Instruction

MI 018-430
June 2005

E69F Current-to-Pneumatic Signal Converter

Invensys®
FOXBORO®

⚠ DANGER

This converter may have agency certification for installation in hazardous locations or for intrinsic safety. Use of the converter in atmospheres for which it has not been certified can cause an explosion resulting in death or injury. Refer to label affixed to the converter for type of certification and observe applicable wiring practices. For conditions of certification, see Table 1, "Product Safety Specifications."

Introduction

General Description

The E69F Current-to-Pneumatic Signal Converter (Figure 1) is a field-mounted instrument that transforms a dc milliampere input signal to a proportional pneumatic output signal.

This output signal can be used either to operate such pneumatic devices as dampers, and valve actuators, and so forth, or as the input to various pneumatic instruments.

Principle of Operation

A dc milliampere input signal is converted to a proportional pneumatic output signal in the following manner (see Figure 2). A coil positioned in the field of a permanent magnet reacts to the current by producing a tangential thrust proportional to the input signal flowing through it. The thrust, acting through coil flexures, varies the gap between a flapper and a nozzle. This causes a change in the output pressure of the relay, which is also the converter output pressure. This pressure is fed to a feedback bellows which exerts a force on a feedback flexure to move the nozzle and establish a throttling relationship between the flapper and the nozzle.

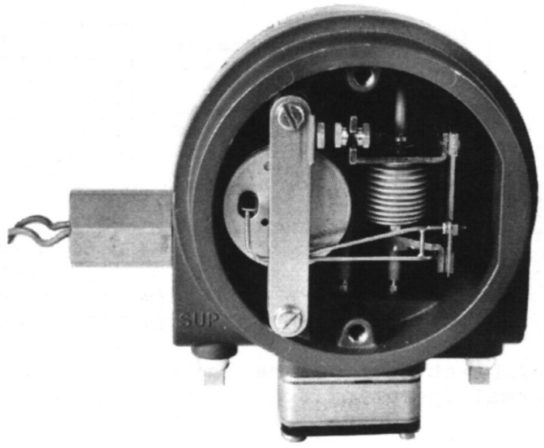

Figure 1.

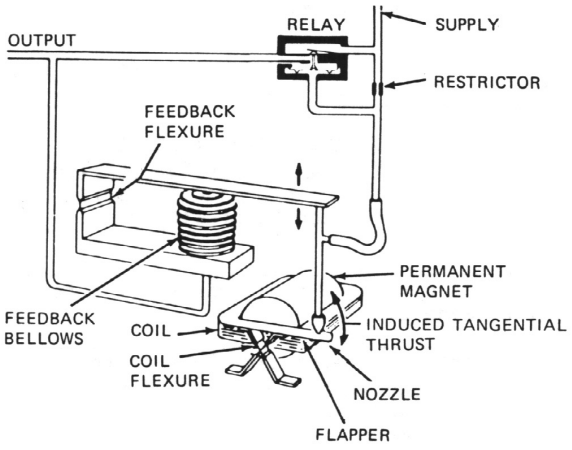

Figure 2.

Standard Specifications

Input and Output Ranges

Input Ranges (mA)	Output Ranges[3]	
	kPa	psi
4 to 20[1]	20 to 100	3 to 15
	–	3 to 27
or	40 to 200	6 to 30
	7 to 125	1 to 18
10 to 50[2]	7 to 220	1 to 32

[1] 4 to 12 or 12 to 20 mA. Split ranges available with addition of a flat spring.

[2] 10 to 30 or 30 to 50 mA. Split ranges available with addition of a flat spring.

[3] Direct or reverse, as specified.

— NOTE

Ranges are listed in kPa and psi. For alternative ranges in kg/cm^2 or bar, divide applicable kPa values by 100.

Supply Pressure

Nominal	Limits
140 kPa or 20 psi	130 and 160 kPa or 19 and 23 psi
240 kPa or 35 psi	225 and 260 kPa or 33 and 38 psi

Supply pressure must not be less than 20 kPa or 3 psi above the maximum signal.

Input Resistance

4 to 20 mA Input: 170 Ω
10 to 50 mA Input: 27 Ω

Air Consumption

20 to 100 kPa or 3 to 15 psi output:

40G Relay: 0.5 m^3/h (0.30 cfm) at standard conditions.

All other outputs: 40D Relay:

1.3 m^3/h (0.75 cfm) at standard conditions with 140 kPa or 20 psi supply.
1.7 m^3/h (1.0 cfm) at standard conditions with 240 kPa or 35 psi supply.

Ambient Temperature Limits

Normal Operating Conditions:

-30 and +60°C (-20 and +140°F)

Operative Limits: -40 and +80°C (-40 and +180°F)

Calibrated Accuracy

±0.5% of span; but ±2% of span with output signals of 7 to 125 and 7 to 220 kPa or 1 to 18 and 1 to 32 psi

Mass

(Approximate) 2.3 kg (5 lb)

Product Safety

For electrical classification of converter, refer to data plate. For conditions of certification, refer to Table 1.

Table 1. Product Safety Specifications

Testing Laboratory, Types of Protection, and Area Classification	Conditions of Certification	Elec. Class Code
CSA certified intrinsically safe for Class I, Groups A, B, C, and D, Division 1.	4 to 20 mA input only. Connect per TI 005-105. Temperature Class T6.	CS-E/CB-A
CSA certified explosionproof for Class I, Group D, Division 1, Class II, Groups E, F, and G, Division 1 and Class III.	4 to 20 and 10 to 50 mA input. Temperature Class T6. E69F-T only.	CS-E/CD-A
CSA certified nonincendive for Class I, Groups A, B, C, and D, Division 2.		
CSA certified nonincendive for Class I, Groups A, B, C, and D, Division 2.	4 to 20 and 10 to 50 mA input. Temperature Class T6. E69F-B only.	CS-E/CN-A

Table 1. Product Safety Specifications (Continued)

Testing Laboratory, Types of Protection, and Area Classification	Conditions of Certification	Elec. Class Code
FM certified intrinsically safe for Class I, Groups A, B, C, and D, Division 1 and Class II, Groups E and G, Division 1.	4 to 20 mA input only. Connect per TI 005-101. Temperature Class T6.	CS-E/FB-A
FM certified intrinsically safe for Class I, Groups C and D, Division 1 and Class II, Groups E and G, Division 1.	4 to 20 mA input only. Connect to Honeywell Class 38 Barrier. Refer to TI 005-101 for barrier types and groups. Temperature Class T6.	CS-E/FB-H
FM certified intrinsically safe for Class I, Groups A, B, C, and D, Division 1 and Class II, Groups E and G, Division 1.		
FM certified explosionproof for Class I, Groups C and D, Division 1 and Class II, Groups E and G, Division 1.	4 to 20 and 10 to 50 mA input. Temperature Class T6. E69F-T only.	CS-E/FD-A
FM certified nonincendive for Class I, Groups A, B, C, and D, Division 2 and Class II, Group G, Division 2.		
FM certified nonincendive for Class I, Groups A, B, C, and D, Division 2 and Class II, Group G, Division 2.	4 to 20 and 10 to 50 mA input. Temperature Class T6. E69F-B only.	CS-E/FN-A
ATEX intrinsically safe EEx ia Gas Group IIC, Zone 0.	4 to 20 mA input only. Connect to an intrinsically safe circuit with a maximum current of 90 mA. Temperature Class T6.	CS-E/KA-E
ATEX nonincendive EEx nA for Gas Group II, Zone 2.	Temperature Class T6.	CS-E/KN-A
ATEX certified flameproof EEx d for IIB, Zone 1 (CENELEC)	4 to 20 mA and 10 to 50 mA input. Temperature Class T5. E69F-T only.	CS-E/LD-E

Installation

Dimensions

Refer to Dimensional Print DP 018-430 for converter dimensional and mounting data.

Typical Converter Mounting

Unless otherwise noted, all mounting hardware is supplied with converter. See Figures 3, 4, and 5.

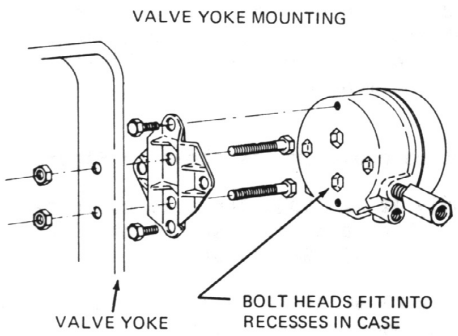

Figure 3.

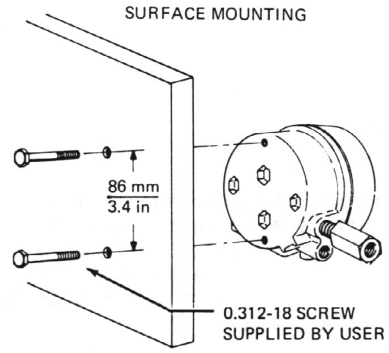

Figure 4.

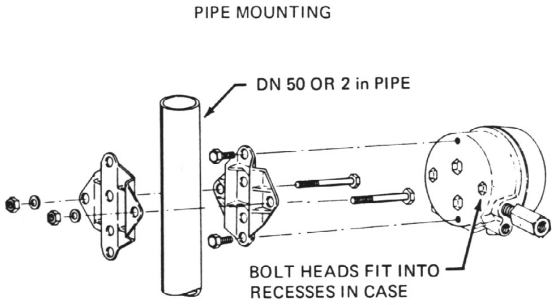

Figure 5.

Installation Piping and Wiring

Installation piping and wiring are shown in Figure 6. Converter is shown mounted on a valve yoke.

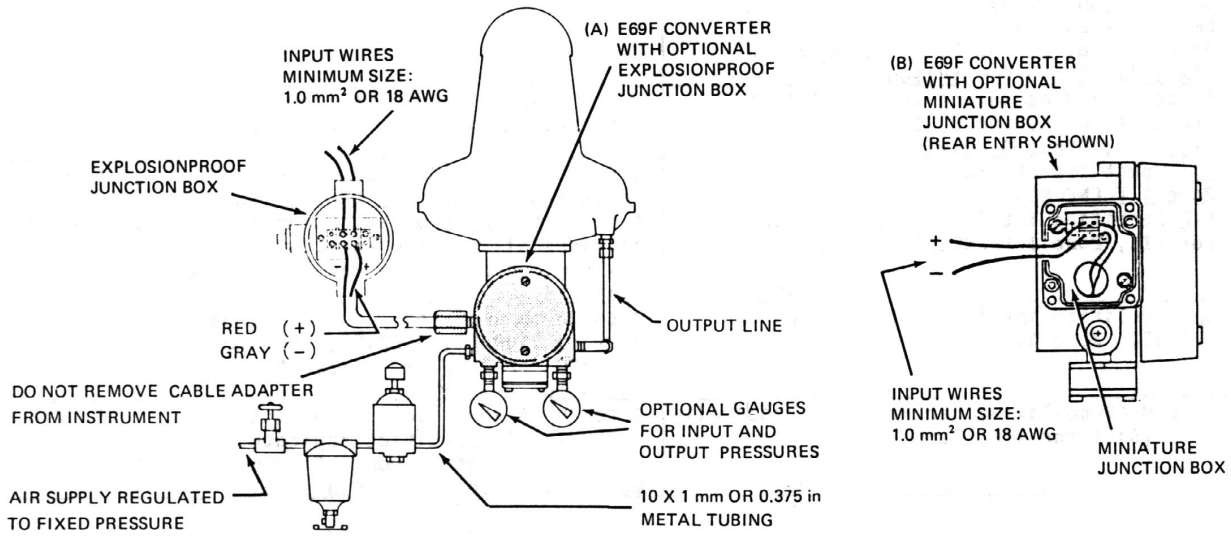

Figure 6.

Calibration

For simplicity, the procedure below assumes a converter with a 4 to 20 mA input and a 20 to 100 kPa or 3 to 15 psi output. For other ranges, substitute the applicable values. The specific input and output are listed on the converter data plate.

Equipment Setup

Calibration setup is shown in Figure 7.

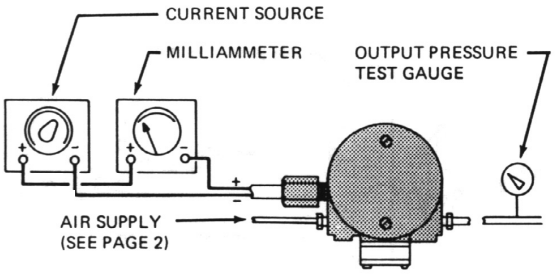

Figure 7.

— NOTE

Accuracy is dependent on accuracy of milliammeter. For ±0.5% accuracy use DVM across a 100 Ω precision resistor in place of milliammeter.

Procedure

NOTE

Any adjustment to the span will interact with the zero adjustment and will change the initial zero setting. Therefore, any adjustment made to the span must be followed by readjustment of zero.

1. Set up equipment as shown in Figure 7.
2. Apply 12 mA (50%) input to converter and adjust output (zero screw) to 60 kPa or 9 psi (50%). See Figure 8.
3. Apply 20 mA (100%) input to converter and note amount of error above or below 100 kPa or 15 psi (100%) output. If error is greater than ±2% (1.6 kPa or 0.025 psi), perform Step 4. If error is less than ±2%, proceed to Step 5.

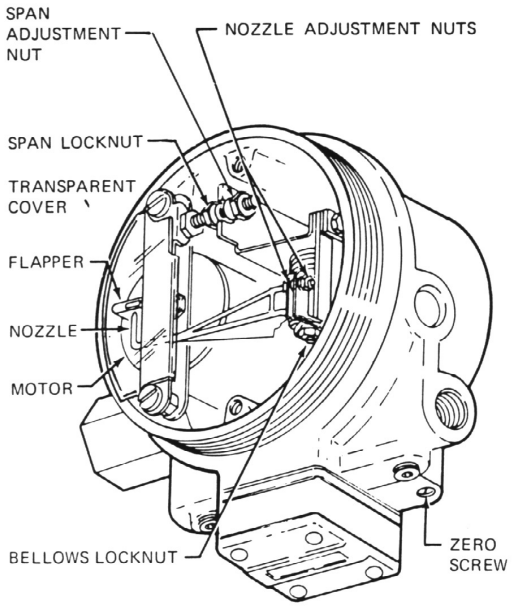

Figure 8.

4. Loosen 5/16-inch bellows locknut. Note reference line on bellows. Rotate bellows[1] so that reference line moves toward motor to decrease span or away from motor to increase span until the error is within ±2%. Tighten bellows locknut.

   Repeat Steps 2 and 3.
5. See Figure 9. Loosen the 5/16-inch span locknut and turn the 5/16-inch span adjustment nut a proportional amount (noted in Step 3) based on the following: 1/6 of a turn (point to point on the hexagonal nut) corrects the error by 0.5%.

1. Bellows Assembly is on an eccentric.

⚠ CAUTION

The span locknut must be loosened prior to span adjustment. Do not force nuts against each other to make small span changes. Forcing nuts together could result in stripping of threads.

6. Disregard output changes that occur when span adjustment is made. Tighten span locknut.

⚠ CAUTION

Do not overtighten span locknut when locking in place as threads could become stripped.

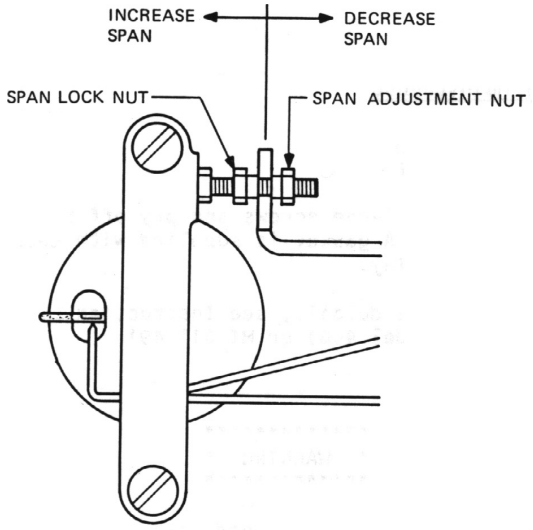

Figure 9.

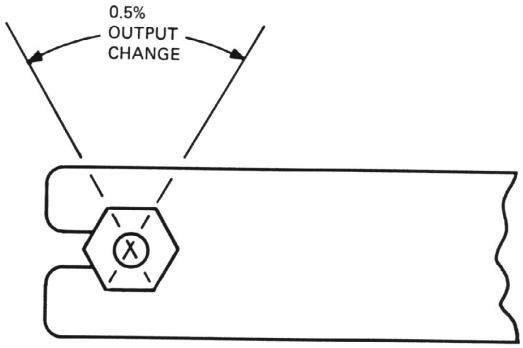

Figure 10.

7. Apply 12 mA (50%) input to converter and adjust output (zero screw) to 60 kPa or 9 psi (50%).

8. Apply 20 mA (100%) input and check output for 100 kPa or 15 psi (100%). If output is not correct, repeat Steps 5 through 7.
9. Apply 4 mA (0%) and check output for 20 kPa or 3 psi (0%). If necessary, readjust zero screw for correct output.
10. Apply 100% input and check output. If output is not correct, repeat Steps 5 and 8 until both 0% and 100% outputs are correct.

Maintenance

Relay Maintenance

To Remove Relay

Remove the two large screws and pry off relay. See Figure 11. A gasket is supplied with each replacement relay.

For maintenance details, see Instruction MI 011-493 (Model 40G) or MI 011-491 (Model 40D).

⚠ CAUTION

If converter is equipped with explosionproof cover, three flame arresters are present. Arresters must remain in place for explosionproof protection.

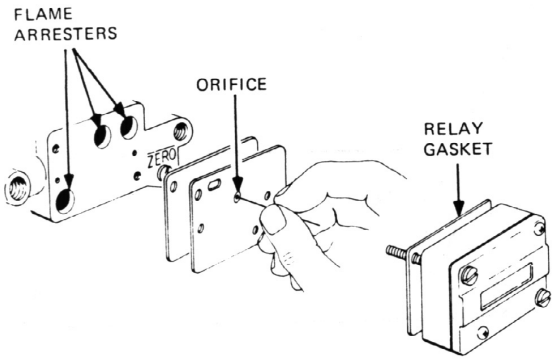

Figure 11.

To Clean Restrictor

Remove relay. See "To Remove Relay" procedure.

Clean by inserting a 0.1 mm (0.005 in) diameter wire (or Foxboro cleaning wire, Part 0042527) through orifice.

Converter Modifications

— NOTE

Foxboro does not consider the following modifications a field conversion. They are considered factory modifications due to the complexity of the procedures and the large amount of time required to perform them. If the modifications must be made in the field, use the following procedures and contact Foxboro for additional assistance.

To Reverse Converter Action

The existing action of the converter is indicated by the marking on the exposed top of the motor cover: INC-INC (increasing input produces an increasing output), or INC-DEC (increasing input produces a decreasing output). When reinstalling the motor (Step 9 below), the exposed marking on the motor cover must indicate the desired action.

1. Disconnect instrument from installation (input wiring, air lines, and mounting bolts).
2. Remove two screws holding span bracket. See Figure 12.

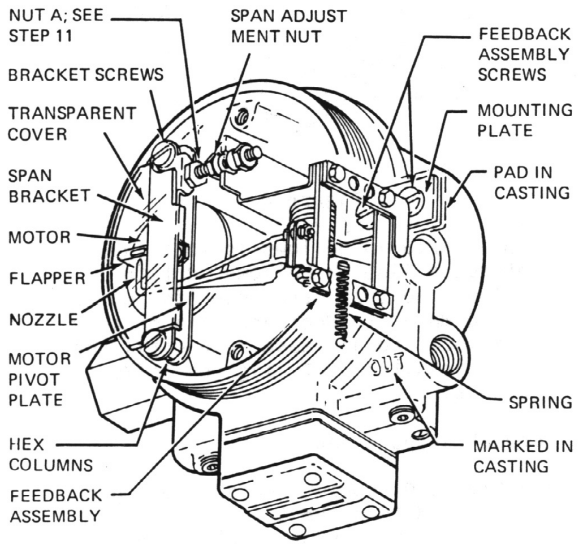

Figure 12.

3. Remove two screws holding feedback assembly (with bellows). Note routing of tubing for later replacement.

— NOTE

Do not remove mounting plate from feedback assembly. Remove as a unit.

4. Lift aside feedback assembly (do not damage nozzle) to expose spring on bottom of case. Slide transparent cover off span bracket as shown in Figure 13. Unhook spring from motor bracket.

   (For convenience, feedback assembly can be removed entirely by disconnecting tubing. Note identification of tubing for later reconnection.)

5. On feedback assembly, remove two hex head (formerly buttonhead) screws. Interchange locations of angle bracket and spacer. See Figure 13.

   Reinstall hex head screws and tighten to a torque of 3.4 to 4.0 N•m (30 to 35 lb•in).

   Switching locations of angle bracket and spacer allows the Ni-Span angle bracket to correct for temperature induced errors in the INC-DEC mode.

   Figure 13 shows parts in INC-INC arrangement.

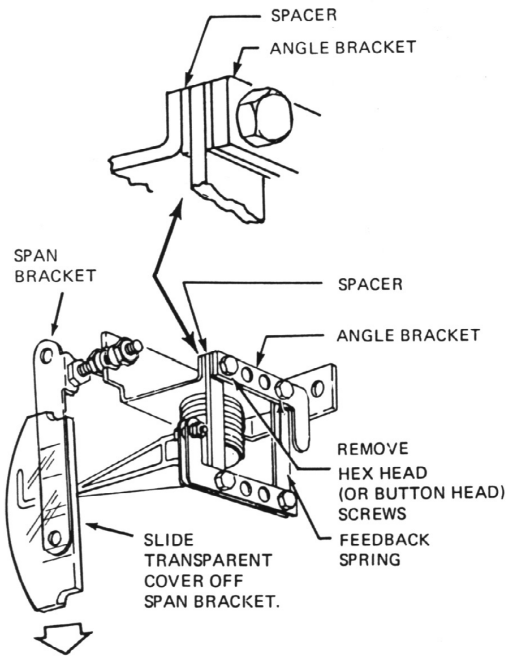

Figure 13.

6. Remove hex columns (use 5/16-inch wrench), and lift off motor pivot plate. See Figure 12.
7. Lift out motor. Carefully lift flapper straight up from flapper arm on motor. Do not deform flapper. Holding on to flapper arm on other end of motor while removing will prevent internal motor flexure deformation.
8. Remove two screws holding bracket to bottom of motor. See Figure 14.

   Invert motor and reinstall bracket (on side of motor that was formerly on top).

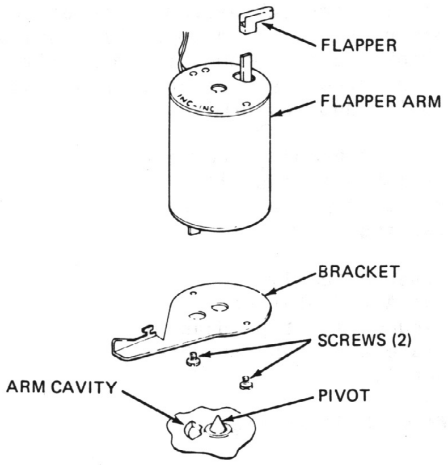

Figure 14.

9. Wind excess wire clockwise around motor and carefully place motor into position in the case assuring that bottom arm is in cavity provided. Make sure that wires will not interfere with moving parts and pivot is in hole at bottom of motor.

NOTE

Marking on top of motor must indicate desired action.

10. Reinstall motor pivot plate and hex columns. Adjust motor pivot screw to remove all end play (approximately 1/8 to 1/4 turn interference) and lock in place. Reconnect spring on motor bracket. Reinstall flapper on flapper arm maintaining gap as shown in Figure 15.

⚠ CAUTION

Flapper contains damping material as shown in Figure 15. If damping material is removed, converter operates erratically.

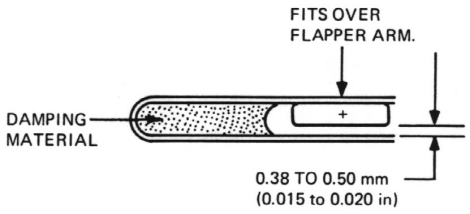

Figure 15.

11. Reinstall feedback assembly and other remaining parts. Make sure that tubing is not kinked and is connected properly. Tighten screws removed in Steps 2 and 3 gradually and uniformly.

    When tightening feedback assembly screws, line up mounting plate with pad on casting.

After assembly, loosen nut A (identified in Figure 12), tap adjacent plate and then retighten nut A.

12. Perform "Full Realignment."

To Change to a Split-Range Converter Input

The converter input can be changed to a split-range with the addition of a flat spring (available from Foxboro). Refer to page 2 for available ranges.

1. Refer to Table 2 for parts required. Obtain parts from Foxboro.
2. Perform Steps 1 through 4 in "To Reverse Converter Action" section.
3. Loosen the four hex head screws (formerly button head screws) but do not remove them. See Figure 16.

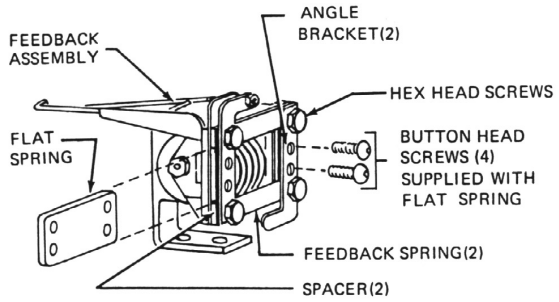

Figure 16.

4. Insert the flat spring into space between the feedback springs.
5. Line up edges of flat spring, angle bracket, feedback spring, and spacer to be flush with feedback assembly bracket.
6. Insert four buttonhead screws supplied with flat spring and tighten assembly securely.
7. Tighten four hex head screws to a torque of 3.4 to 4.0 N•m (30 to 35 lb•in).
8. Perform Steps 11 and 12 in "To Reverse Converter Action" on page 10.

Table 2. Parts Required to Change to a Split-Range Input (One Spring and Four Screws)

If Output Range Is:		Part Name and Part Number	
kPa	**psi**	**Spring (1)**	**Spring Mounting Screws (4)**
20 to 100 or 40 to 200	3 to 15, 6 to 30, or 3 to 27	B0130WU	X0168TF
7 to 125 or 7 to 220	1 to 18 or 1 to 32	B0130XQ	

Full Realignment

Full realignment is required when converter action has been reversed, range has been changed to a split range, or converter was disassembled for some other reason.

1. Set up equipment as shown in Figure 7.
2. Apply 12 mA (50%) input signal and adjust zero screw to bring flapper arm to horizontal position (at 90° to edge of span bracket, as shown in Figure 17).
3. Loosen span locknut. Turn 5/16-inch span adjustment nut to position nozzle to center of flapper arm, as shown in Figure 17. Tighten span locknut.
4. Move 5/32-inch nozzle adjustment nuts (see Figure 8) to obtain 60 kPa or 9 psi output within 2% (1.6 kPa or 0.25 psi). Tighten nuts.

⚠ CAUTION

Thread will strip if nuts are overtightened.

5. Nozzle should now be at 90° to flapper. If not, trim slightly with zero screw and repeat Step 4.
6. Set input to 4 mA (0%) and adjust zero screw for 20 kPa or 3 psi (0%) output.
7. Momentarily turn off power. When power is returned, output should respond crisply. If not, recheck Step 5 at 12 mA (50%) input and repeat Steps 6 and 7.
8. Calibrate converter.

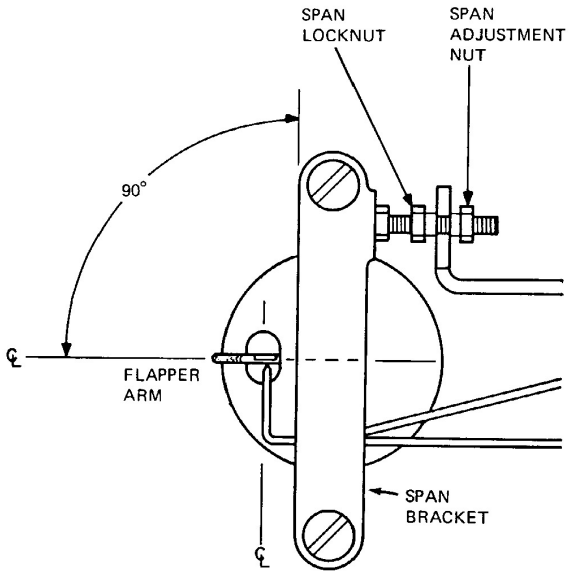

Figure 17.