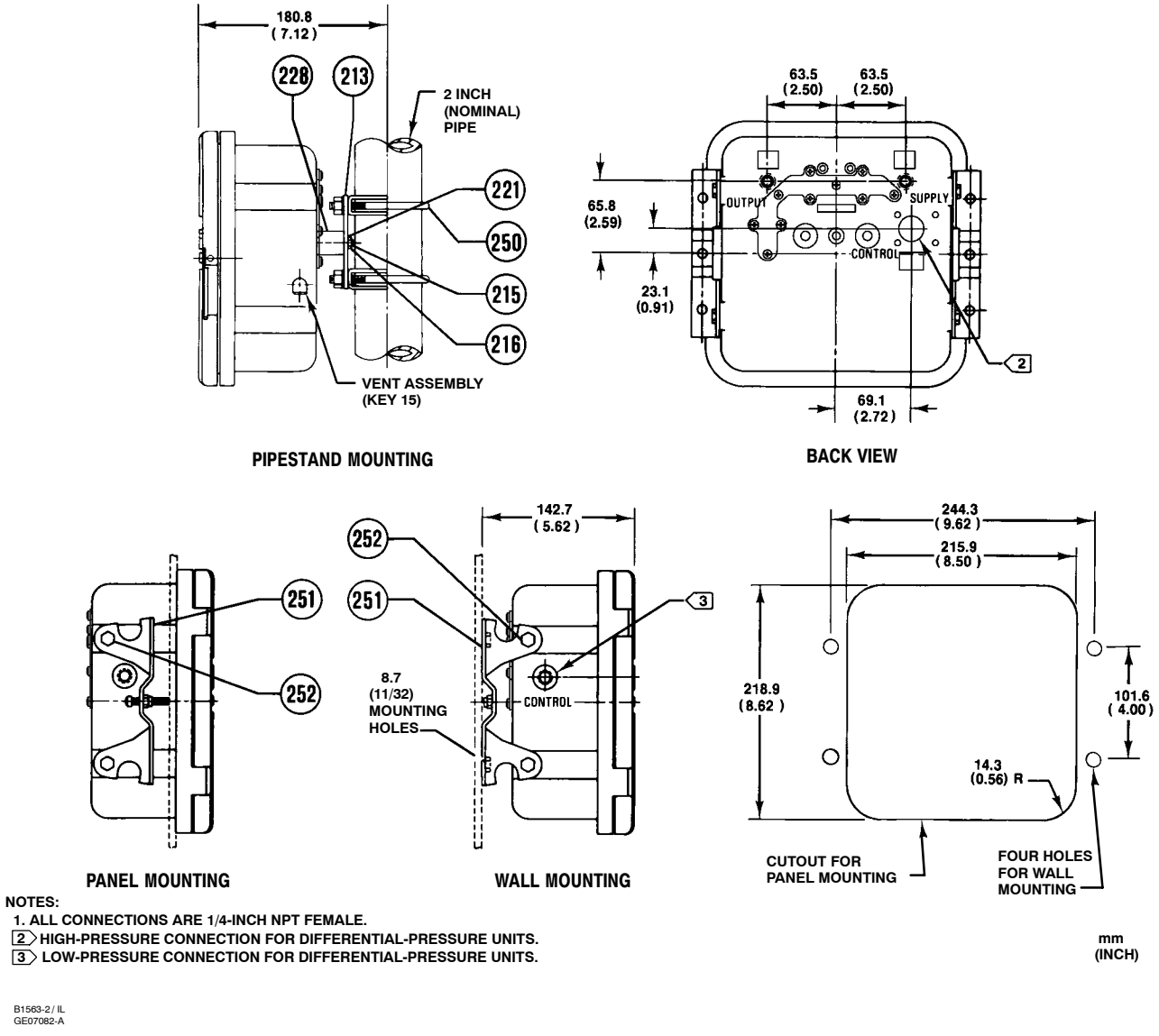


Figure 3. Panel, Wall, and Pipestand Mounting

Process Pressure

WARNING

To avoid personal injury or property damage resulting from the sudden release of pressure when using corrosive media, make sure the tubing and instrument components that contact the corrosive medium are of suitable noncorrosive material.

Also refer to the Installation Warning at the beginning of this section.

The pressure connections to the controller depend upon the type of pressure sensing, gauge or differential. Gauge pressure controllers use either a Bourdon tube or bellows as the sensing element, as indicated in table 2. Differential pressure controllers use two bellows to sense differential pressure.

For gauge pressure instruments: The control pressure block (key 8 in figure 18) has two connections. Process pressure can be connected either to the CONTROL connection on the back of the case, or to the connection on the left side of the case, shown in figure 3, depending on the instrument application. Plug the unused connection.

Table 5. Supply Pressure Requirements

OUTPUT SIGNAL RANGE		NORMAL OPERATING SUPPLY PRESSURE(1)	MAXIMUM ALLOWABLE SUPPLY PRESSURE TO PREVENT INTERNAL PART DAMAGE
Bar	0.2 to 1.0 or 0 and 1.4 (differential gap)	1.4	2.8
	0.4 to 2.0 or 0 and 2.4 (differential gap)	2.4	2.8
Psig	3 to 15 or 0 and 20 (differential gap)	20	40
	6 to 30 or 0 and 35 (differential gap)	35	40

1. If this pressure is exceeded, control may be impaired.

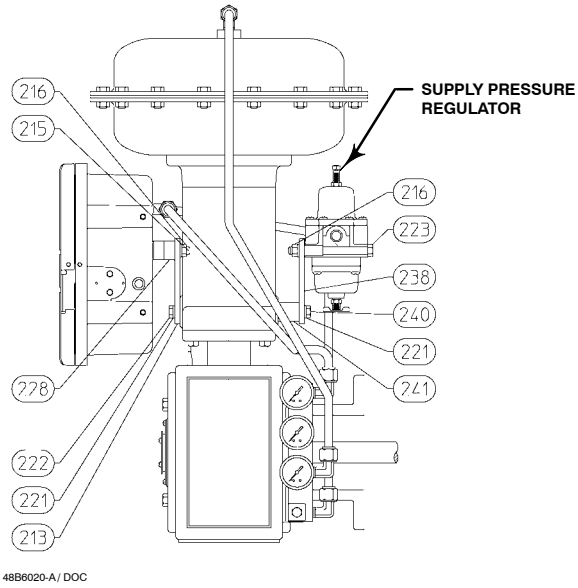
Table 6. Common Signal Pressure Conversions

Mps	kg/cm^2	bar	kPa	Psi
0.02	0.2	0.2(2)	20(1)	3
0.03	0.3	0.3	35	5
0.04	0.4	0.4	40(1)	6
0.05	0.5	0.5	50	7
0.06	0.6	0.6	60	9
0.07	0.8	0.8	75	11
0.08	0.8	0.8	80	12
0.09	1.0	1.0	95	14
0.10	1.0(3)	1.0(2)	100(1)	15
0.12	1.3	1.2	125	18
0.14	1.4	1.4	140	20
0.15	1.5	1.5	150	22
0.17	1.8	1.7	170	25
0.18	1.9	1.9	185	27
0.20	2.0	2.0(3)	200(1)	30
0.22	2.2	2.2	220	32
0.23	2.3	2.3	230	33
0.24	2.5	2.4	240	35
0.34	3.5	3.4	345	50
0.55	5.6	5.5	550	80
0.69	7.0	6.9	690	100
1.03	10.5	10.3	1035	150

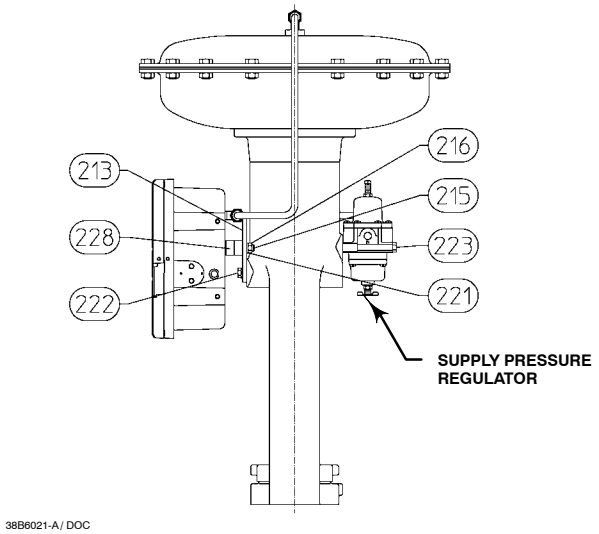
1. Values as listed in ANSI/S7.4.
2. Values as listed in IEC Standard 382.
3. Values rounded to correspond with kPa values.

For differential pressure instruments: Connect the low pressure line to the CONTROL connection on the side of the case and the high pressure line to the CONTROL connection on the back of the case as shown in figure 3.

When installing process piping, follow accepted practices to ensure accurate transmission of the process pressure to the controller or transmitter. Install shutoff valves, vents, drains, or seal systems as needed in the process pressure lines. If the instrument is located such that the adjacent process pressure lines will be approximately horizontal, the lines should slope downward to the instrument for liquid-filled lines and upward to instruments for gas-filled lines. This will minimize the possibility of air becoming trapped in the sensor with liquid-filled lines or of condensation becoming trapped with gas-filled lines. The recommended slope is 83 mm per meter (1 inch per foot).



TYPICAL ROTARY ACTUATOR



TYPICAL SLIDING STEM ACTUATOR

Figure 4. Actuator Mounting

If a controller is being used in conjunction with a control valve to control pipeline pressure, connect the process pressure line in a straight section of pipe approximately 10 pipe diameters from the valve but away from bends, elbows, and areas of abnormal fluid velocities. For pressure-reducing service, the process line must be connected downstream of the valve. For pressure-relief service, the process pressure line must be connected upstream of the control valve. Install a needle valve in the process pressure line to dampen pulsations.

Vent Assembly

WARNING

Personal injury or property damage could result from fire or explosion of accumulated gas, or from contact with hazardous gas, if a flammable or hazardous gas is used as the supply pressure medium. Because the instrument case and cover assembly do not form a gas-tight seal when the assembly is enclosed, a remote vent line, adequate ventilation, and necessary safety measures should be used to prevent the accumulation of flammable or hazardous gas. However, a remote vent pipe alone cannot be relied upon to remove all flammable and hazardous gas. Vent line piping should comply with local and regional codes, and should be be as short as possible with adequate inside diameter and few bends to reduce case pressure buildup.

CAUTION

When installing a remote vent pipe, take care not to overtighten the pipe in the vent connection. Excessive torque will damage the threads in the connection.

The vent assembly (key 15, figure 3) or the end of a remote vent pipe must be protected against the entrance of all foreign matter that could plug the vent. Use 13 mm (1/2-inch) pipe for the remote vent pipe, if one is required. Check the vent periodically to be certain it has not become plugged.

Controller Operation

Proportional-Only Controllers

This section describes the adjustments and procedures for calibration and startup. Adjustment locations are shown in figure 5 unless otherwise specified. All adjustments must be made with the cover open. When the adjustments and calibration procedures are complete, close and latch the cover.

To better understand the adjustments and overall operation of the controller, refer to the Principle of Operation section in this manual for proportional-only controllers. Refer also to the schematic diagram in figure 14.

Adjustments

Adjustment: Set Point

Adjust the pressure-setting knob by turning the knob clockwise to increase the set point and counterclockwise to decrease the set point. Note: The dial setting and actual process pressure may vary significantly, especially with a wide proportional band setting.

Adjustment: Proportional Band

To adjust the proportional band, rotate the proportional band knob to the desired value.

The proportional band adjustment determines the amount of change in controlled pressure required to cause the control valve to stroke fully. It may be adjusted from 3-100 percent of the nominal sensing element pressure rating.

Calibration: Proportional-Only Controllers

Unless otherwise indicated, key number locations are shown in figure 5.

Provide a process pressure source capable of simulating the process pressure range of the controller. If an output pressure gauge is not provided, install a suitable pressure gauge for calibration purposes.

Connect a pressure source to the supply pressure regulator and be sure the regulator is delivering the correct supply pressure to the controller. The controller must be connected open loop (Open loop: The controller output pressure changes must be

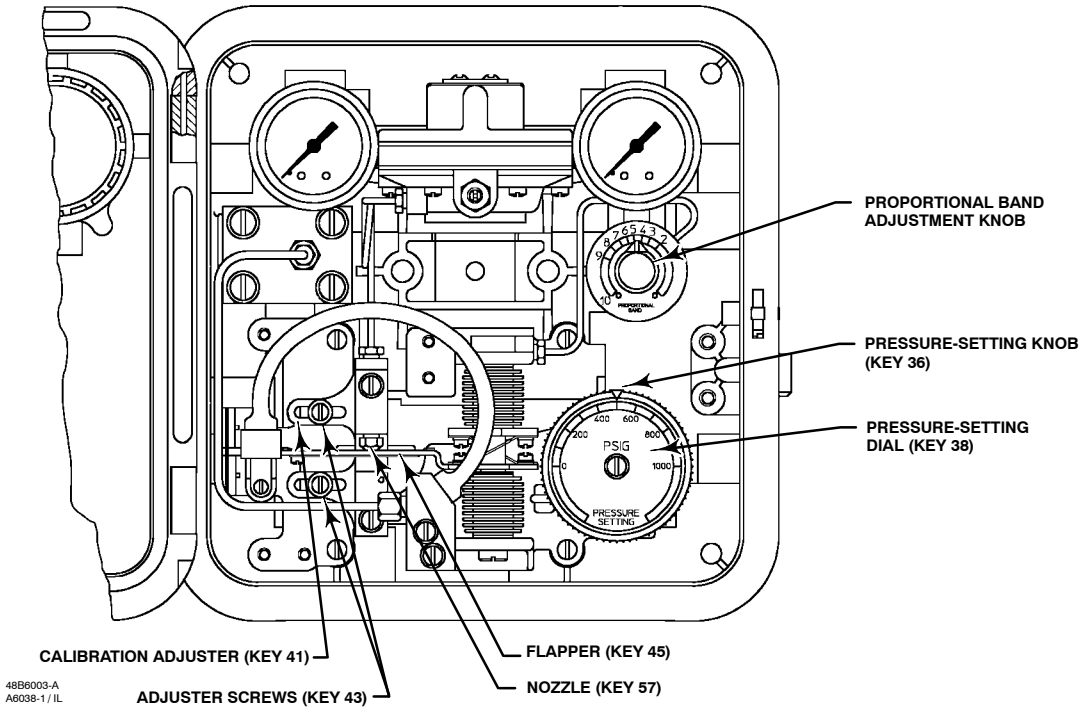


Figure 5. Proportional-Only Controller Adjustment Locations

dead ended into a pressure gauge). The following procedures use a 0.2 to 1.0 bar (3 to 15 psig) output pressure range as an example. For a 0.4 to 2.0 bar (6 to 30 psig) output range, adjust the values as appropriate.

1. Complete the above connections and provide a process pressure equal to the sensing element range.

2. Rotate the proportional band knob, shown in figure 5, to 1.5 (15 percent proportional band).

3. Verify that the calibration adjuster screws (key 43) are at mid-position in the calibration adjuster (key 41) slots.

Depending upon the controller action, perform one or the other of the following procedures.

For direct-acting controllers:

4. Apply an input pressure equal to the sensing element lower range value.

5. Rotate the pressure setting knob to the minimum value.

6. Adjust the nozzle (key 57) until the controller output pressure is between 0.6 and 0.7 bar (8 and 10 psig.)

7. Apply an input pressure equal to the sensing element upper range value.

8. Rotate the pressure-setting knob to the maximum value.

Note

When performing the span adjustment in step 9, do not watch the output gauge while changing the calibration adjuster. The change in output is not a good indication of the change in span. While moving the calibration adjuster, the output pressure may change in the opposite direction than expected. For example, while moving the calibration adjuster to increase span, the output pressure may decrease. This should be disregarded since even though the output pressure decreases, the span is increasing.

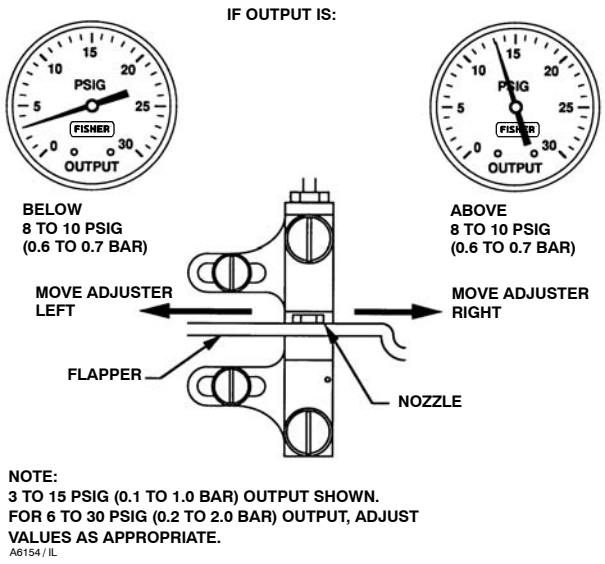


Figure 6. Direct-Acting Controller Span Adjustment—Proportional-Only Controllers

Proper controller response depends on nozzle-to-flapper alignment.

When performing span adjustments, carefully loosen both calibration adjuster screws while holding the calibration adjuster in place. Then move the calibration adjuster slightly in the required direction by hand or using a screwdriver. Verify proper nozzle-to-flapper alignment and hold the calibration adjuster in place while tightening both adjustment screws.

9. If the output is not between 0.6 and 0.7 bar (8 and 10 psig), adjust the controller span by loosening the two adjusting screws (key 43) and moving the calibration adjuster (key 41) a small distance as indicated in figure 6.

10. Repeat steps 4 through 9 until no further adjustment is necessary.

11. Proceed to the startup procedure for proportional controllers.

For reverse-acting controllers:

4. Apply an input pressure equal to the sensing element upper range value.

5. Rotate the pressure setting knob to the maximum value.

6. Adjust the nozzle (key 57) until the controller output pressure is between 0.6 and 0.7 bar (8 and 10 psig).

7. Apply an input pressure equal to the sensing element lower range value.

8. Rotate the pressure-setting knob to the minimum value.

Note

When performing the span adjustment in step 9, do not watch the output gauge while changing the calibration adjuster. The change in output is not a good indication of the change in span. While moving the calibration adjuster, the output pressure may change in the opposite direction than expected. For example, while moving the calibration adjuster to increase span, the output pressure may decrease. This should be disregarded since even though the output pressure decreases, the span is increasing.

Proper controller response depends on nozzle-to-flapper alignment.

When performing span adjustments, carefully loosen both calibration adjuster screws while holding the calibration adjuster in place. Then move the calibration adjuster slightly in the required direction by hand or using a screwdriver. Verify proper nozzle-to-flapper alignment and hold the calibration adjuster in place while tightening both adjustment screws.

9. If the output is not between 0.6 and 0.7 bar (8 and 10 psig), adjust the controller span by loosening the two adjusting screws (key 43) and moving the calibration adjuster (key 41) a small distance as indicated in figure 7.

10. Repeat steps 4 through 9 until no further adjustment is necessary.

11. Proceed to the startup procedure for proportional controllers.

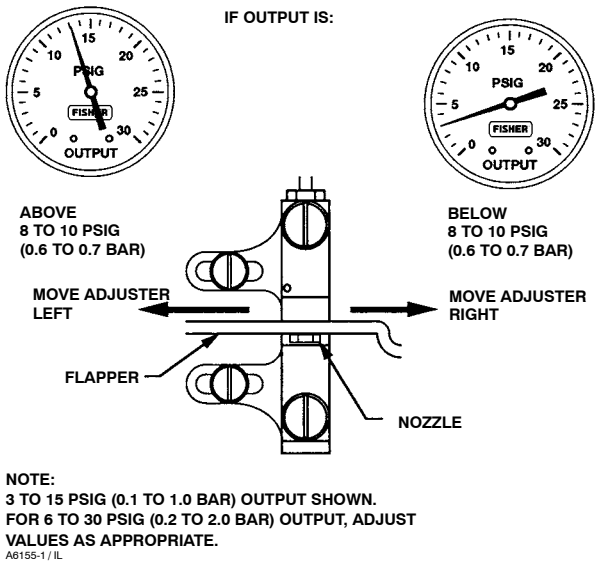


Figure 7. Reverse-Acting Controller Span Adjustment — Proportional-Only Controllers

Startup: Proportional-Only Controllers (General Tuning Guidelines)

Calibrate the controller prior to this procedure.

1. Be sure that the supply pressure regulator is delivering the proper supply pressure to the controller.

2. Rotate the pressure-setting knob to the desired set point.

3. Set the proportional band adjustment to 100 percent for fast processes (example: liquid pressure or liquid flow). For slow processes (example: temperature), calculate the percentage from the equation below:

For a slow process, determine the initial proportional band setting in percent from the following equation:

$$\frac{200 \times \text{Allowable Overshoot}}{\text{Pressure Span}} = \text{P.B.}$$

For example:

$$\frac{200 \times 1.4 \text{ bar}}{2.1 \text{ bar}} \cong 13\% \qquad \left(\frac{200 \times 2 \text{ psig}}{30 \text{ psig}} \cong 13\% \right)$$

(1.3 proportional band setting)

4. Proportional Action

Disturb the system by tapping the flapper lightly or change the set point a small amount and check for system cycling. If the system does not cycle then lower the proportional band (raising the gain) and disturb the system again. Continue this procedure until the system cycles. At that point, double the proportional band setting.

Note

Proportional band adjustment affects the set point. Proportional-only controllers will show some offset from set point depending upon proportional band setting and process demand. After adjusting the proportional band, re-zero by carefully rotating the nozzle (key 57) until the steady-state process pressure equals the process pressure knob reading.

This tuning procedure may be too conservative for some systems. The recommended proportional band setting should be checked for stability by introducing a disturbance and monitoring the process.

Proportional-Plus-Reset Controllers

This section describes the adjustments and procedures for calibration and startup. The adjustment locations are shown in figure 8 unless otherwise specified. All adjustments must be made with the cover open. When the adjustments and calibration procedures are complete, close and latch the cover. To better understand the adjustments and overall operation of the controller, refer to the Principle of Operation section in this manual for proportional-plus-reset controllers. Refer also to the schematic diagram in figure 14.

Adjustments

Adjustment: Set Point

Adjust the pressure-setting knob by turning the knob clockwise to increase the set point and counterclockwise to decrease the set point.

Rotate the knob until the indicator points to the desired set point pressure value. The pressure setting dial will reflect the desired set point if the controller is accurately calibrated.

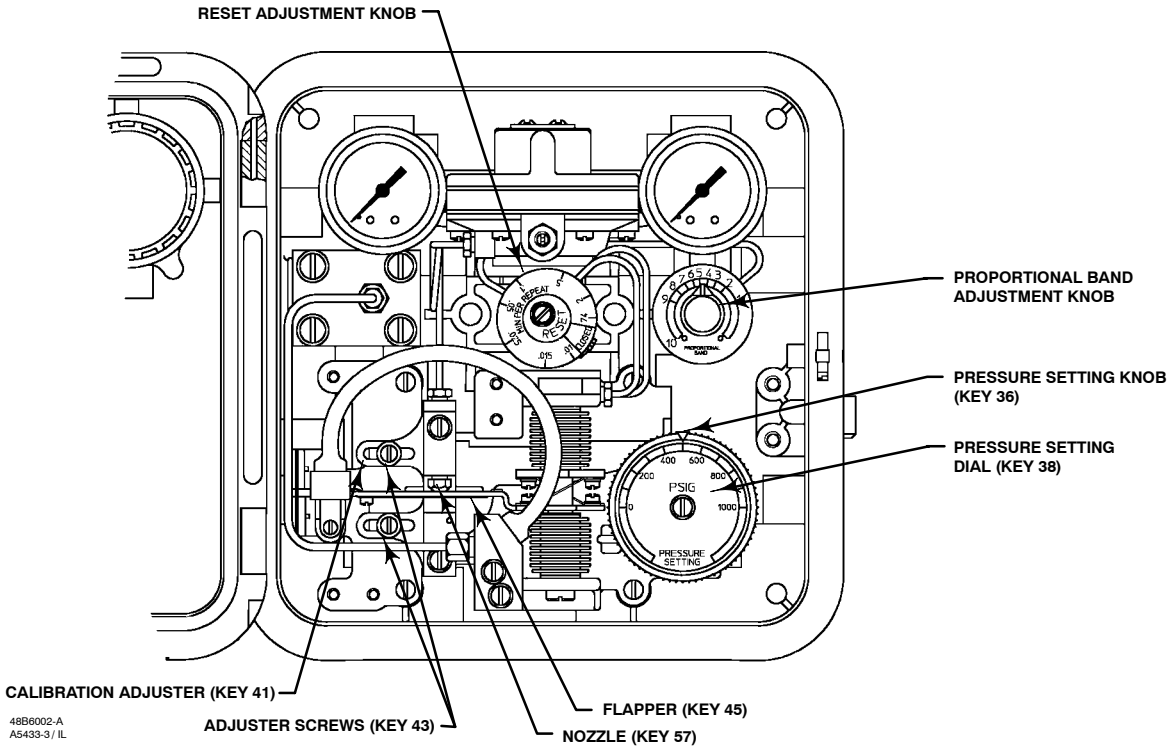


Figure 8. Proportional-Plus-Reset Controller Adjustment Locations

Adjustment: Proportional Band

To adjust the proportional band, rotate the proportional band knob to the desired value.

The proportional band adjustment determines the amount of change in controlled pressure required to cause the control valve to stroke fully. It may be adjusted from 3-100 percent of the nominal sensing element pressure rating.

Adjustment: Reset

To adjust reset action turn the knob clockwise to decrease the minutes per repeat. Turn the knob counterclockwise to increase the minutes per repeat. Increasing the minutes per repeat provides a slower reset action.

The reset adjustment dial is calibrated in minutes per repeat. By definition, this is the time in minutes required for the reset action to produce an output change which is equal to the change produced by proportional control action. This is in effect, the time in minutes required for the controller to increase (or decrease) its output pressure by an amount equal to a proportional increase (or decrease) caused by a change in set point or process pressure.

Adjustment: Anti-Reset Windup

The externally mounted differential relief valve can be mounted to relieve on increasing or decreasing output pressure.

Calibration

Calibration: Proportional-Plus-Reset Controllers

Unless otherwise indicated, key number locations are shown in figure 8.

Before starting this procedure:

- Provide a process pressure source capable of simulating the process pressure range of the controller.

- If an output pressure gauge is not provided, install a suitable pressure gauge for calibration purposes. The controller must be connected open loop (Open loop: The controller output pressure changes must be dead ended into a pressure gauge).

Note

Type 4160KF and 4162KF (anti-reset windup) controllers are supplied with two O-rings (key 367, not shown), an anti-reset windup cover (key 369, not shown), and two machine screws (key 368, not shown). Use these parts in the next step.

1. For controllers with anti-reset windup (Type 4160KF and 4162KF), record the direction of the arrow on the anti-reset windup assembly (key 186, in figure 19). Remove the assembly and install the two O-rings (key 367, not shown), and cover (key 369, not shown) supplied with the controller. Secure the cover with the two machine screws (key 368, not shown) provided.

2. Connect regulated supply pressure to the controller. Do not exceed the normal operating pressure in table 5.

3. Rotate the reset knob to 0.01 minutes per repeat (fastest setting).

4. Rotate the proportional band knob to 1.5 (15 percent proportional band).

5. Verify that the calibration adjuster screws (key 43) are at mid-position in the calibration adjuster (key 41) slots.

Depending upon the controller action, perform one or the other of the following procedures.

For direct-acting controllers:

6. Apply an input pressure equal to the sensing element lower range value.

7. Rotate the pressure setting knob to the minimum value.

8. Adjust the nozzle (key 57) until the controller output pressure is between 0.6 and 0.7 bar (8 and 10 psig).

9. Apply an input pressure equal to the sensing element upper range value.

10. Rotate the pressure-setting knob to the maximum value.

Note

When performing the span adjustment in step 11, do not watch the output gauge while changing the calibration adjuster. The change in output is not a good indication of the change in span. While moving the calibration adjuster,

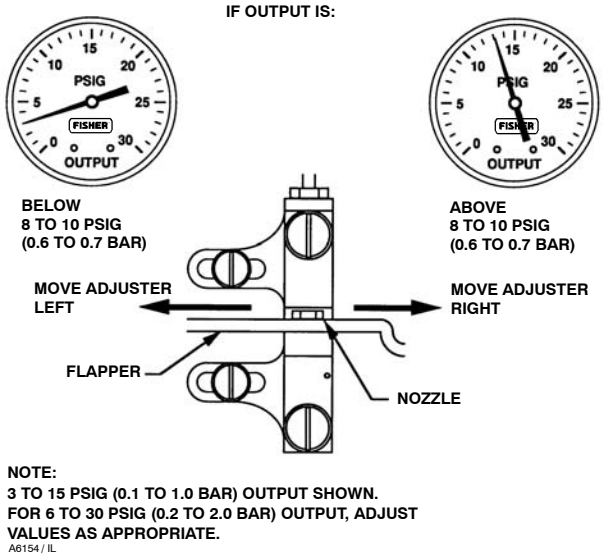


Figure 9. Direct-Acting Controller Span Adjustment —Proportional-Plus-Reset Controllers

the output pressure may change in the opposite direction than expected. For example, while moving the calibration adjuster to increase span, the output pressure may decrease. This should be disregarded since even though the output pressure decreases, the span is increasing.

Proper controller response depends on nozzle-to-flapper alignment.

When performing span adjustments, carefully loosen both calibration adjuster screws while holding the calibration adjuster in place. Then move the calibration adjuster slightly in the required direction by hand or using a screwdriver. Verify proper nozzle-to-flapper alignment and hold the calibration adjuster in place while tightening both adjustment screws.

11. If the output pressure is not between 0.6 and 0.7 bar (8 and 10 psig), adjust the controller span by loosening the two adjusting screws (key 43) and moving the calibration adjuster (key 41) a small distance as indicated in figure 9.

12. Repeat steps 6 through 11 until no further adjustment is necessary.

13. For controllers with anti-reset windup (Type 4160KF and 4162KF), remove the two machine screws, anti-reset windup cover, and two O-rings installed in step 1 of this procedure. Install the anti-reset windup assembly (key 186) with the arrow pointing in the direction recorded in step 1.

14. Proceed to the Startup procedures for proportional-plus-reset controllers.

For reverse-acting controllers:

6. Apply an input pressure equal to the sensing element upper range value.

7. Rotate the pressure setting knob to the maximum value.

8. Adjust the nozzle (key 57) until the controller output pressure is between 0.6 and 0.7 bar (8 and 10 psig).

9. Apply an input pressure equal to the sensing element lower range value.

10. Rotate the pressure-setting knob to the minimum value.

Note

When performing the span adjustment in step 11, do not watch the output gauge while changing the calibration adjuster. The change in output is not a good indication of the change in span. While moving the calibration adjuster, the output pressure may change in the opposite direction than expected. For example, while moving the calibration adjuster to increase span, the output pressure may decrease. This should be disregarded since even though the output pressure decreases, the span is increasing.

Proper controller response depends on nozzle-to-flapper alignment.

When performing span adjustments, carefully loosen both calibration adjuster screws while holding the calibration adjuster in place. Then move the calibration adjuster slightly in the required direction by hand or using a screwdriver. Verify proper nozzle-to-flapper alignment and hold the calibration adjuster in place while tightening both adjustment screws.

11. If the output pressure is not between 0.6 and 0.7 bar (8 and 10 psig), adjust the controller span by loosening the two adjusting screws (key 43) and moving the calibration adjuster (key 41) a small distance as indicated in figure 10.

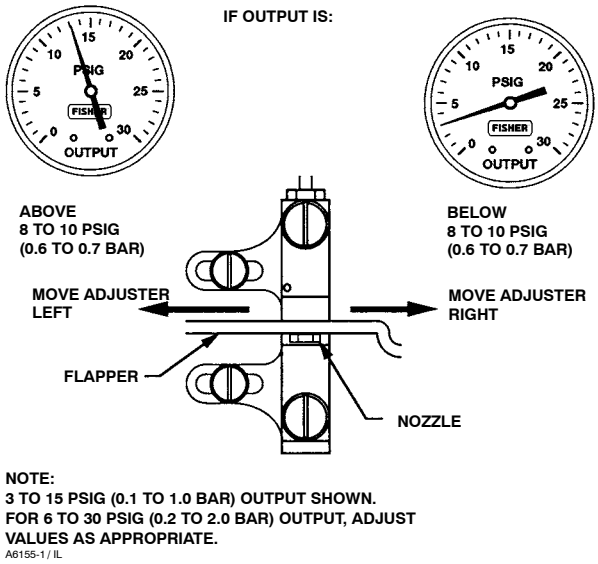


Figure 10. Reverse-Acting Controller Span Adjustment—Proportional-Plus-Reset Controllers

12. Repeat steps 6 through 11 until no further adjustment is necessary.

13. For controllers with anti-reset windup (Type 4160KF and 4162KF), remove the two machine screws, anti-reset windup cover, and two O-rings installed in step 1 of this procedure. Install the anti-reset windup assembly (key 186) with the arrow pointing in the direction recorded in step 1.

14. Proceed to the Startup procedures for proportional-plus-reset controllers.

Calibration: Anti-Reset Windup

Controllers with anti-reset windup have a differential relief valve assembly (figure 19). This relief valve is set at the factory to relieve at a 0.3 bar (5 psi) pressure difference between the reset bellows pressure and the proportional bellows pressure. The valve can be adjusted to relieve from 0.14 to 0.4 bar (2 to 7 psig).

The relief valve can relieve on either rising controller output pressure or falling controller output pressure. If the arrow on the relief valve points toward the bottom of the controller case as shown in figure 19, the valve will relieve on falling output pressure. If the arrow points in the opposite direction, the valve will relieve on rising output pressure. The valve can be removed and reinstalled with the arrow pointing in the opposite direction to change the relief action.

Startup: Proportional-Plus-Reset Controllers (General Tuning Guidelines)

Calibrate the controller prior to this procedure.

1. Be sure that the supply pressure regulator is delivering the proper supply pressure to the controller.

2. Rotate the pressure-setting knob to the desired set point.

3. Start with a reset setting of 0.05 minutes per repeat (m/r) for fast processes, and 0.5 m/r for slow processes.

4. Set the proportional band adjustment to 100 percent for fast processes (example: liquid pressure or liquid flow). For a slow process (example: temperature), calculate the percentage from the equation below:

For a slow process, determine the initial proportional band setting in percent from the following equation:

$$\frac{200 \times \text{Allowable Overshoot}}{\text{Pressure Span}} = \text{P.B.}$$

For example:

$$\frac{200 \times 1.4 \text{ bar}}{2.1 \text{ bar}} \cong 13\% \qquad \left(\frac{200 \times 2 \text{ psig}}{30 \text{ psig}} \cong 13\%\right)$$

(1.3 proportional band setting)

5. Proportional Action:

Disturb the system by tapping the flapper lightly or change the set point a small amount and check for system cycling. If the system does not cycle then lower the proportional band (raising the gain) and disturb the system again. Continue this procedure until the system cycles. At that point, double the proportional band setting and begin tuning the reset.

6. Reset Action:

Disturb the system. If the system does not cycle then speed up the reset and disturb the system again. Continue this procedure until the system cycles. When the system cycles multiply the reset time setting by a factor of three (3) and slow the reset down to the new value. The reset is now tuned.

This tuning procedure may be too conservative for some systems. The recommended proportional band and reset setting should be checked for stability by introducing a disturbance and monitoring the process as previously described. For some applications, tighter control may be desirable.

Differential Gap Controllers

This section describes the adjustments and procedures for calibration and startup. The adjustment locations are shown in figure 5 unless otherwise specified. The output of each controller is checked at the factory before the instrument is shipped.

To convert a differential gap controller to a proportional-only controller or vice versa, refer to the appropriate procedure in the Maintenance section.

If the process pressure can be varied through all or part of the sensing element range or through the two desired switching points, use the process pressure for calibration. If not, provide a pressure source to simulate the process pressure range for calibration procedures.

To better understand the adjustments and overall operation of the controller, refer to the Principle of Operation section in this manual for differential gap controllers and the schematic diagram in figure 14.

Adjustments

Adjustment: Set Point

The position of the pressure-setting knob determines the location of the differential gap within the range of the pressure sensing element. Move the pointer to the desired pressure where the output of the controller should switch from zero to full supply pressure with rising process pressure (direct-acting controllers) or with falling process pressure (reverse-acting controllers).

Adjustment: Proportional Band

The proportional band adjustment shown in figure 5 determines the width of the differential gap. The width of the gap is the difference between the process pressures at which the controller output will switch from zero to full supply pressure, or from full supply pressure to zero. The relationship between the proportional band dial setting and the differential gap is shown in figure 11.

Calibration: Differential Gap Controllers

The output of each controller is checked at the factory before the unit is shipped. Before placing the controller in control of a process loop, check to verify that the controller is calibrated correctly for the application. The controller must be connected open loop (Open loop: The controller output pressure changes must be dead ended into a pressure gauge).

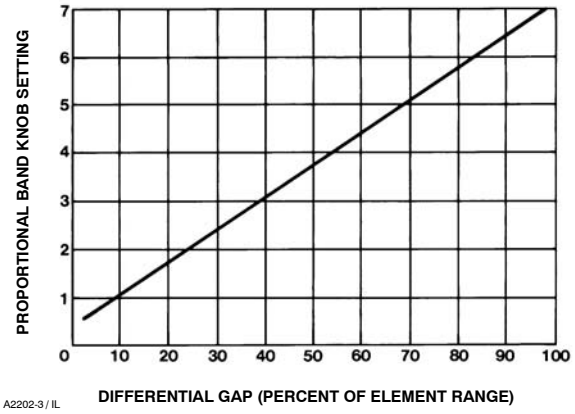


Figure 11. Differential Gap Adjustment for Differential Gap Controllers

1. Temporarily convert the differential gap controller to a proportional-only controller by disconnecting the proportional tubing (key 104, figure 16) from the mounting base. Reinstall the tubing into the other connection in the mounting base as shown in figure 16. Do not invert the reversing block (key 59, figure 16).

2. Use the calibration procedures for proportional-only controllers.

3. Upon completion of the calibration procedures, reinstall the tubing (key 104) in its original location, and continue with the following procedures.

Note

After reinstalling the tubing (key 104) in step 3 a slight offset of the output pressure will be noticed due to switching from the proportional bellows to the reset bellows. This is because the effective area and spring rate of the two bellows may not match. Performing step 5b below adjusts for this offset.

4. Refer to figure 11 to determine the proportional band dial setting required for the desired differential gap.

For example, assume that a 0 to 100 psig sensing element is being used and the controller is to switch from zero to full supply pressure at a process pressure of 80 psig with rising process pressure and from full supply pressure to zero at 20 psig with falling pressure. (This is for a direct-acting controller.) The differential gap is:

$$\frac{5.5 \text{ bar} - 1.3 \text{ bar}}{6.9 \text{ bar}} \times 100 = 60\%$$

$$\left(\frac{80 \text{ psig} - 20 \text{ psig}}{100 \text{ psig}} \times 100 = 60\% \right)$$

From figure 11, the proportional band dial setting should be approximately 4.5; rotate the proportional band knob to 4.5.

5. Setting the process pressure

For a Direct-Acting Controller:

a. Rotate the pressure-setting knob to the pressure at which the controller output is to switch to the upper switching point (zero to full supply pressure) with rising process pressure. In the above example, this pressure is 5.5 bar (80 psig).

b. Increase pressure to the sensing element while monitoring the output pressure gauge. The controller output pressure should switch from zero to full supply pressure when the upper switching point is reached with rising input pressure.

Note

If the upper switching point is not correct, adjust the nozzle to correct the error. Repeat step 5b until the input pressure and upper switching point are at the desired setting.

c. With falling input pressure, the output should switch from full supply pressure back to zero when the lower switching point is reached.

Reverse-acting controllers produce the opposite response.

6. Vary the process pressure and observe the switching points. Widen or narrow the differential gap by rotating the proportional band knob, then repeat the above steps.

If the output is within the limits stated, refer to the startup procedures in this section. If the output pressure cannot be adjusted within the limits stated, refer to the maintenance procedures.

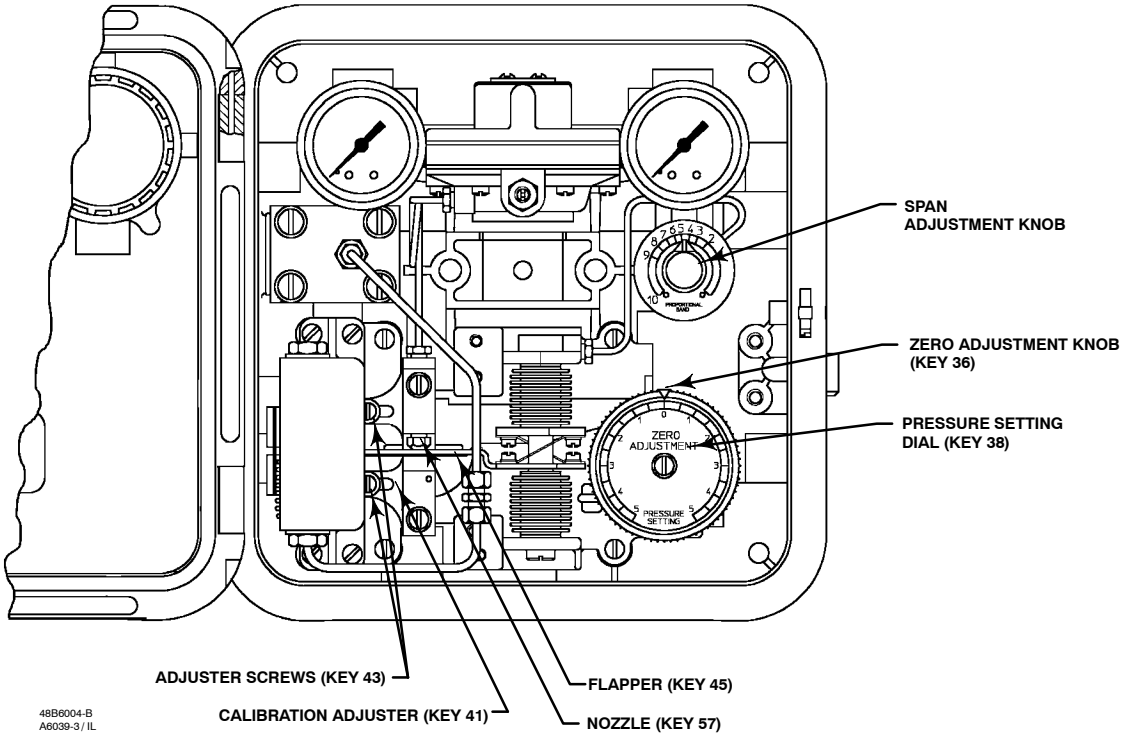


Figure 12. Transmitter Adjustment Locations

Startup: Differential Gap Controllers

Calibrate the controller prior to this procedure.

1. Be sure that the supply pressure regulator is delivering the proper supply pressure to the controller.

2. Adjust the proportional band knob for the proper differential gap (see figure 11).

3. If the controller is used in conjunction with a control valve, slowly open the upstream and downstream manual shutoff valves, and close the bypass valves.

4. To change the differential gap, perform steps 1 through 4 of the calibration for differential gap controllers procedure.

Transmitter Operation

This section describes the adjustments and procedures for calibration and startup. Refer to figure 12 for the adjustment locations. All adjustments must be made with the cover open.

When the adjustments and calibration procedures are complete, close and latch the cover.

To better understand the adjustments and overall operation of the transmitter, refer to the Principle of Operation section in this manual for transmitters. Refer also to the schematic diagram in figure 14.

Adjustments

Adjustment: Zero

The pressure-setting dial is marked ZERO ADJUSTMENT PRESSURE SETTING. Zero is in the center of the dial, and the pressure values increase to the right and left of the center as shown in figure 12. To set the zero, rotate the pointer around the pressure setting dial. Rotate the pointer clockwise to increase or counterclockwise to decrease the output depending on transmitter action and desired setting.

For direct-acting transmitters, zero adjustment determines the process pressure at which the transmitter output signal will be at its lower range limit.

The dial (key 38) graduations are approximate indications of the transmitter zero setting. When making adjustments, do not rely solely on the dial

setting. Monitor the process pressure and output pressure to be sure the desired settings are attained.

Adjustment: Span

The span adjustment dial is graduated from 0 to 10. A setting of 10 on the dial represents a span setting of 100 percent of the process sensing element range. The transmitter achieves the highest accuracy when the span is 100 percent.

The transmitter span adjustment shown in figure 12 is the same as the controller proportional band adjustment.

Calibration: Transmitters

The output of each transmitter is checked at the factory before the unit is shipped. The transmitter provides an output signal that is proportional to the pressure applied to the sensing element. The output pressure has no direct effect on the process pressure.

The transmitter is calibrated at the factory and should not need additional adjustment. Use the following calibration procedures when the sensing element has been changed or other maintenance procedures have altered the calibration of the transmitter. The following procedures use a 0.1 to 1.0 bar (3 to 15 psig) output pressure range as an example. For other output pressure ranges [such as 0.2 to 2.0 bar (6 to 30 psig)] adjust the values to match the application.

Provide a process pressure source capable of simulating the process pressure range of the transmitter. If an output pressure gauge is not provided, install a suitable pressure gauge for calibration purposes(1). Connect a pressure source to the supply pressure regulator and be sure the regulator is delivering the correct supply pressure to the transmitter.

Unless otherwise indicated, key number locations are shown in figure 12.

1. Complete the above connections and provide a process pressure equal to the sensing element range.

2. Rotate the span adjustment knob to 10 on the dial (100 percent span).

3. Verify that the calibration adjuster screws (key 43) are at mid-position in the calibration adjuster (key 41) slots.

Depending upon the transmitter action, perform one or the other of the following procedures.

For direct-acting transmitters:

4. Rotate the zero adjustment knob to zero.

5. Set the input pressure to zero.

6. Adjust the nozzle (key 57) until the transmitter output pressure is at 0.1 bar (3 psig).

7. Apply an input pressure equal to the sensing element upper range value.

Note

Proper transmitter response depends on nozzle-to-flapper alignment.

When performing the span adjustment in step 8, carefully loosen both calibration adjuster screws while holding the calibration adjuster in place. Then move the calibration adjuster slightly in the required direction by hand or using a screwdriver. Verify proper nozzle-to-flapper alignment and hold the calibration adjuster in place while tightening both adjustment screws.

8. If the output pressure is not 15 psig, adjust the span by loosening the two adjusting screws (key 43) and moving the calibration adjuster (key 41) a small distance as indicated in figure 13.

9. Repeat steps 4 through 8 until no further adjustment is necessary.

10. Proceed to the startup procedure for transmitters.

For reverse-acting transmitters:

4. Rotate the zero adjustment knob to zero.

5. Apply an input pressure equal to the sensing element upper range limit.

6. Adjust the nozzle (key 57) until the transmitter output pressure is at 0.1 bar (3 psig).

7. Set the input pressure equal to zero.

Note

Proper transmitter response depends on nozzle-to-flapper alignment.

When performing the span adjustment in step 8, carefully loosen both calibration adjuster screws while

1. For stability, some transmitter applications will require additional volume than just the gauge. Provide a minimum volume of approximately 25 cm^3 (1.5 in^3) or greater if stability is a problem.

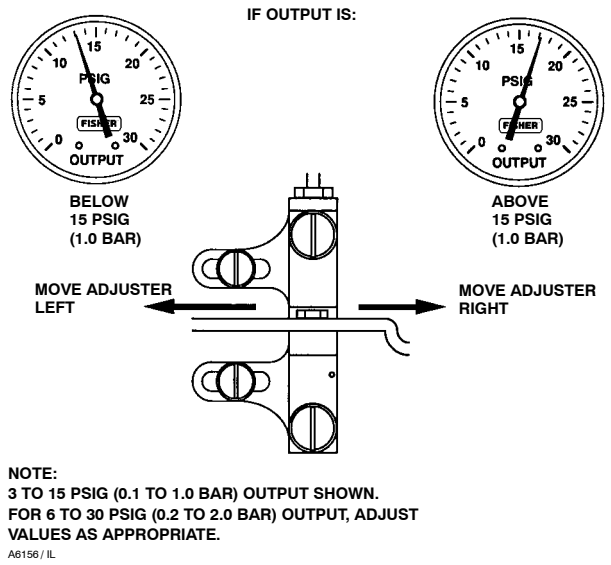


Figure 13. Transmitter Span Adjustment

holding the calibration adjuster in place. Then move the calibration adjuster slightly in the required direction by hand or using a screwdriver. Verify proper nozzle-to-flapper alignment and hold the calibration adjuster in place while tightening both adjustment screws.

8. If the output pressure is not 15 psig, adjust the span by loosening the two adjusting screws (key 43) and moving the calibration adjuster (key 41) a small distance as indicated in figure 13.

9. Repeat steps 4 through 8 until no further adjustment is necessary.

10. Proceed to the startup procedure for transmitters.

Startup: Transmitters

1. Be sure that the supply pressure regulator is delivering the proper supply pressure to the transmitter.

2. Refer to the calibration procedures for the transmitter initial settings.

3. If the transmitter is used in conjunction with a control valve, slowly open the upstream and downstream manual shutoff valves, and close the bypass valves.

Principle of Operation

The following sections describe the operation of a controller or transmitter using a Bourdon tube sensing element. The operation is the same for an instrument using a bellows sensing element (key 71, figure 21) except that movement of the beam is caused by expansion or contraction of the bellows or differential bellows.

Proportional-Only Controllers

As shown in figure 14, supply pressure enters the relay and bleeds through the fixed orifice before escaping through the nozzle. Nozzle pressure also registers on the large relay diaphragm, and loading pressure (controller output pressure) registers on the small relay diaphragm.

A change in the process pressure moves the beam and flapper with respect to the nozzle by either expanding or contracting the Bourdon tube arc. An increasing process pressure with direct action (or decreasing pressure with reverse action) produces a nozzle-flapper restriction that increases the loading on the large relay diaphragm and opens the relay valve. Additional supply pressure flows through the relay chamber to increase the loading pressure on the control valve actuator. A decreasing process pressure with direct action (or increasing pressure with reverse action) produces a nozzle-flapper opening that bleeds off pressure on the large relay diaphragm and opens the relay valve to exhaust controller output pressure from the actuator.

This controller output pressure change feeds back to the proportional bellows, countering the pressure change in the nozzle and equalizes the relay diaphragm pressure differential. The relay valve maintains a new loading pressure according to the change in sensed pressure.

If the proportional valve is wide open, all of the controller output pressure change feeds back to the proportional bellows. The more the proportional valve is closed, the more the controller output pressure change bleeds out through the proportional valve exhaust and the less there is to feed back to the proportional bellows. A fully open proportional valve results in a proportional band of 100 percent; closing the proportional valve reduces the proportional band.

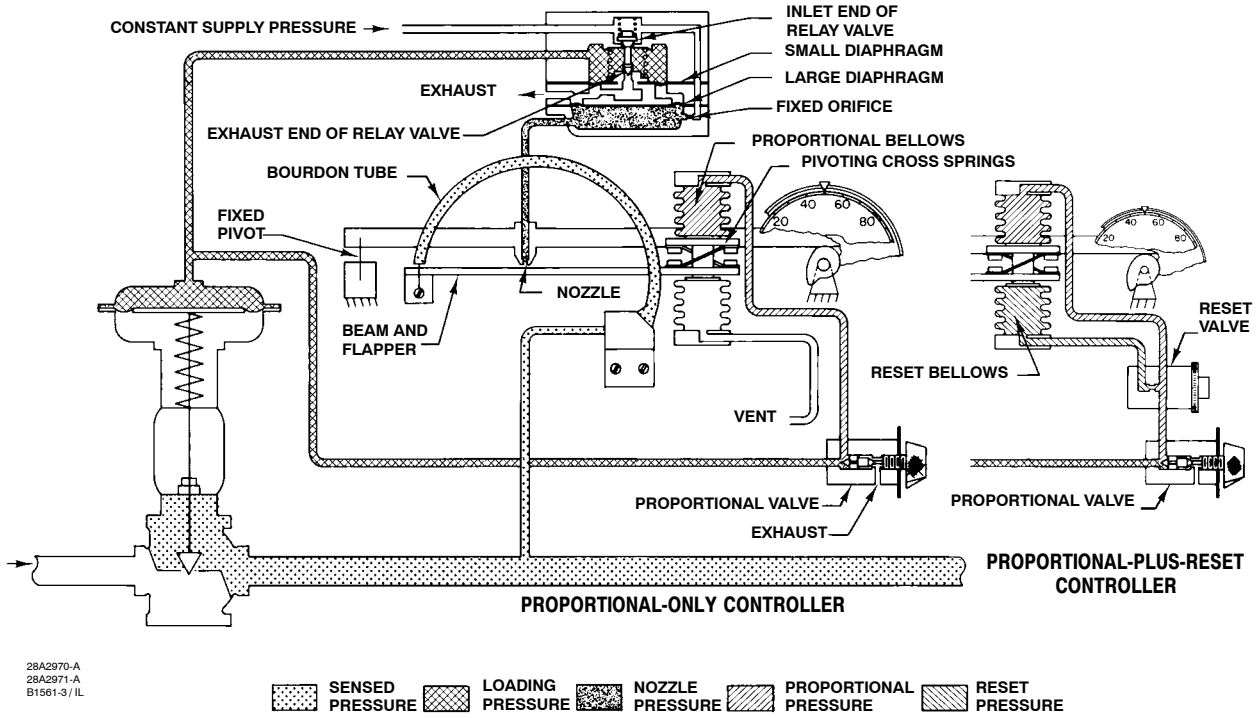


Figure 14. Schematic of Direct-Acting Proportional-Only and Proportional-Plus-Reset Controllers

Proportional-Plus-Reset Controllers

Action of a proportional-plus-reset controller is similar to that of a proportional-only controller except that feedback from the controller output pressure is piped to a reset bellows as well as to the proportional bellows as shown at the right in figure 14.

With an increasing controller output pressure, pressure in the reset bellows increases. Increases in reset bellows pressure moves the beam and flapper closer to the nozzle, starting another increase of pressure throughout the system. Pressure buildup continues until the controlled pressure is brought back to the set point. The reset valve is adjustable to vary the amount of delay in the reset action. Closing the reset valve increases the delay in reset action.

Controllers with Anti-Reset Windup

During a prolonged difference between set point and the controlled variable, such as encountered with intermittent control applications (e.g., batch temperature control or wide open monitors on pressure control), reset ramps the controller output to either zero or full supply pressure; this condition is reset windup. When the controlled variable crosses the set point, there will be a delay before the controller output responds to the change in controlled variable. Anti-reset windup minimizes this delay and permits returning the controlled variable to set point more quickly with minimal overshoot.

As shown in figure 15 a proportional-plus-reset controller with anti-reset windup includes a differential relief valve. The valve consists of two pressure chambers separated by a spring-loaded diaphragm.

For the controller shown in figure 15, proportional pressure registers rapidly on the spring side of the relief valve diaphragm as well as in the proportional bellows, and reset pressure registers on the opposite side of the relief valve diaphragm. As long as controlled pressure changes are slow enough for normal proportional and reset action, the relief valve spring will keep the relief valve diaphragm from opening. However, a large or rapid decrease in controller pressure will cause the relay to exhaust loading pressure from the control device rapidly, and also from the proportional system and spring side of the relief diaphragm. If this decrease on the spring side of the diaphragm is greater than the relief valve spring setting, the diaphragm will move off the relief valve orifice and permit the proportional pressure on the opposite side of the relief valve diaphragm to bleed rapidly into the reset bellows. The anti-reset windup action also can be reversed to relieve with an increasing proportional pressure.

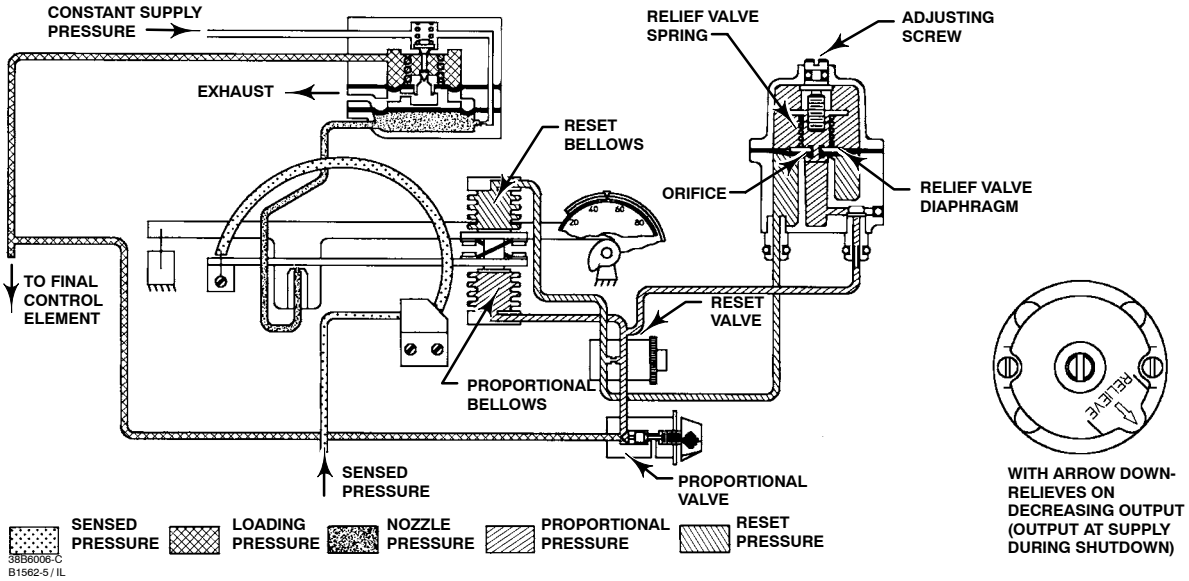


Figure 15. Schematic of Reverse-Acting Proportional-Plus-Reset Controller with Anti-Reset Windup

Differential Gap Controllers

With a differential gap controller, feedback pressure does not counteract the change in flapper position as it does in a proportional-only controller. Instead, feedback pressure is piped through the proportional valve to the bellows located on the side of the beam and flapper opposite the nozzle (the lower bellows in figure 14 for direct-acting controllers). Then, as controller output pressure increases, feedback pressure moves the flapper closer to the nozzle to again increase controller output pressure. This process continues rapidly until the controller output pressure is at the upper range limit. The action of a differential gap controller is so rapid that output pressure changes from zero to maximum as soon as the switching point is reached. The action is similar with falling output pressure. Lower feedback pressure lowers the bellows pressure, which moves the flapper away from the nozzle. This again reduces the output pressure and continues until the output pressure is zero.

Transmitters

Action of a pneumatic transmitter is similar to that of a proportional-only controller. Since the output pressure of the transmitter has no effect on the process pressure, transmitter output pressure is a proportional measure of the process pressure. The proportional valve determines the span of the transmitter, and the pressure setting mechanism determines the zero of the transmitter.

Maintenance

If the installation includes a 67 Series filter regulator, periodically open the drain on the filter regulator to drain accumulated moisture. Also, push the cleaner wire on the relay orifice (key 88, not shown). Check the opening of the vent assembly (key 15, figure 3) or the opening of the remote vent pipe, if one is used. If necessary, clean the openings.

Parts are subject to normal wear and must be inspected and replaced as necessary. The frequency of inspection and parts replacement depends upon the severity of the service conditions.

⚠ WARNING

The following maintenance procedures require taking the controller out of service. To avoid personal injury and property damage caused by the release of pressure or process fluid, observe the following before starting maintenance:

- **Always wear protective clothing, gloves, and eyewear.**
- **Provide some temporary means of control for the process before taking the controller out of service.**
- **Provide a means of containing the process fluid before removing any measurement devices from the process.**

- **Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.**

- **Personal injury or property damage may result from fire or explosion if natural gas is used as the supply medium and preventative measures are not taken. Preventative measures may include: Remote venting of the unit, re-evaluating the hazardous area classification, ensuring adequate ventilation, and the removal of any nearby ignition sources. For information on remote venting of this controller/transmitter, refer to page 9.**

- **Check with your process or safety engineer for any additional measures that must be taken to protect against process media.**

Replacing Gauges

WARNING

Refer to the WARNING at the beginning of the Maintenance Section.

Refer to figures 18 and 19 for key number locations unless otherwise directed.

Three gauge configurations are available for 4150K and 4160K units.

- Output and supply pressure indications

- Output and process pressure indications

- Output, process, and supply pressure indications

One gauge type (key 13) is used for both output and supply pressure indications when the gauges are installed inside the controller case. Key 13 features a 1/8-inch connecting stem that matches the threaded gauge boss extending from the relay base.

In some cases, a process pressure gauge (key 106) covers the position of the internal supply pressure gauge. The supply pressure gauge has been removed and replaced with a pipe plug (key 108).

The pressure control block (key 8) is different to accommodate a different control tubing assembly (key 132) with a pressure connection (key 107) for a process pressure gauge. If a supply pressure gauge is required, a gauge with a 1/4-inch connecting stem (key 14) must be mounted on the supply pressure regulator.

CAUTION

Before performing this procedure, be sure the replacement gauges are the correct range so they are not damaged by overpressure.

Note

Key 13 is used as both a supply gauge and an output gauge on units without a process pressure gauge. A quantity of 2 is required for these units. On units with a process pressure gauge (key 106), key 13 is used for the output gauge. A quantity of 1 is required for these units.

Use key 14 for supply pressure indication when a process pressure gauge is installed. Key 14 installs on the supply pressure regulator.

1. Shut off the supply pressure and process lines to the controller or transmitter.

2. Remove the gauge to be replaced:

- Unscrew the output or supply gauge (key 13) from the relay base.

- Unscrew the process pressure gauge (key 106) from the process connection (key 107).

- Unscrew the supply gauge (key 14) from the supply pressure regulator.

3. Coat the threads of the replacement gauge with a sealant.

4. Screw the replacement gauge into the relay base, process connection, or supply pressure regulator.

5. Check for leaks by applying the correct supply pressure with the nozzle capped to produce full output pressure.

Replacing Bourdon Tube

WARNING

Refer to the WARNING at the beginning of the Maintenance Section.

Refer to figure 20 for key number locations unless otherwise directed.

1. Shut off the supply pressure and process lines to the controller or transmitter.

2. Unscrew the machine screw (key 63) to disconnect the link (key 64) and bearing (key 65) from the beam (key 44). Be careful to avoid losing the bearing (key 65). Washer(s) (key 370) for the machine screw (key 63) are at times furnished for insertion at the beam (key 44) connection to ensure alignment of the connecting link (key 64).

3. Disconnect the control tubing (key 132). Unscrew two screws (key 77) and washers (key 76), and remove the Bourdon tube (key 62).

4. Unscrew the machine screw (key 63), and remove the link and bearing (keys 64 and 65) from the Bourdon tube. Be careful to avoid losing the bearing (key 65).

5. Attach the link and bearing to the replacement Bourdon tube.

6. Attach the Bourdon tube with two machine screws and washers (keys 77 and 76).

7. Connect the link and bearing to the beam (key 44).

8. After connecting the link to the beam, make sure the nozzle is centered in the slot in the beam. If not, carefully loosen the machine screw (key 63) enough so that you can slip a washer (key 370) between the bearing (key 65) and beam (key 44). Retighten the machine screw and check the nozzle and beam alignment.

9. Check to be sure that the beam is parallel with the bottom of the case and that the link (key 64) is in tension. If the beam is not parallel with the case, loosen the machine screws (key 77), reposition the Bourdon tube to get the beam parallel, and retighten the screws.

10. If a Bourdon tube with a different range was installed, remove the machine screw and washer (keys 40 and 39) and dial (key 38). Install a new dial having an adjustment range corresponding to the range of the Bourdon tube. If an optional process pressure gauge (key 106, figure 18) is being used, install a new gauge with the appropriate measurement capability.

11. Check all tubing connections for leaks and the Bourdon tube machine screws, tighten as necessary. Perform the appropriate calibration procedures.

Replacing Bellows Sensing Element

WARNING

Refer to the WARNING at the beginning of the Maintenance Section.

Refer to figure 21 for key number locations unless otherwise directed.

1. Shut off the supply pressure and process lines to the controller or transmitter.

2. Disconnect the tubing from the mounting base (key 30) and calibration adjuster (key 41). Disconnect the tubing that connects the pressure block (key 8, figure 18) to the bellows assembly (key 71), at the pressure block end.

3. Unscrew the four machine screws (key 28, figure 18 or 19), and remove the pressure sensing subassembly from the case.

4. Remove the bellows yoke machine screws and washers (keys 75 and 76), and move the bellows yoke to the right to permit access to the link screw.

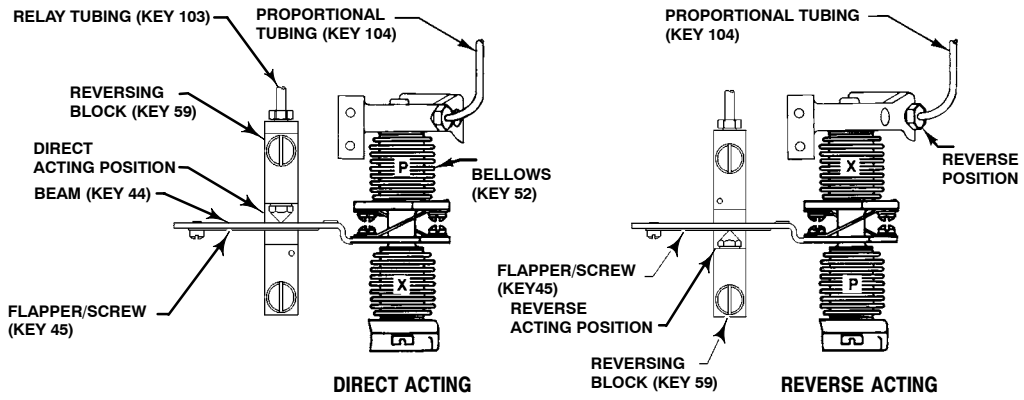
5. Disconnect the link (key 71M) and bearing (key 71L) from the beam. Be careful to avoid losing the bearing.

6. Loosen the nuts that secure the bellows assembly (key 71), and remove this assembly from the bellows yoke (key 70).

7. For a gauge-pressure sensing element (only one bellows in the assembly), install the proper bellows spring (key 80) into the bellows assembly if the input signal range is being changed. See the parts list for the correct part number.

8. Install the new bellows assembly into the bellows yoke.

9. Attach the link and bearing to the bellows assembly. Position the bellows yoke (key 70) on the mounting base (key 30), and attach the link and bearing to the beam. Start but do not tighten the four machine screws (key 75) with washers (key 76) that attach the yoke to the mounting base. Slide the yoke up or down as necessary to position the beam horizontally, as shown in figure 21. Tighten the machine screws.



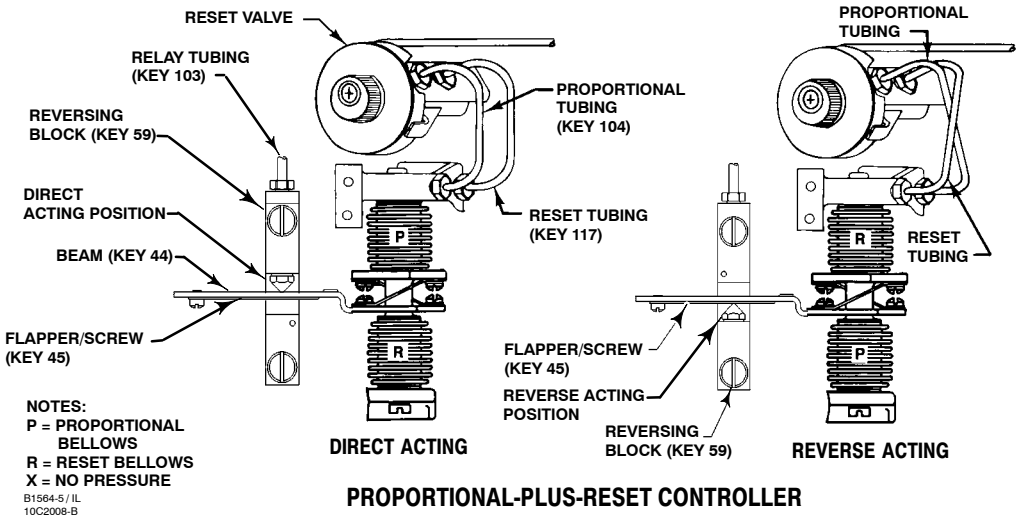


Figure 16. Direct/Reverse Acting Tubing Connections

10. Replace the subassembly in the case and secure with the four machine screws (key 28, figure 18 or 19). Reconnect all tubing.

11. If a bellows assembly with a different range is installed, remove the machine screws and washer (keys 40 and 39) and dial (key 38), and install a new dial having an adjustment range corresponding to the range of the bellows. If an optional process pressure gauge (key 106, figure 18) is being used, install a new gauge with the appropriate measurement capability.

12. Check all tubing connections for leaks and the bellows yoke machine screws, tighten as necessary. Perform the appropriate calibration procedures.

Changing Proportional or Reset Valve

WARNING

Refer to the WARNING at the beginning of the Maintenance Section.

1. Disconnect the appropriate tubing and remove the proportional band valve assembly (figure 18 or 19) or the reset restriction valve assembly (figure 19) by unscrewing it from the relay base (key 4, figure 18 or 19). Install the desired replacement assembly.

2. Connect the tubing, check all connections for leaks and perform the appropriate calibration procedures.

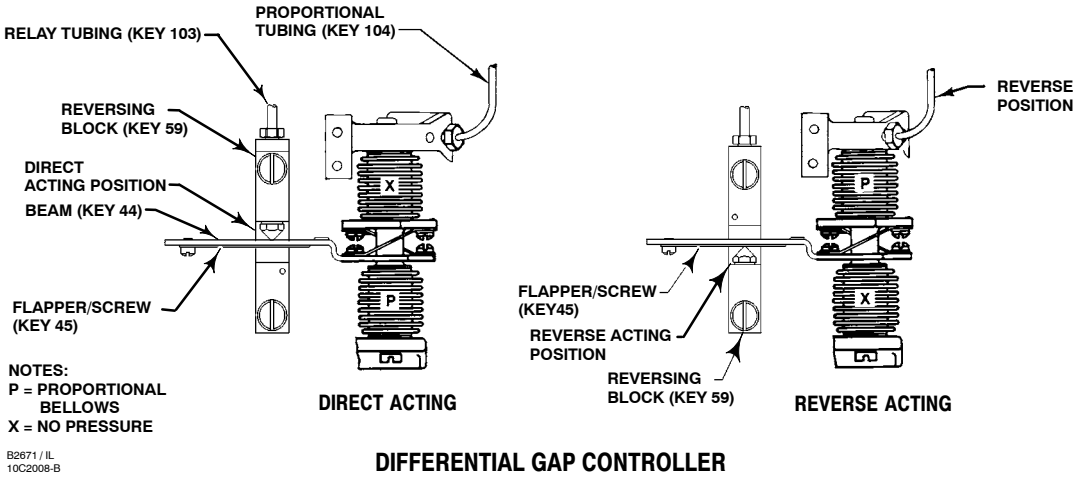


Figure 16. Direct/Reverse Acting Tubing Connections (Continued)

Changing Anti-Reset Windup Differential Relief Valve (4160KF)

WARNING

Refer to the WARNING at the beginning of the Maintenance Section.

Refer to figure 19 for key number locations.

1. Note the controller output pressure (zero or supply) when the process is shut down.

2. Remove the differential relief valve assembly.

3. Refer to figure 19. Install the replacement relief valve with the arrow positioned so that the controller output will be as noted in step 1 when the process is shut down.

Changing Action

WARNING

Refer to the WARNING at the beginning of the Maintenance Section.

Proportional-Only to a Differential Gap Controller

A proportional-only controller may be changed to a differential gap controller, or vice versa, by changing the position of the proportional tubing (key 104, figure 16). Refer to figure 16 for key number locations.

1. Isolate the controller from process, control, and supply pressure. Vent any trapped pressure from the controller before proceeding with the following steps.

2. Disconnect the proportional tubing (key 104) from the mounting base (key 30, figure 20 or 21) and reinstall it in the other connection in the mounting base.

3. Do not invert the reversing block unless also changing the controller action.

4. Check all connections for leaks with a soap-and-water solution. Perform the appropriate calibration procedure.

Direct to Reverse Action

Use the numbered steps below to change from direct action (increasing pressure produces increasing output pressure) to reverse action (increasing pressure produces decreasing output pressure), or vice versa. Changing the action is accomplished by reversing the positions of the reversing block and bellows tubing(s). Refer to figure 16 for key number locations unless otherwise directed.

1. Isolate the controller or transmitter from process, control, and supply pressure. Vent any trapped pressure from the controller or transmitter before proceeding with the following steps.

2. Locate the new tubing and reversing block positions for the action desired.

3. Locate the two bellows and the reversing block (key 59, figure 16).

4. Disconnect the tubing:

   a. **For a proportional-only controller or for a transmitter**, disconnect the proportional tubing

(key 104) from the mounting base (key 30, figure 20 or 21) and reconnect it in the opposite hole.

b. **For a proportional-plus-reset controller**, disconnect the proportional tubing (key 104) and reset tubing (key 117) from the mounting base (key 30, figure 20 or 21), and reconnect them in the opposite hole.

5. Change the reversing block assembly (key 59):

a. Remove the sealing screw (key 56, figure 20 or 21). Inspect the O-ring (key 55, figure 20 or 21) located in the recessed area under the sealing screw head. Replace the O-ring if necessary.

b. Remove the reversing block screw (key 61, figure 20 or 21) and reversing block assembly (key 59). Inspect the O-rings (key 55) located in the recessed area under the reversing block screw head and between the reversing block assembly and the calibration adjuster (key 41, figure 20 or 21). Replace these O-rings, if necessary.

c. Position the reversing block assembly, with O-ring, on the calibration adjuster (key 41) so that the nozzle is on the opposite side of the beam (key 44, figure 20 or 21) from which it was removed. Properly position the reversing block assembly so that the alignment pin engages the hole in the calibration adjuster. Install the reversing block screw (key 61) with O-ring (key 55).

d. Install the sealing screw (key 56) with O-ring in the hole previously covered by the reversing block assembly.

6. Check all connections for leaks with a soap-and-water solution. Perform the appropriate calibration procedures.

Relay Replacement

WARNING

Refer to the WARNING at the beginning of the Maintenance Section.

Key numbers used in this procedure are shown in figure 18 or 19 except where indicated.

1. Shut off the supply pressure and process pressure line(s) to the controller or transmitter.

2. Disconnect the tubing (key 103) from the relay.

3. Unscrew the output or supply pressure gauge (key 13).

4. To remove the relay assembly, unscrew two Phillips-head machine screws (key 81, not shown) located behind the relay on the back of the case.

5. Remove the relay gasket (key 7, figure 18).

6. A new relay can be installed as a replacement. If a new relay is being installed, continue with the next step.

7. Attach the replacement relay and new relay gasket with machine screws inserted through the back of the case. Reinstall the output or supply gauge.

8. Connect the tubing, and check all connections for leaks. Perform the appropriate calibration procedures.

Changing Output Signal Range

WARNING

Refer to the WARNING at the beginning of the Maintenance Section..

Use the following information and subsequent procedures when changing the output signal range of the controller or transmitter. Use the following procedure:

- **For a controller or transmitter**, use this procedure to change from a 0.2 to 1.0 bar (3 to 15 psig) to a 0.4 to 2.0 bar (6 to 30 psig) output signal range or vice versa.

- **For a differential gap controller**, use this procedure to change from a 0 and 1.0 bar (0 and 20 psig) to a 0 and 2.4 bar (0 and 35 psig) output signal range or vice versa.

- When changing the supply pressure source to a new range, refer to table 5 for supply pressure requirements for the output signal range selected.

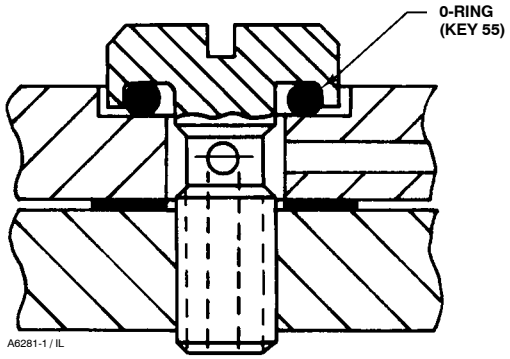


Figure 17. Bellows Screw Detail

Also, make appropriate changes to the nameplate of the controller or transmitter, reflecting the new range selections. Refer to figure 20 or 21 for key number locations unless otherwise directed.

1. Shut off the supply pressure and process lines to the controller or transmitter.

2. Disconnect the tubing from the mounting base (key 30) and calibration adjuster (key 41). Disconnect the tubing that connects the pressure block (key 8, figure 18 or 19) to the Bourdon tube or bellows assembly (key 62 or 71), at the pressure block end.

3. Unscrew the machine screws (key 28, figure 18 or 19), and remove the subassembly from the case.

4. If the controller or transmitter uses a Bourdon tube sensing element, disconnect the Bourdon tube from the beam (key 44) by removing the screw (key 63). Be careful to avoid losing the bearing (key 65). Unscrew the machine screws (key 77), and remove the washers and Bourdon tube (keys 76 and 62).

5. Unscrew the bellows screws (key 54) from each end of the mounting base (key 30). [Note: The bellows screws (key 54) have an O-ring (key 55, figure 17) installed beneath the bellows screw head. Remove the O-ring and obtain a replacement when re-assembling the bellows.]

6. Compress the bellows so that the end of the bellows and beam can be removed from the end of the mounting base (key 30) and unscrewed from the stud (key 51, not shown) that connects the bellows.

7. With the stud that connects the two bellows in place in the spacer (key 50), screw the new bellows onto the stud. Install new gaskets (key 53) on each bellows.

Note

The bellows screw (key 54) has an O-ring (key 55) installed beneath the bellows screw head as shown in figure 17. Be sure this O-ring is in place before installing the screw into the mounting base.

8. Compress the bellows, and install them into the mounting base (key 30). With the beam parallel with the mounting base, secure the bellows with the bellows screws (key 54).

9. After tightening the bellows screws, make sure that the nozzle (key 57) is centered on the flapper (key 45).

10. Replace the subassembly in the case and secure with the machine screws (key 28, figure 18 or 19). Install the Bourdon tube if it was removed; refer to the Replacing Bourdon Tube section if needed. Reconnect all tubing.

11. Unscrew the supply and output gauges (key 13, figure 18 or 19) and install new gauges with correct ranges.

12. Check all tubing connections and the bellows machine screws for leaks, tighten as necessary. Perform the appropriate calibration procedures.

Parts Ordering

Whenever corresponding with your Emerson Process Management sales office about this equipment, mention the serial number of the unit. The serial number can be found on the nameplate (key 22, figure 18). When ordering replacement parts, also state the complete 11-character part number of each part required as found in the following parts list.

Note

Use only genuine Fisher replacement parts. Components that are not supplied by Emerson Process Management should not, under any circumstances, be used in any Fisher instrument. Use of components not supplied by Emerson Process Management will void your warranty, might adversely affect the performance of the instrument, and might jeopardize worker and workplace safety.

Note

Neither Emerson, Emerson Process Management, Fisher, nor any of their affiliated entities assumes responsibility for the selection, use, and maintenance of any product. Responsibility for the selection, use, and maintenance of any product remains with the purchaser and end-user.

Parts Kits

Key	Description	Part Number
	Controller Repair Kits	
	Kit contains keys 5, 9, 10, 21, 24, 45, 46, 53, 55, 56, 57, 58, 59, 60, 61, 63, 64, and 65	
	Standard Temperature	R4150X00L12
	High Temperature	R4150X00H22
	Relay Replacement Kits	
	Kit contains key 7 and 43 and the replacement relay	
	Standard Temperature	RRELAYX0L22
	High Temperature	RRELAYX0H22
	Case Assembly Seal Kit	
	Kit contains 3 Manifold Seals, 1 Manifold Seal Cover, and 10 Mounting Screws	R4150KX0012

Parts List

Key	Description	Part Number

Assemblies (Figures 18 and 19)

	Case & Cover Std. Ass'y	GE09600X012
	Case & Cover Ass'y w/ Anti-Reset, −40 to 71°C (−40 to 160°F)	GE09601X012
	Case & Cover Std. Ass'y, 2 Psig Pressure tested	GE09600X022
	Case & Cover Std. Ass'y, 2 Psig Pressure tested, w/ Anti-Reset, −40 to 71°C (−40 to 160°F)	GE09601X032
	Proportional Band Valve or Span Adjustment Assembly	
	Std and High Temperature, aluminum	10A9122X032
	Stainless steel construction	10A9122X082
	Reset Restriction Valve Assembly	
	Standard Temperature	
	For all except Type 4160KF and 62KF	19A4361X012
	Reset Restriction Valve Assembly	
	Standard Temperature	
	For Type 4160KF and 62KF	19A4363X012
	Relay Assembly	
	Standard Temperature	22B0463X012
	High Temp, Type 4150K, 50KS, 52K, 52KS, 57K, 60K, 62K, and 64K	22B0462X012
	w/sst instrument construction	
	Standard Temp	22B0463X032
	High Temp, Type 4150K, 50KS, 57K, 60K	22B0462X022
	w/process pressure gauge	1J251035072
	For differential pressure instruments, sst	1H673035072

Common Parts (Figures 18, 19, 20, and 21)

Key	Description	Part Number
1	Case and Cover Assembly, aluminum	

Note

Refer to Assemblies for Case and Cover Assembly part numbers.

7*	Relay Gasket, for all series	
	Std Temp, chloroprene	1C897403012
	High Temp, silicone	1N873804142
8	Control Pressure Block	
	For gauge pressure instruments, sst w/o process pressure gauge	16A0979X012
9*	O-Ring, nitrile, for all series	1C376206992
10*	Gasket, chloroprene, for all series (not shown)	1C328603012
11*	Sealing Washer (not shown) Use w/0.14 bar (2 psi) pressure-tested case and cover (2 req'd)	1J186999012

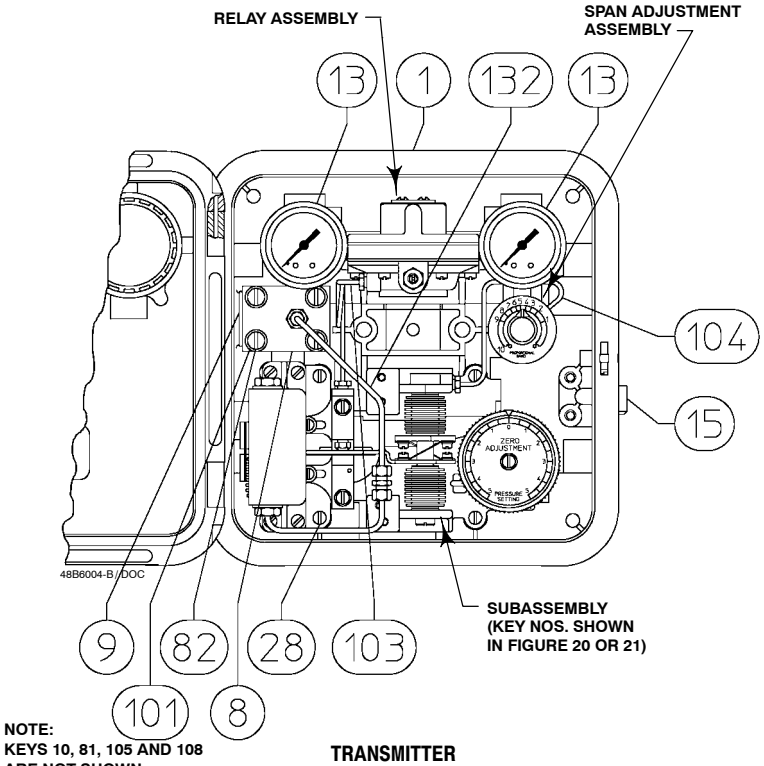
Note

Key 13 is used as both a supply gauge and an output gauge on units without a process pressure gauge. A quantity of 2 is required for these units. On units with a process pressure gauge (key 106), key 13 is used for the output gauge. A quantity of 1 is required for these units.

Use key 14 for supply pressure indication when a process pressure gauge is installed. Key 14 installs on the supply pressure regulator.

13*	Supply and Output Pressure Gauge, w/o process pressure gauge (1/8-inch connecting stem), ABS plastic, black enamel/polycarbonate/nitrile (2 req'd)	
	Dual scale	
	0-2.0 kg/cm^{2}0 and 0-30 psig	11B8577X042
	0-4.0 kg/cm^{2}0 and 0-60 psig	11B8577X052
	Triple scale	
	0-2.0 bar, 0-0.2 MPa, and 0-30 psig	11B8577X012
	0-4.0 bar, 0-0.4 MPa, and 0-60 psig	11B8577X022
13*	Output Pressure Gauge, w/process pressure gauge (1/8-inch connecting stem) (1 req'd)	
	Triple scale	
	0-2.0 bar, 0-0.2 MPa, and 0-30 psig	11B8577X012
	0-4.0 bar, 0-0.4 MPa, and 0-60 psig	11B8577X022
14*	Supply Pressure Gauge, w/process pressure gauge (1/4-inch connecting stem), ABS plastic, black enamel/polycarbonate/nitrile	
	Triple scale	
	0-2.0 bar, 0-0.2 MPa, and 0-30 psig	11B8579X022
	0-4.0 bar, 0-0.4 MPa, and 0-60 psig	11B8579X032
15	Vent Ass'y	27A5516X012
22	Plate, Instruction, aluminum	12B6338X0A2
28	Machine Screw, steel pl (4 req'd)	1E985428982
30	Mounting Base, aluminum	26A7668X012
31	Flexure Strip, sst	1C897836012

*Recommended spare parts



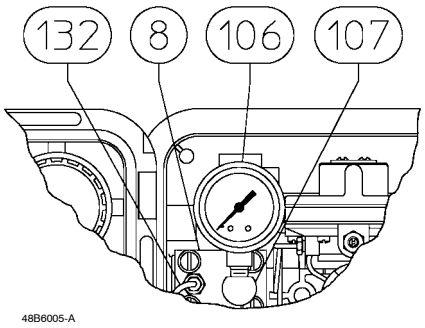


Figure 18. Typical Direct-Acting 4150K Series Assembly
(Refer to figure 22 for the Front View of the Case & Cover Assembly)

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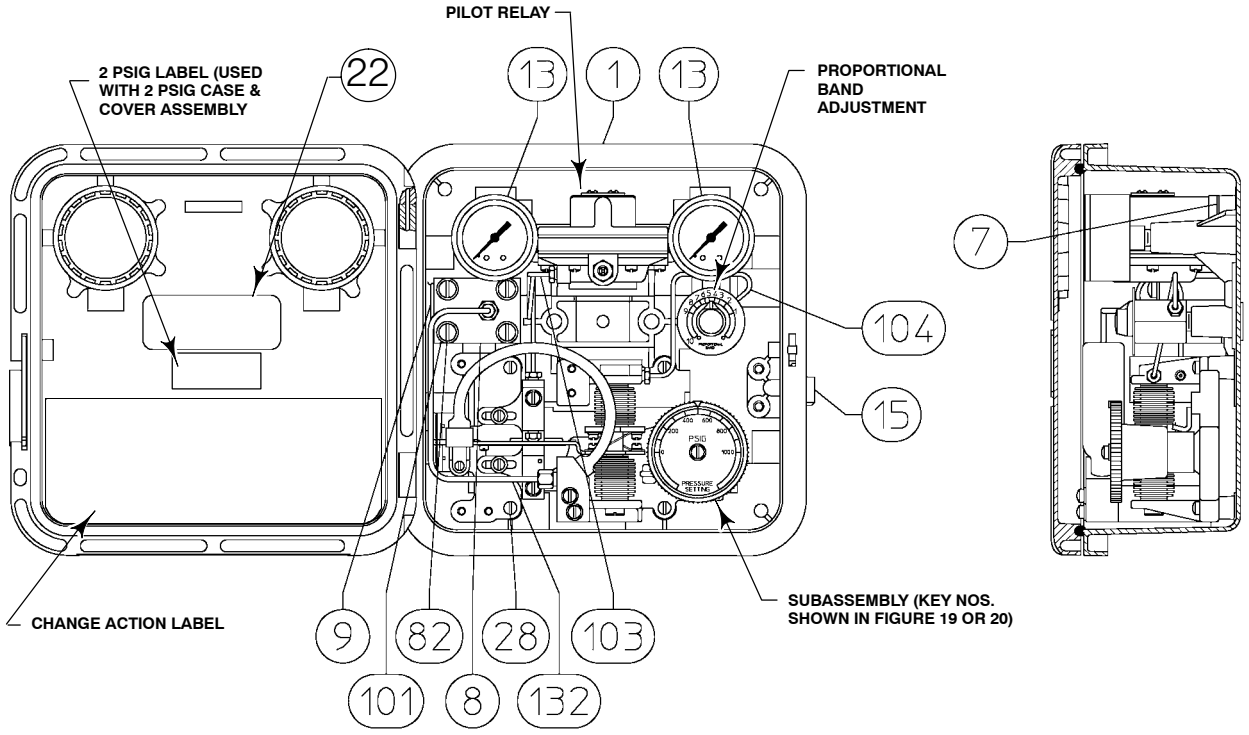
Key	Description	Part Number
32	Flexure Strip Washer, steel pl (2 req'd)	16A7671X012
33	Machine Screw, steel pl (4 req'd)	14B4995X012
34	Pressure Set Arm, steel pl	36A7669X012
35	Rotary Spring, sst	1J423437022
36	Knob, PPS	36A7670X012
37	Knob Spring, steel pl	1C221527022
38	Dial, aluminum	
	For Bourdon tube controllers	
	0-30 psig	16A7662X012
	0-60 psig	16A7662X022
	0-100 psig	16A7662X032
	0-150 psig	16A7662X412
	0-200 psig	16A7662X042
	0-300 psig	16A7662X052
	0-600 psig	16A7662X062
	0-1000 psig	16A7662X072
	0-1500 psig	16A7662X082
	0-3000 psig	16A7662X092
	0-5000 psig	16A7662X102
	0-8000 psig	16A7662X112
	0-10,000 psig	16A7662X122
	0-200 kPa	16A7662X142
	0-400 kPa	16A7662X152
	0-700 kPa	16A7662X162
	0-1400 kPa	16A7662X172
	0-2000 kPa	16A7662X182
	0-4000 kPa	16A7662X192
	0-7000 kPa	16A7662X202
	0-10,000 kPa	16A7662X212
	0-20,000 kPa	16A7662X222

Key	Description	Part Number
38	Dial, aluminum	
	For Bourdon tube controllers (continued)	
	0-35,000 kPa	16A7662X232
	0-55,000 kPa	16A7662X242
	0-70,000 kPa	16A7662X252
	0-100%	16A7662X272
	0-2 bar	16A7662X482
	0-4 bar	16A7662X442
	0-7 bar	16A7662X472
	0-14 bar	16A7662X462
	0-20 bar	16A7662X492
	0-40 bar	16A7662X452
	0-70 bar	16A7662X502
	0-100 bar	16A7662X512
	0-200 bar	16A7662X522
	0-350 bar	16A7662X532
	0-550 bar	16A7662X542
	0-700 bar	16A7662X552
	For bellows sensing element controllers	
	Gauge pressure	
	0-60 inches wc	16A7662X282
	0-140 inches wc	16A7662X292
	0-5 psig	16A7662X302
	0-10 psig	16A7662X312
	0-15 psig	16A7662X322
	0-20 psig	16A7662X332
	0-30 psig	16A7662X012
	0-200 kPa	16A7662X142
	0-10 inches Hg vacuum	16A7662X342



NOTE:
KEYS: 10, 81, 105 NOT SHOWN

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PROPORTIONAL-ONLY CONTROLLER

Figure 18.Typical Direct-Acting 4150K Series Assembly (continued)

Key	Description	Part Number
38	Dial, aluminum	
	For bellows sensing element controllers	
	Gauge pressure (continued)	
	0-30 inches Hg vacuum	16A7662X352
	30-0-30 inches wc compound	16A7662X362
	15 in. Hg vacuum-0-7.5 psig compound	16A7662X372
	30 in. Hg vacuum-0-15 psig compound	16A7662X382
	0-60 inches wc vacuum	16A7662X392
	Differential pressure	
	0-80 inches wc	16A7662X402
	0-10 psig	16A7662X312
	0-20 psig	16A7662X332
	0-30 psig	16A7662X012
	0-200 kPa	16A7662X142
	0-2 bar	16A7662X482
	For all Type 4155K, 57K, and 58K transmitters	16A7664X012
39	Washer, steel pl	1R982025072
40	Machine Screw, steel pl	1E175828982
41	Calibration Adjuster, steel pl	2H266244012
42	Washer, steel (2 req'd)	1E873028992
43	Machine Screw, steel pl (2 req'd)	1A5733X0012
44	Beam, steel	1H266825072
45	Flapper, K93602 nickel alloy	1H266941132
46	Machine Screw, steel pl	1B275128992
47	Cross Spring, sst (2 req'd)	1H266037032
48	Washer, steel pl (4 req'd)	1H267128982
49	Machine Screw, steel pl (4 req'd)	1A346128982
50	Spacer, zinc	1H265944012
51	Bellows Stud, brass (not shown)	1H265814012

Key	Description	Part Number
52*	Feedback Bellows Ass'y	
	Brass	
	0.2-1.0 bar (3-15 psig) (2 req'd)	14A5726X012
	0.4-2.0 bar (6-30 psig) (2 req'd)	14A5726X032
	Stainless steel	
	0.2-1.0 bar (3-15 psig) (2 req'd)	14A5726X022
	0.4-2.0 bar (6-30 psig) (2 req'd)	14A5726X042
53*	Gasket	
	Std Temp, chloroprene (2 req'd)	1D397003012
	High Temp, silicone (2 req'd)	1N873604142
54	Bellows Screw (2 req'd)	
	Brass	22B8036X012
	Stainless steel	22B8036X022

Note

A total of 5 O-rings (key 55) are used. 1 O-ring is used under the sealing screw (key 56), 1 O-ring is used under the reversing blockscrew (key 61), 1 O-ring is used between the reversing block ass'y (key 59) and the calibration adjuster (key 41), and 1 O-ring is used in the recessed area under the head of each of the bellows screws (key 54).

55*	O-Ring,	
	Std Temp, nitrile (5 req'd)	1D687506992
	High Temp, fluoroelastomer (5 req'd)	1N430406382
56	Sealing Screw, sst	14A5721X012
57*	Nozzle, sst	1U639135132

*Recommended spare parts

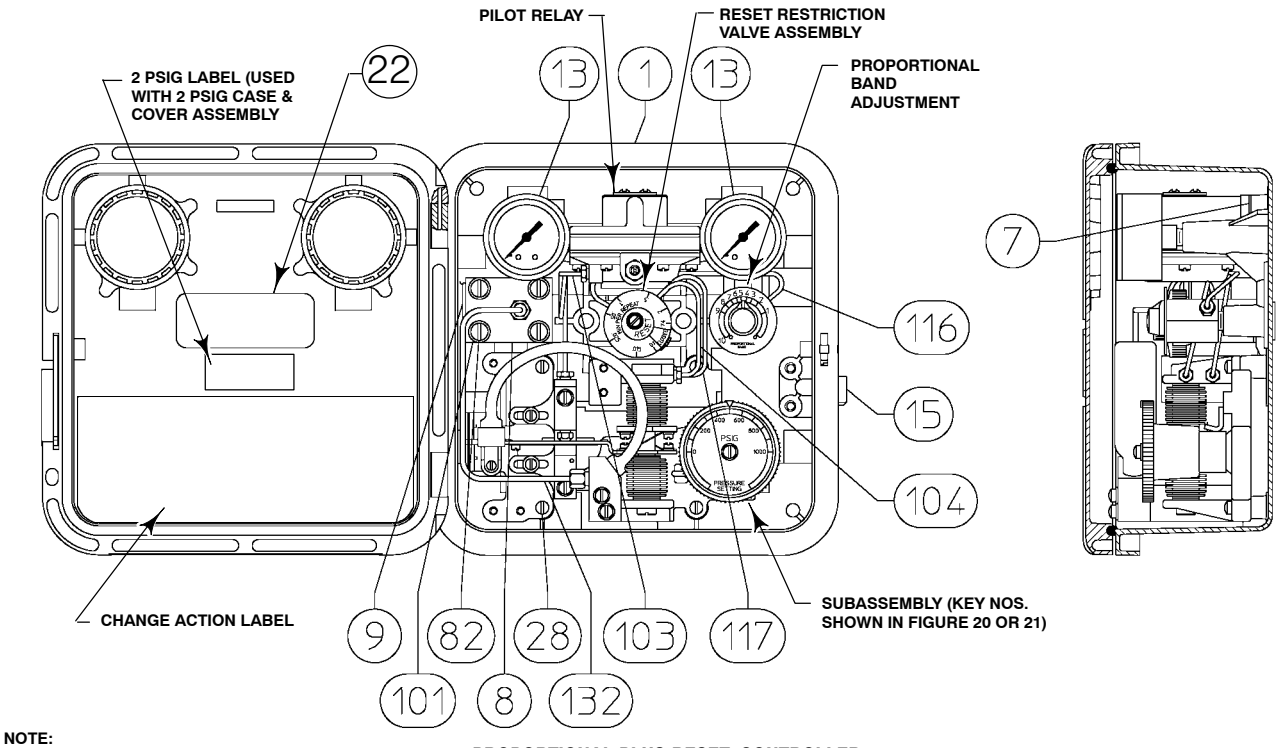


Figure 19. Typical Direct-Acting 4160K Series Assembly
(Refer to figure 22 for the Front View of the Case & Cover Assembly)

Key	Description	Part Number
58*	Nozzle O-Ring,	
	Std Temp, nitrile	1E222606992
	High Temp, fluoroelastomer	1N838706382
59	Reversing Block, steel pl	26A0975X012
60	Sleeve, POM	16A0976X012
61	Reversing Block Screw, sst	24A5720X012
62*	Bourdon Tube	See table 7
63	Machine Screw, steel pl	
	Bourdon tube instruments only (2 req'd)	1A331928982
64*	Connecting Link, Bourdon tube instruments only	
	Std., N04400	1L379641012
	Bourdon tube w/optional travel stop, Stainless steel	1L611235022
65*	Link bushing, sst	
	Bourdon tube instruments only (2 req'd)	1L379546202
66	Travel Stop Assembly, steel	
	optional w/Bourdon tube	1H7793000A2
67	Lockwasher, steel pl (2 req'd)	
	Use w/optional Bourdon tube travel stop	1H267228982
68	Machine Screw, steel pl (2 req'd)	
	Use w/optional Bourdon tube travel stop	1H267628982
69	Cap Screw, steel pl	
	Use w/optional Bourdon tube travel stop	1H779232982
70	Bellows Yoke, zinc	
	Use w/gauge and differential pressure bellows	2H453844012

Key	Description	Part Number
71*	Gauge Pressure Bellows (input)(1)	
	Brass	
	0-150 mbar (0-60 inches wc) positive, 0-150 mbar (6-60 inches wc) vacuum, and 75-0-75 mbar (30-0-30 inches wc) compound	1L3780000A2
	0-250 mbar (0-100 inches wc) positive, Type 4158K only	1L3788000A2
	0-0.35 mbar (0-5 psig) positive and for 0-350 mbar (0-10 inches Hg) vacuum	1L3781000A2
	0-0.5 bar (0-7.5 psig) positive, 4158K only	1L3789000A2
	0-0.7 bar (0-10 psig) positive	1L3782000A2
	0-1.0 bar (0-15 psig) positive, 0-1.0 bar (0-30 inches Hg) vacuum, and 500-0-500 mbar (15-0-7.5 psig) compound	1L3783000A2
	0-1.4 bar (0-20 psig) positive	1L3784000A2
	0-2.0 bar (0-30 psig) positive and 1.0-0-1.0 bar (30-0-15 psig) compound	1L3785000A2
	Stainless steel,	
	0-1.0 bar (0-15 psig) positive, 0-1.0 bar (0-30 inches Hg) vacuum, and 500-0-500 mbar (15-0-7.5 psig) compound	1L3786000A2
	0-2.0 bar (0-30 psig) positive, 1.0-0-1.0 bar (30-0-15 psig) compound	1L3787000A2

*Recommended spare parts
1. If ordering the bellows (key 71) to change the range of a gauge pressure controller, also order the appropriate bellows spring (key 80). Also order keys 72, 73, and 74, if you do not have them.

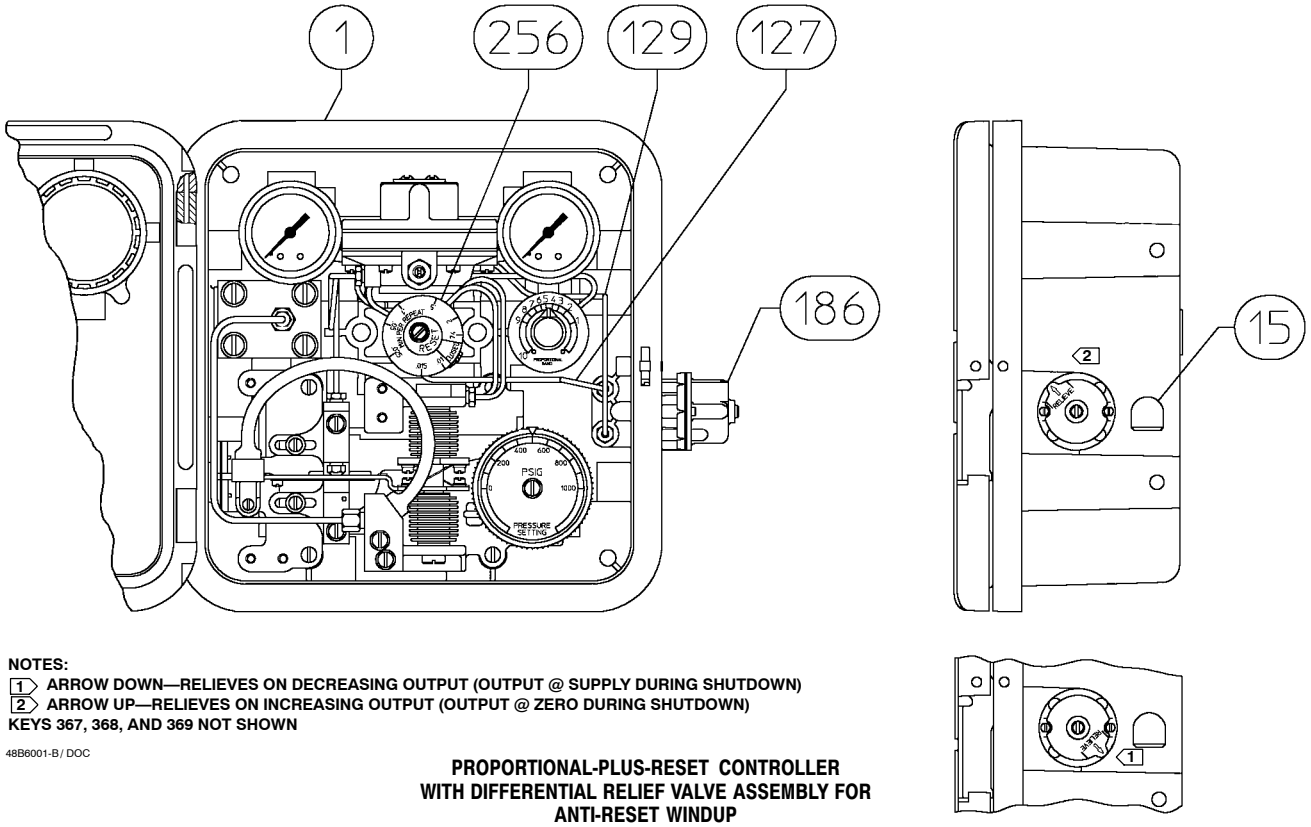
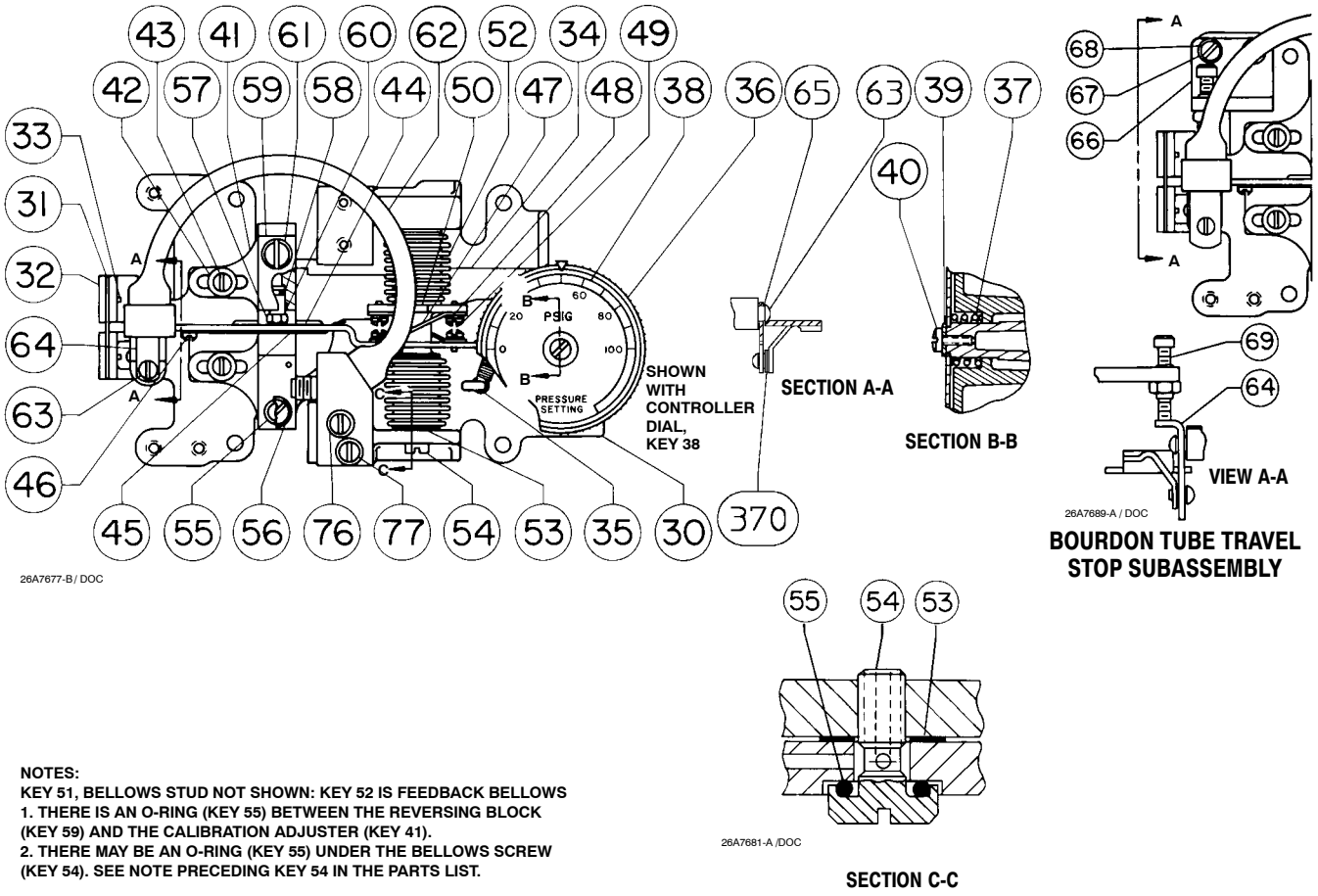


Figure 19. Typical Direct-Acting 4160K Series Assembly (continued)

Key	Description	Part Number
71*	Differential-Pressure Bellows (input)	
	Brass	
	0-200 mbar (0-80 inches wc)	2L3790000A2
	0-0.7 bar (0-10 psi)	2L3791000A2
	0-1.4 bar (0-20 psi)	2L3792000A2
	Stainless steel,	
	0-2.0 bar (0-30 psi)	2L3793000A2
71K	Machine Screw, steel pl(2)	
	bellows sensing instruments only (2 req'd)	1A331928982
71L*	Bearing(2)	
	bellows sensing instruments only (2 req'd)	1L379546202
71M*	Link(2) bellows sensing instruments only	1L379641012
72	Jam Nut, steel pl	
	Gauge pressure bellows instruments only	1A946324122
73	Washer, steel pl	
	Gauge pressure bellows instruments only	1B865928982
74	Spring Seat, pl brass	
	Gauge pressure bellows instruments only	1H453214022
75	Machine Screw, steel pl	
	Gauge and differential pressure	
	bellows instruments (4 req'd)	1H267628982
76	Washer, steel pl	
	for Bourdon tube instruments (2 req'd)	1H267228982
	for bellows sensing instruments (4 req'd)	1H267228982
77	Machine Screw, steel pl	
	Bourdon tube instruments only (2 req'd)	1H267728982
79	Screw, nylon Transmitters only	1A3461X0042
80	Spring, gauge pressure bellows instruments only	
	Steel pl	
	0-150 mbar (0-60 inches wc) positive,	
	0-150 mbar (0-60 inches wc) vacuum,	
	75-0-75 mbar, and	
	(30-0-30 inches wc) compound	1J729227022
	0-250 mbar (0-100 inches wc) positive,	
	0-0.35 bar (0-5 psig) positive, and	
	0-350 mbar (0-10 inches Hg) vacuum	1H448227022
	0-0.5 bar (0-7.5 psig) positive	1K525727022
	0-0.7 bar (0-10 psig) positive	1K493427022
	0-1.0 bar (0-15 psig) positive,	
	0-1.0 bar (0-30 inches Hg) vacuum,	
	500-0-500 mbar (15-0-7.5 psig) compound	1H448327022
	0-1.4 bar (0-20 psig) positive	1K525927022

*Recommended spare parts
2. This part is part of the bellows assembly, key 71



NOTES:
KEY 51, BELLOWS STUD NOT SHOWN: KEY 52 IS FEEDBACK BELLOWS
1. THERE IS AN O-RING (KEY 55) BETWEEN THE REVERSING BLOCK (KEY 59) AND THE CALIBRATION ADJUSTER (KEY 41).
2. THERE MAY BE AN O-RING (KEY 55) UNDER THE BELLOWS SCREW (KEY 54). SEE NOTE PRECEDING KEY 54 IN THE PARTS LIST.

Figure 20. Controller Subassembly with Bourdon Tube Sensing Element

Key	Description	Part Number
80	Spring, gauge pressure bellows instruments only (continued)	
	0-2.0 bar (0-30 psig) positive, 1.0-0-1.0 bar (30-0-15 psig) compound 316 SST	1H448427022
	0-1.0 bar (0-15 psig) positive, 0-1.0 bar (0-30 inches Hg) vacuum, 500-0-500 mbar (15-0-7.5 psig) compound	1H641137012
	0-2.0 bar (0-30 psig) positive, 1.0-0-1.0 bar (30-0-15 psig) compound	1H641237012
81	Machine Screw, steel pl (not shown) (2 req'd)	1H527128982
82	Machine Screw, steel pl (4 req'd)	1C333328982
101	Lockwasher, steel pl (4 req'd)	1C225628982
103	Relay Tubing Assembly, sst	1H6861000A2
104	Compensator Tubing Assembly, sst	
	Types 4150K, 50KS, 52K, 52KS, 54K, 55K, 57K, and 58K	1H6864000A2
	Types 4160K, 60KF, 62K, 62KF and 64K	1H6870000A2
105	Plug, S31600 (316 SST), (not shown) used with gauge pressure only	1A767535072

Key	Description	Part Number
	Note	
	Controllers with bellows sensing element use only the 2.0 bar, 0 to 0.2 MPa, and 0 to 0 to 30 psig triple scale brass and stainless steel process pressure gauges. Differential pressure controllers do not use a process pressure gauge.	
106*	Process Pressure Gauge (use only when specified)	
	Triple scale	
	ABS plastic/Brass	
	0-2.0 bar, 0-0.2 MPa, and 0-30 psig	11B8578X012
	0-4.0 bar, 0-0.4 MPa, and 0-60 psig	11B8578X022
	0-11 bar, 0-1.1 MPa, and 0-160 psig	11B8578X032
	0-20 bar, 0-2.0 MPa, and 0-300 psig	11B8578X042
	0-40 bar, 0-4.0 MPa, and 0-600 psig	11B8578X052
	0-69 bar, 0-6.9 MPa, and 0-1000 psig	11B8578X062
	ABS plastic/Stainless steel	
	0-2.0 bar, 0-0.2 MPa, and 0-30 psig	11B8584X022
	0-20 bar, 0-2.0 MPa, and 0-300 psig	11B8584X012
	0-69 bar, 0-6.9 MPa, and 0-1000 psig	11B8584X032

*Recommended spare parts

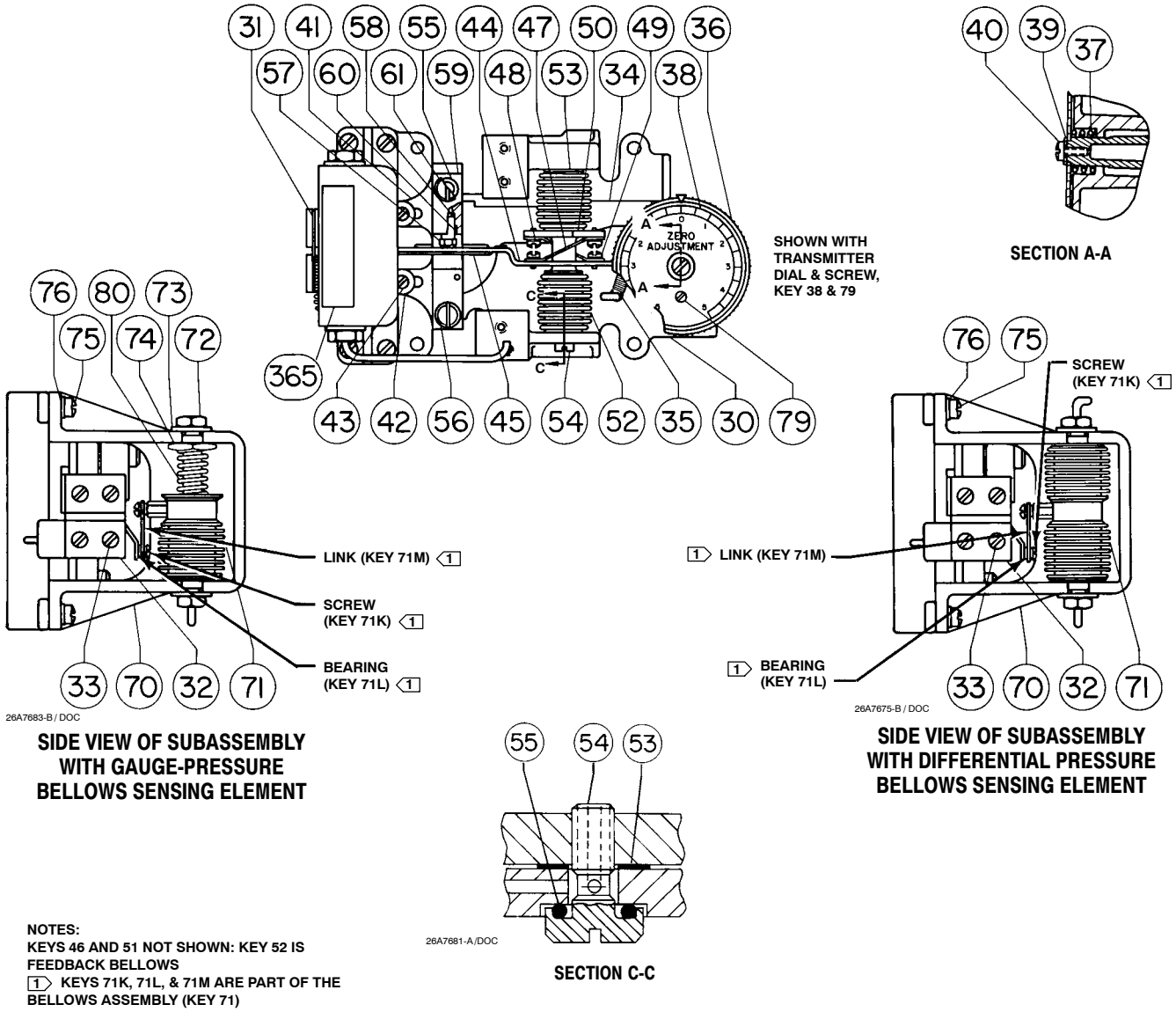


Figure 21. Controller Subassembly with Either Gauge-Pressure Bellows or Differential-Pressure Bellows Sensing Element

Key	Description	Part Number
107	Pressure Connection, sst	
	Use w/process gauge	1J251235162
108	Pipe Plug, steel pl (not shown)	
	Use w/process gauge,	
	not used w/Bourdon tube protector	1E823128982
115	Mounting Screw for reset restriction valve	
	Type 4160K, 60KF, 62K, 62KF, and 64K	
	1/4-20 UNC, steel pl (not shown)	1H527028982
116	Reset Tubing Ass'y, sst	
	Type 4160K, 60KF, 62K, 62KF, and 64K	1H6866000A2
117	Compensator Tubing Ass'y, sst	1H6868000A2
127	Tubing Assembly, sst	
	Type 4160KF and 4162KF only	27B9975X012
129	Tubing Assembly, sst	
	Type 4160KF and 4162KF only	27B9976X012
132	Control Tubing Assembly	
	For Bourdon tube instruments	
	w/o process pressure gauge	
	Stainless steel	1H3011000A2
	N05500 (not used on Type 4151K)	1H3011X0022
	w/process pressure gauge, sst	1J2530000A2
	For gauge-pressure bellows instruments, sst	
	w/o process pressure gauge	1H4526000A2
	w/process pressure gauge	1J2553000A2
	For differential-pressure	
	bellows instruments, sst	1H4526000A2
133	Control Tubing Assembly, sst	
	For differential-pressure instruments only	1H6732000A2
167	Label, Use w/2 psi (0.14 bar) pressure-tested	
	case and cover	12A9842X012

Key	Description	Part Number
186	Anti-Reset Windup Ass'y	
	For Type 4160KF and 4162KF	21A6447X0A2
365	Label, bellows sensing instruments only	
	Gauge pressure instruments	
	0-60 inches wc	11B5655X062
	0-100 inches wc	11B5655X272
	0-140 inches wc	11B5655X082
	0-5 psig	11B5655X012
	0-7.5 psig	11B5655X262
	0-10 psig	11B5655X022
	0-15 psig	11B5655X032
	0-20 psig	11B5655X042
	0-30 psig	11B5655X052
	Differential pressure instruments	
	0-80 inches wc	11B5655X222
	0-60 inches wc	11B5655X062
	0-10 psi	11B5655X232
	0-20 psi	11B5655X242
	0-30 psi	11B5655X252
366	Pipe Plug, Use w/0.14 bar (2 psi) pressure-tested case and cover (2 req'd)	1P2796X0012
367*	O-Ring (not shown)	
	Type 4160KF and 4162KF only (2 req'd)	1C853806992
368	Machine Screw (not shown)	
	Type 4160KF and 4162KF only (2 req'd)	1U8842X0012
369	Anti-Reset Windup Cover (not shown)	
	Type 4160KF and 4162KF only (2 req'd)	2V597308012
370	Plain Washer, brass	1H339718992

Mounting Parts for Panel, Wall, Pipestand, or Actuator Mounting (Figures 3 and 4)

213	Mounting Plate, steel	
	For yoke mounting on Types 470, 472, 513, 656, 657 and 667	1C221825022
	For yoke mounting on Type 480	
	Vertical	3L276725092
	Horizontal	3J854725012
	For yoke mounting on Types 1051 and 1052	
	Size 40, positions 1 and 3 w/switch and Size 60, position 1 w/switch	23A8891X012
	All others	1C221825022
	For yoke mounting on Type 1061	
	Size 30, positions 1 and 3 w/switch and position 1 w/o switch, Size 40, position 1 w/switch and Sizes 80 and 100, position 3 w/o switch	23A8891X012
	All others	1C221825022
	For pipe stand mounting	3N975725092
	For mounting on Type 115	3J779825012
	For mounting on Type 115C	2K654825022
215	Machine Screw, steel pl (specify quantity req'd)	
	5/16 UNC X 1 inch	1C639128982
	5/16 UNC X 1-1/2 inches	1H304728982
	5/16 UNC X 2 inches	1B762424052
216	Hex Nut, steel pl (specify quantity req'd)	
	For casing mounting on Types 126 and 127 and for filter regulator mounting on Types 1051, 1052 and 1061	1A352724122
	All other types and mountings	1C332828982

Key	Description	Part Number
220	Mounting Bracket, steel pl (not shown)	
	For casing mounting on Types 126, 127, 657, 667, 1051 and 1052 and for casing-mounted filter regulator on Types 1051 and 1052	1F401225072
221	Lockwasher, steel pl (specify quantity req'd)	1C225728982
222	Cap Screw, steel pl (specify quantity req'd)	
	5/16 UNC X 3/4 inch	1A381624052
	5/16 UNC X 1 inch	1A352624052
	5/16 UNC X 1-1/8 inches	1C379124052
	5/16 UNC X 1-1/4 inches	1B787724052
	5/16 UNC X 1-3/4 inches	1A553424052
	5/16 UNC X 2-1/2 inches	1C870224052
	5/16 UNC X 3-5/8 inches	1C398824052
	3/8 UNF X 1-1/8 inches	1A582824052
223	Cap Screw, steel pl	
	Types 1051 and 1052 with either case or yoke mounted regulator and Type 1061 with yoke mounted regulator (2 req'd)	T14109T0012
228	Spacer Spool, steel (specify quantity req'd)	
	Types 470, 472, 480, 513, 656, 657, 667, pipe stand 1051, 1052 and 1061	1F906724092
	Type 115	
	W/o regulator or w/one regulator	1K153424092
	W/two regulators	1K414424092
	Type 115C	1K654724092
229	Cap Screw, steel pl (not shown) (specify quantity req'd)	
	Type 115	
	w/o regulator or w/one regulator	1F960324052
	w/two regulators	1C870224052
	Type 115C	1D770424052
	Types 126 and 127	1B227524052
	Types 1051 and 1052 casing-mounted controller	1A582824052
230	Cap Screw, steel pl (not shown)	
	Types 126 and 127	1C595824052
231	Pipe Nipple, steel (not shown) (specify quantity req'd)	
	For casing mounting on Types 126 and 127 W/Types 67FR, 67R, 254, 254F and 1301	11A3740X012
232	Pipe Tee, steel (not shown)	
	For casing mounting on Types 126 and 127 W/Types 67R, 254 and 1301	1B8606X0012
238	Mounting Plate, steel	
	For yoke-mounted filter regulator	
	Types 1051, 1052 and 1062 sizes 40 and 60	1C221825022
	Types 1061 size 30	23A8891X012
240	Cap Screw, steel	
	For yoke-mounted filter regulator on Types 1051 and 1052 sizes 40 and 60 (2 req'd)	1A553424052
241	Spacer Spool, steel	
	For yoke mounted filter regulators on Types 1051 and 1052 sizes 40 and 60 (2 req'd)	1C559024092
242	Spacer Spool, steel (not shown)	
	For yoke mounting on	
	Types 1051 and 1052 size 40 (2 req'd)	1V102624092
	Type 1061 sizes 30, 80 and 100 (2 req'd)	1J830724092
243	Street Elbow, pl galvanized malleable iron (not shown)	
	For mounting on Types 470, 472, 480, 513, 656, 657, 667, panel, pipe stand, 1051, 1052 and 1061 w/nipple-mounted filter regulator	1A913221992

*Recommended spare parts

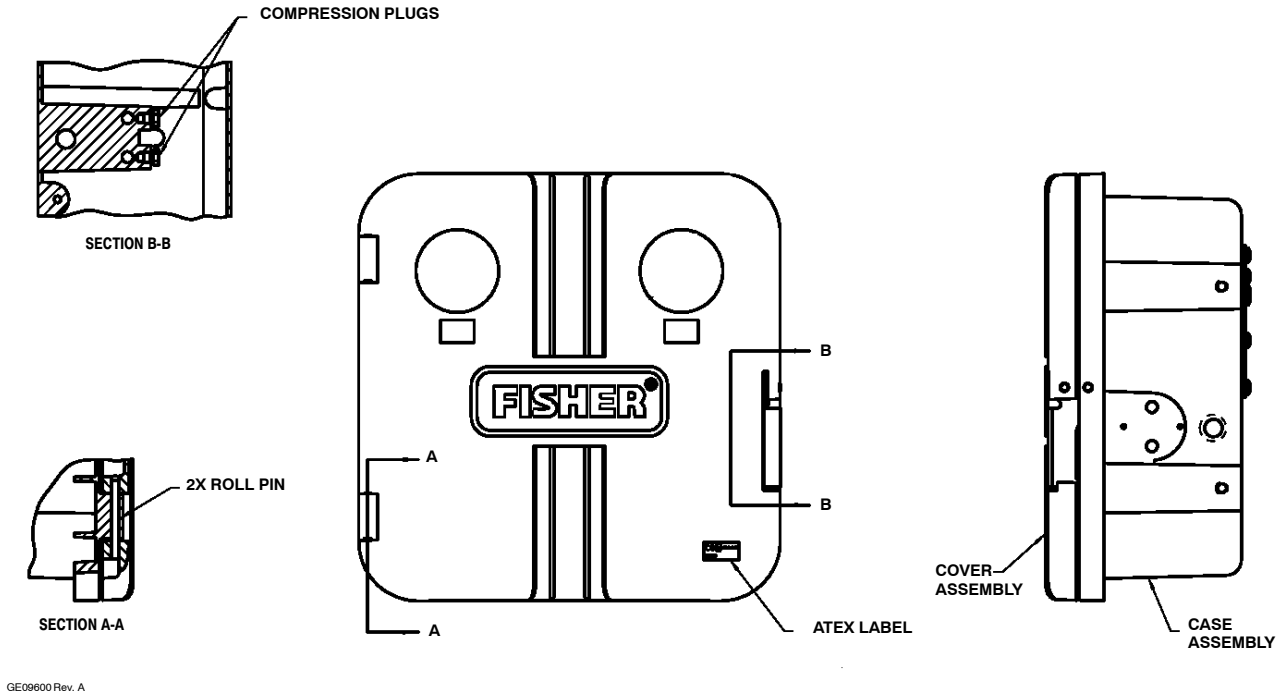


Figure 22. Front View of Case and Cover Assembly

Key	Description	Part Number
244	Pipe Nipple, pl galvanized steel (not shown)	
	For mounting on Types 470, 472, 480, 513, 656, 657, panel, pipe stand, 1051, 1052 and 1061 w/nipple-mounted filter regulator	1D239726232
250	Clamp, Steel	
	For pipe stand mounting (2 req'd)	1P427028982
251	Bracket Assembly, steel	
	For panel or wall mounting (2 req'd)	1H2892000A2
252	Cap Screw, steel pl	
	For panel or wall mounting (4 req'd)	1B848024052

Key	Description	Part Number
	Note	
	Specify quantity of fittings.	
	Connector, Brass	
	1/8-inch NPT X 1/4-inch od tubing	1A395914012
	1/4-inch NPT X 1/4-inch od tubing	1A636814012
	1/4-inch NPT X 3/8-inch od tubing	1B885618992
	Elbow, Brass	
	1/8-inch NPT X 1/4-inch od tubing	1A685018992
	1/4-inch NPT X 1/4-inch od tubing	1A397118992
	1/4-inch NPT X 3/8-inch od tubing	1B884618992

Table 7. Key 62* Bourdon Tube

PRESSURE RANGE		MATERIAL	
kPa	**Psig**	**Stainless Steel**	**N05500(1)**
0-200	0-30	32B1243X012	---
0-400	0-60	32B1243X022	---
0-700	0-100	32B1243X032	---
0-1400	0-200	32B1243X042	---
0-2000	0-300	32B1244X052	---
0-4000	0-600	32B1244X062	32B1244X202
0-7000	0-1000	32B1244X072	32B1244X212
0-10,000	0-1500	32B1245X082	32B1245X222
0-20,000	0-3000	32B1245X092	---
0-35,000	0-5000	32B1245X102	---
0-55,000	0-8000	32B1245X112	---
0-70,000	0-10,000	32B1245X122	

1. For NACE applications.

A subassembly with Bourdon tube sensing element as shown in figure 20 contains the following key numbers: 30 through 37, 39 through 61, 63, 65, 76, and 77. When ordering the subassembly as indicated in table 8, one of each of the following key numbered parts must also be ordered to complete the subassembly: dial, key 38; Bourdon tube, key 62; and connecting link, key 64.

Table 8. Subassemblies with Bourdon Tube Sensing Element

OUTPUT PRESSURE RANGE		FEEDBACK BELLOWS MATERIAL	STANDARD	HIGH TEMPERATURE
Bar	Psig			
0.2 to 1/0 or 0 and 1.4 differential gap	3 to 15 or 0 and 20 differential gap	Brass	26A7677X012	26A7677X022
		Stainless steel	26A7677X052	26A7677X062
0.4 to 2.0 or 0 and 2.4 differential gap	6 to 30 or 0 and 35 differential gap	Brass	26A7677X032	26A7677X042
		Stainless steel	26A7677X072	26A7677X082

A subassembly with gauge pressure bellows sensing element as shown in figure 21 contains the following key numbers: 30 through 37, 39 through 61, 71K, and 71L. The machine screws, key 77, quantity of 2, and washers, key 76, quantity of 2, also come with the subassembly. The two washers, key 76, may be used with the machine screws, key 75, but four washers and machine screws are required so two more washers must be ordered. The machine screws, key 77, are not used on subassemblies with bellows input so they may be discarded. Although two machine screws, key 71K, and two bearings, key 71L, are included with the subassembly, they are also included with the bellows assembly, key 71. When ordering the subassembly as indicated in table 9, one of each of the following key numbered parts, unless other quantities are indicated, must also be ordered to complete the subassembly: dial, key 38; bellows yoke, key 70; bellows assembly, key 71; jam nut, key 72; washer, key 73; spring seat, key 74; machine screw, key 75, quantity of 4; washer, key 76, quantity of 2; and spring, key 80. The link, key 71M, is included with the bellows assembly, key 71. If ordering parts for a transmitter, a screw, key 79, must also be ordered.

Table 9. Subassemblies with Gauge-Pressure Sensing Element

OUTPUT PRESSURE RANGE		FEEDBACK BELLOWS MATERIAL	STANDARD	HIGH TEMPERATURE
Bar	Psig			
0.2 to 1/0 or 0 and 1.4 differential gap	3 to 15 or 0 and 20 differential gap	Brass	26A7677X012	26A7677X022
		Stainless steel	26A7677X052	26A7677X062
0.4 to 2.0 or 0 and 2.4 differential gap	6 to 30 or 0 and 35 differential gap	Brass	26A7677X032	26A7677X042
		Stainless steel	26A7677X072	26A7677X082

A subassembly with differential pressure bellows sensing element as shown in figure 21 contains the following key numbers: 30 through 37, 39 through 61, 71K, and 71L. The machine screws, key 77, quantity of 2, and washers, key 76, quantity of 2, also come with the subassembly. The two washers, key 76, may be used with the machine screws, key 75, but four washers and machine screws are required so two more washers must be ordered. the machine screws, key 77, are not used on subassemblies with bellows input so they may be discarded. Although two machine screws, key 71K, and two bearings, key 71L, are included with the subassembly, they are also included with the bellows assembly, key 71. When ordering the subassembly as indicated in table 10, one of each of the following key numbered parts, unless other quantities are indicated, must also be ordered to complete the subassembly: dial, key 38; bellows yoke, key 70; bellows assembly, key 71; machine screw, key 75, quantity of 4; and washer, key 76, quantity of 2. The link, key 71M, is included with the bellows assembly, key 71. If ordering parts for a transmitter, a screw, key 79, must also be ordered.

Table 10. Subassemblies with Differential-Pressure Bellows Sensing Element

OUTPUT PRESSURE RANGE		FEEDBACK BELLOWS MATERIAL	STANDARD	HIGH TEMPERATURE
Bar	Psig			
0.2 to 1/0 or 0 and 1.4 differential gap	3 to 15 or 0 and 20 differential gap	Brass	26A7677X012	26A7677X022
		Stainless steel	26A7677X052	26A7677X062
0.4 to 2.0 or 0 and 2.4 differential gap	6 to 30 or 0 and 35 differential gap	Brass	26A7677X032	26A7677X042
		Stainless steel	26A7677X072	26A7677X082

4150K and 4160K Controllers and Transmitters

Instruction Manual
Form 5177
March 2006

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