

11GM Series Pressure Transmitter Styles C and D



The 11GM Series Pressure Transmitter is a force-balance instrument that measures pressure and transmits it as a proportional pneumatic signal.

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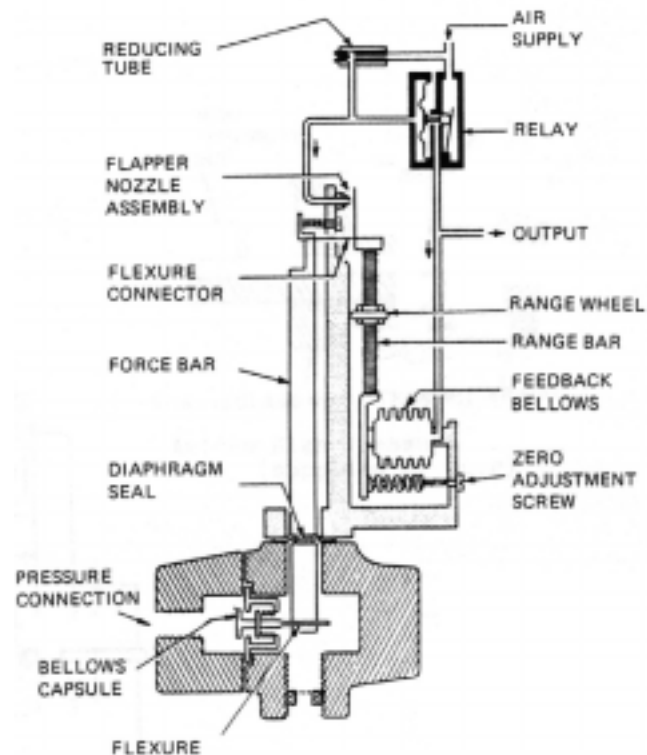
Capsule Identification 23

Principle of Operation

The pressure being measured is applied to a bellows capsule. The force on the capsule is transmitted through a flexure to the lower end of the force bar. The metal diaphragm seal serves as both a fulcrum for the force bar and as a seal for the pressure chamber. The force is transmitted through the flexure connector to the range bar which pivots on the range wheel.

Any movement of the range bar causes a minute change in the clearance between the flapper and nozzle. This produces a change in the output pressure from the relay to the feedback bellows until the force on the feedback bellows balances the force on the bellows capsule.

The output pressure which is established by this force balance is the transmitted signal and is proportional to the pressure applied to the bellows capsule. This signal is transmitted to a pneumatic receiver to record, indicate, and/or control.



Specifications

Measurement Range:

Capsule	In MPa				In psi			
	Upper Range Limits	Span Limits		Maximum Overrange	Upper Range Limits	Span Limits		Maximum Overrange
		Minimum	Maximum			Minimum	Maximum	
A	0.6	0.07	0.55	0.7	90	10	80	100
B	2.4	0.14	1.4	3.5	350	20	200	500
C	5	0.3	2.8	7	750	40	400	1000
D	10	0.7	7	14	1500	100	1000	2000
E	20	1.4	14	28	3000	200	2000	4000

Notes:

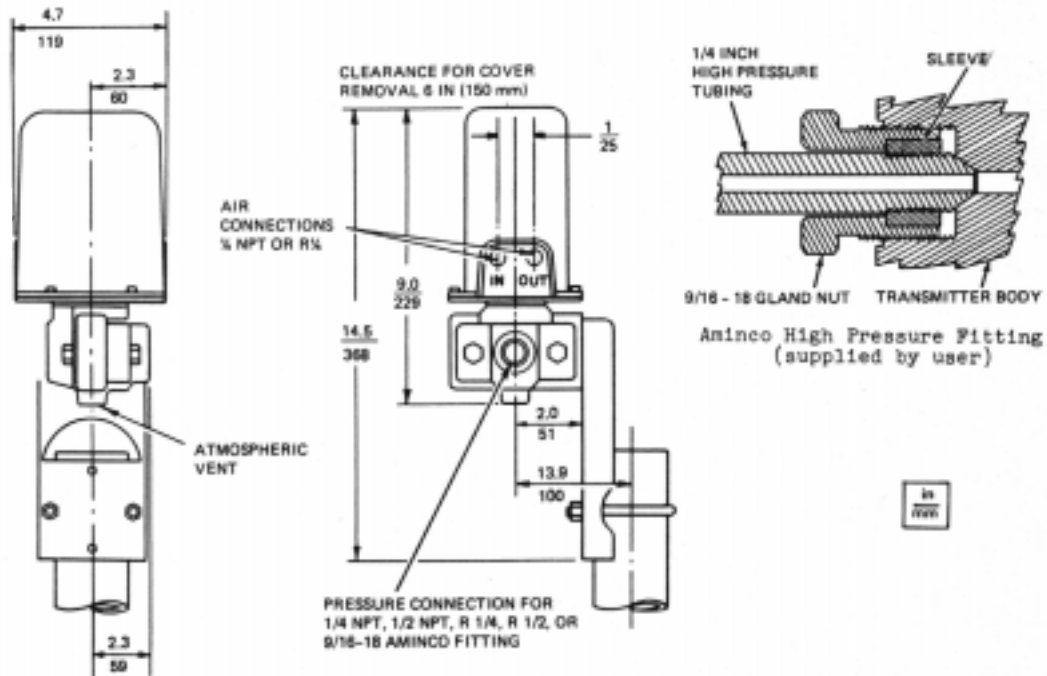
1. Lower Range limit is full vacuum.
2. Zero screw provides elevation or suppression up to 10% of span.
3. With optional suppression kit, sum of suppression plus span cannot exceed upper range limit.
With optional elevation kit, lower range values can be as low as full vacuum.

Output Signal: 20 to 100 kPa or 3 to 15 psi
 Accuracy: ±0.5% of span
 Ambient Temperature Limits
 Normal Operating Conditions: -40 and +120°C (-40 and +250°F)
 Operative Limits: -45 and +140°C (-50 and +280°F)
 Air Supply Limits: 120 and 150 kPa or 18 and 22 psi
 Mass: 4.5 kg (10 lb)
 Air Consumption: 0.5 m³/h (0.3 cfm) at standard conditions
 Environmental Protection: Topworks enclosure meets the requirements of IEC IP54.

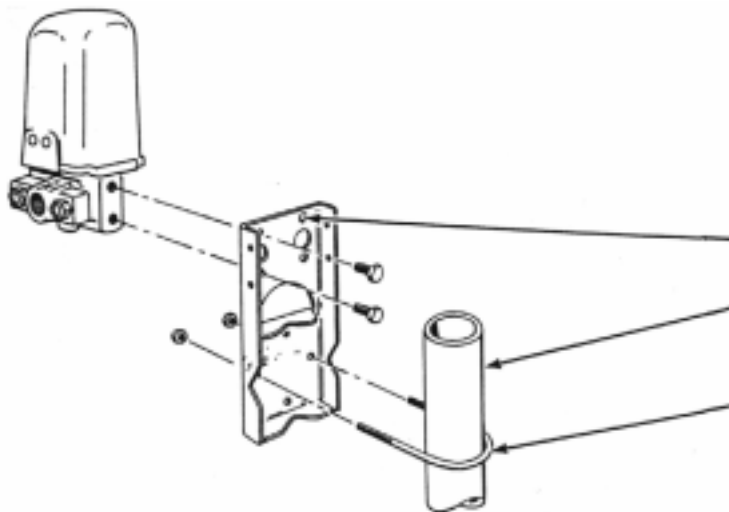
— NOTE —
 Pressures are listed in kPa (or MPa) and psi. For alternative ranges in kg/cm² or bar, divide applicable kPa values by 100.

Installation

Transmitter Dimensions



Transmitter Mounting



Transmitter may be mounted in any position.

After transmitter is mounted, tighten all bolts.

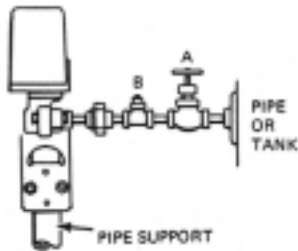
Either set of mounting holes may be used.

Pipe may be clamped to another pipe, or flanged and bolted to floor or wall.

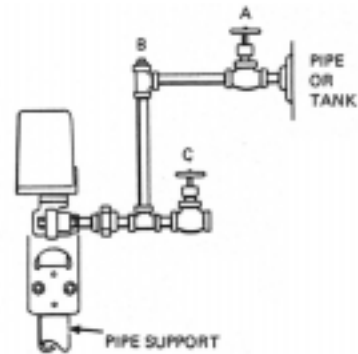
U-bolt secures assembly to a nominal 50 mm (2 in) pipe. U-bolt may be revolved 90° for use with horizontal pipe.

Typical Transmitter Piping

TRANSMITTER AT LEVEL OF PRESSURE TAP

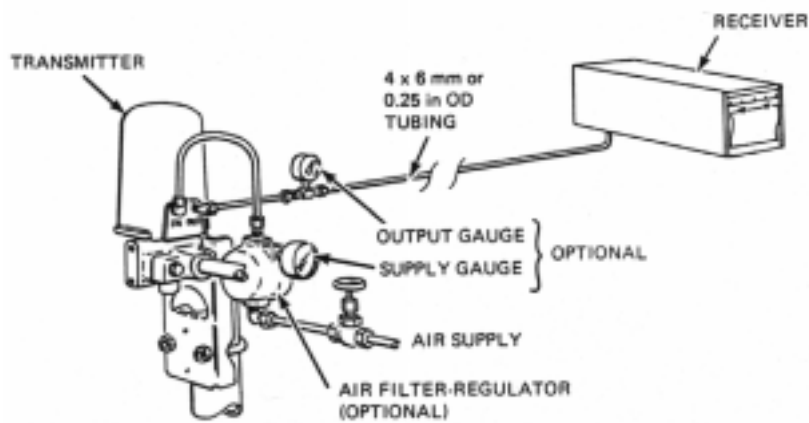


TRANSMITTER BELOW LEVEL OF PRESSURE TAP



When zeroing transmitter (see page 5), close valve A and open plug B, or insert a test gauge at B to read applied pressure and adjust output to appropriate value. When transmitter is located below pressure tap, use valve C as a drain, or as a filling valve for seal fluid.

Air Supply and Transmission Piping



Zero Adjustment

Make zero adjustment with transmitter in operating position.

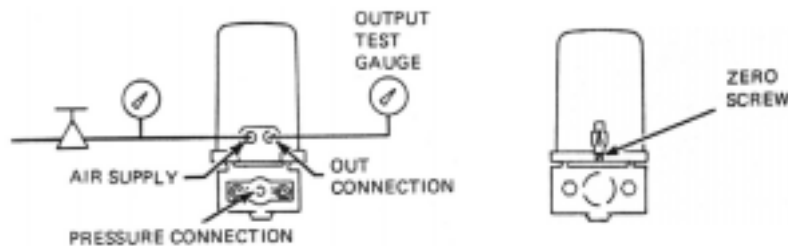
Without Elevation or Suppression Kit

1. Adjust air supply to pressure at which transmitter will operate.
2. If lower range value is zero:
Vent pressure connection. With liquid filled system, vent at level of pressure tap.

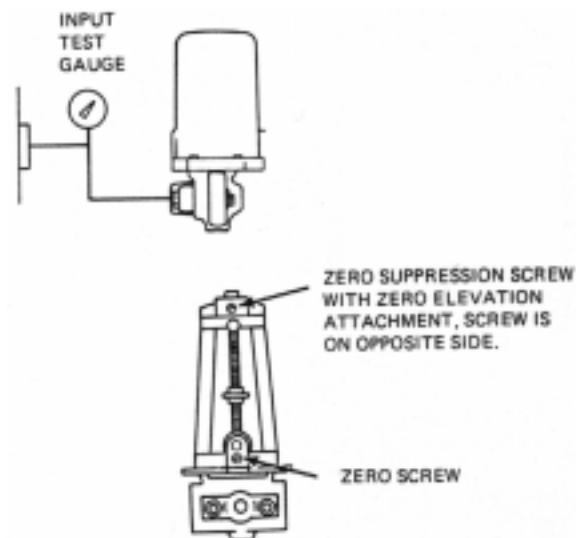
If lower range value is **not** zero:

Complete Steps 2 and 3 in section below before continuing.

3. Connect at 0 to 140 kPa or 0 to 20 psi test gauge to OUT connection.
4. Adjust zero screw so that output is 20 kPa or 3 psi, or calculated value.
5. Disconnect test gauge and reconnect receiver. If necessary, change zero adjustment on receiver so that reading is zero.



With Elevation or Suppression Kit



1. Set up equipment as shown above, but do not vent pressure to atmosphere.
2. Insert test gauge in measurement line. For liquid filled systems, insert gauge at level of pressure tap.

3. Adjust pressure to some value between 20 and 100 kPa or 3 and 15 psi. Using the formula below, calculate output corresponding to this pressure.
4. Adjust elevation or suppression screw so that output is approximately the calculated value.
Adjust zero screw so that the output is exactly at the calculated value.
If necessary, change zero adjustment on receiver so that reading is calculated value.

$$\text{Output} = \text{Output Span} * \left(\frac{\text{Test Gauge Reading} - \text{Lower Range Value}}{\text{Upper Range Value} - \text{Lower Range Value}} \right) + \text{Minimum Output} *$$

*Output Span = 80 kPa or 12 psi
Minimum Output = 20 kPa or 3 psi

Example: Instrument Range, 100 to 200 psi
 Test Gauge Reading, 125 psi
 Output Signal, 3 to 15 psi

$$\text{Output} = (12) \left(\frac{125 - 100}{200 - 100} \right) + 3 = 6 \text{ psi}$$

Maintenance and Servicing

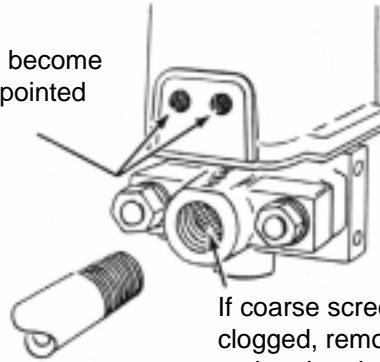
Supply Air Filter



Blow out filter at least once a day.

To Replace Screen Filters

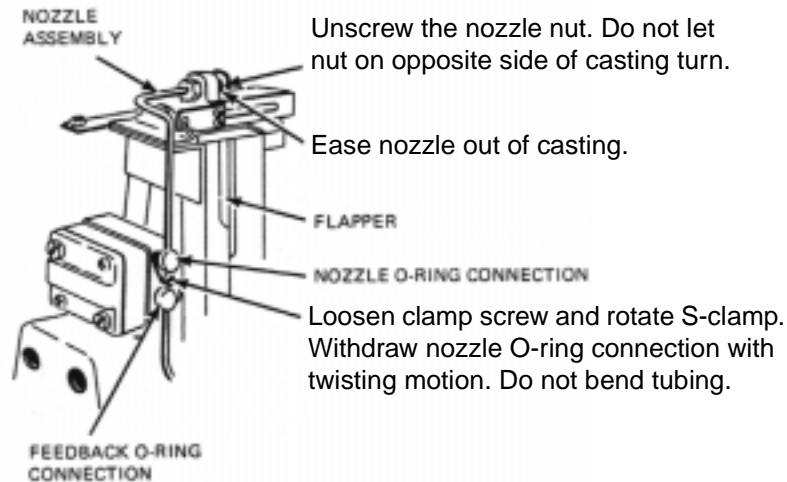
If fine screen air filters become clogged, remove with pointed tool and replace.



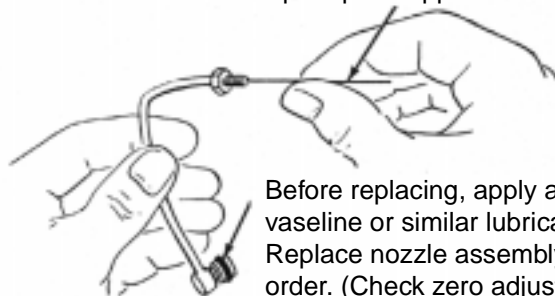
If coarse screen air filters become clogged, remove with a pointed tool and replace.

To Clean Nozzle Assembly

An accumulation of dirt at the flapper nozzle may cause a zero shift.



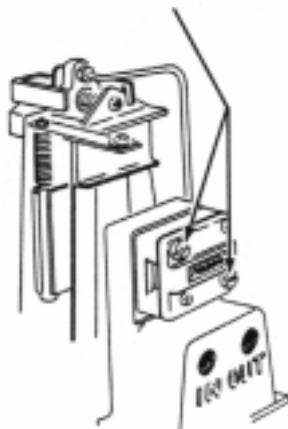
Clean nozzle with 0.030-inch diameter wire, compressed air, or suitable solvent. Wipe top of flapper clean.



Before replacing, apply a thin film of vaseline or similar lubricant to O-ring. Replace nozzle assembly in reverse order. (Check zero adjustment.)

To Replace Relay

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

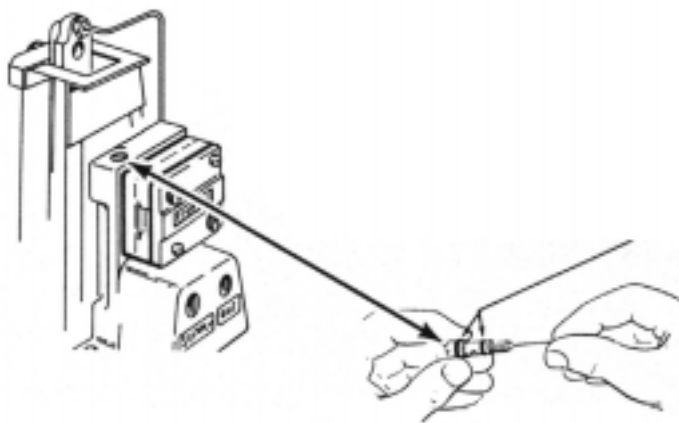


For servicing, see Instruction MI 011-493.

To Clean Restrictor

A plugged restrictor will cause low output pressure.

1. Unscrew restrictor from top of relay base.
2. Clean with a 0.0005-inch diameter wire (Part 004257).
3. Before reinstalling, apply a thin film of vaseline or similar material to O-rings.



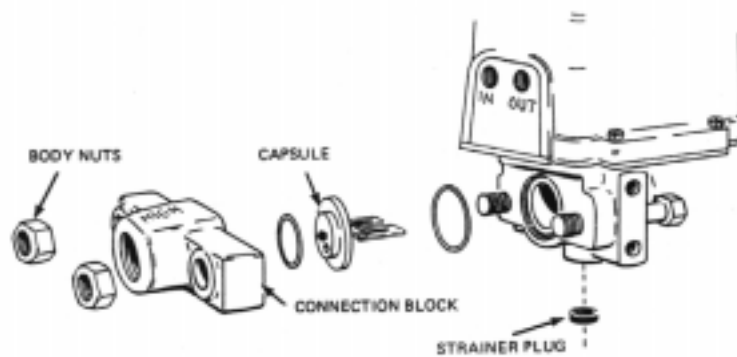
— NOTE —
On earlier models, restrictor was located either under relay or on side of relay base.

To Change Range

The transmitter range may be changed to any value within the limits of the capsule by changing the span and zero adjustments. If the desired range is outside the limits of the capsule installed in the transmitter, a different capsule is required. (If the capsule is changed, and capsule “A” is involved, a different connection block and capsule O-ring are required. See PL 006-266 for further details.)

Refer to table on “Specifications” on page 2 for range, span, and overrange limits for the various capsules. Refer to “Transmitter and Capsule Identification” on page 23 for capsule identification.

To Remove Bellows Capsule

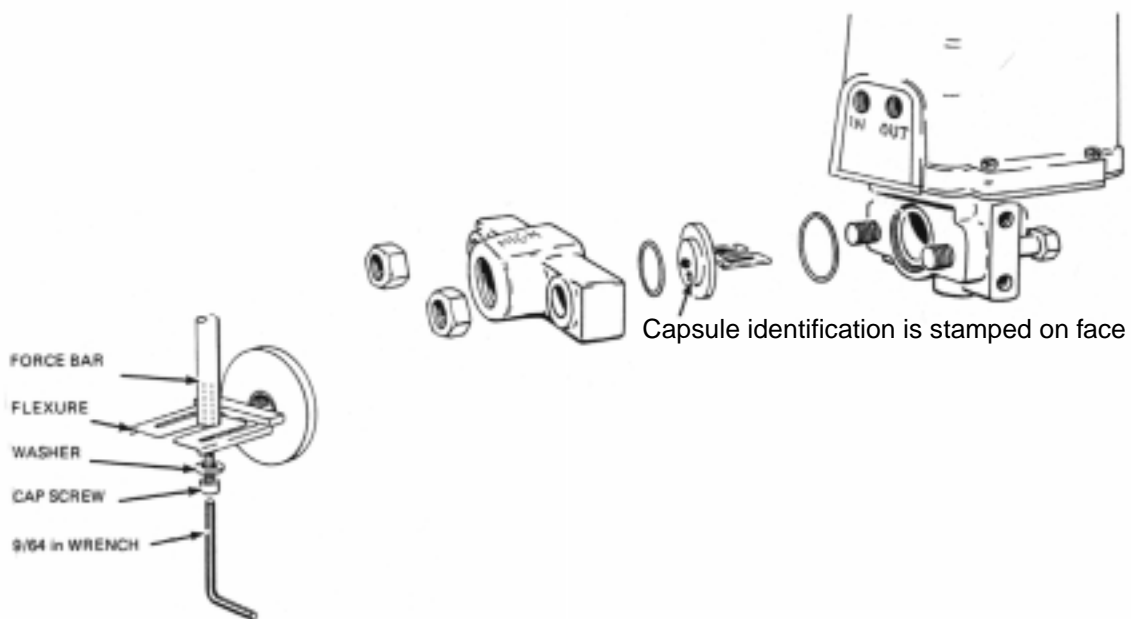


1. Remove strainer plug with 1/4-inch hex key wrench. Insert 9/64-inch hex key wrench in opening and loosen, but do not remove, flexure cap screw. See illustration below.
2. Remove the two body nuts and lift off pressure connection block from transmitter. Do not remove bolts.
3. Lift out capsule. Do not bend flexure.

To Install Bellows Capsule

When capsule is replaced, use new O-rings.

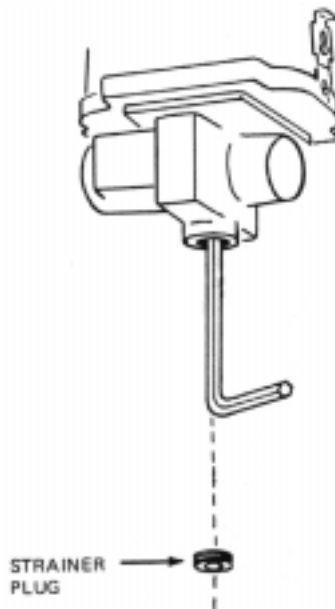
1. Lubricate O-rings with a thin film of Vaseline or similar lubricant. Position larger ring in recess in body and smaller ring over shoulder of capsule.
2. Insert capsule with flexure horizontal against bottom of force bar.
3. Loosely screw cap screw into force bar to clamp flexure lightly.
4. Position connection block over bolts and tighten nuts gradually to 55 N·m (40 lb·ft) torque.
5. Tighten flexure against bottom of force bar as described in “to adjust flexure cap screw”, then calibrate transmitter (see “Calibration” on page 12).



To Adjust Flexure Cap Screw

This adjustment should be made if the capsule has been replaced, or the cap screw loosened.

1. Set up calibration equipment as shown on “Calibration Equipment” on page 12.
2. Disconnect elevation or suppression attachment as described in Step 2 of “Calibration Procedure” on page 14.
3. Vent pressure connection to the transmitter.
4. Remove strainer plug and loosen flexure locknut using 9/64-inch hex key wrench.
5. With no pressure on transmitter adjust zero screw for 20 kPa or 3 psi output.
6. Carefully tighten flexure cap screw and observe output.
If output change is less than 1.4 kPa or 0.2 psi, readjust zero screw to bring output to 20 kPa or 3psi.
If output change is greater than 1.4 kPa or 0.2 psi, repeat Steps 4, 5, and 6. If change persists, check capsule installation (see “To Install Bellows Capsule” on page 10) then repeat “To Adjust Flexure Cap Screw” on page 11.
7. Replace strainer plug and calibrate transmitter.



Calibration

Calibration Notes

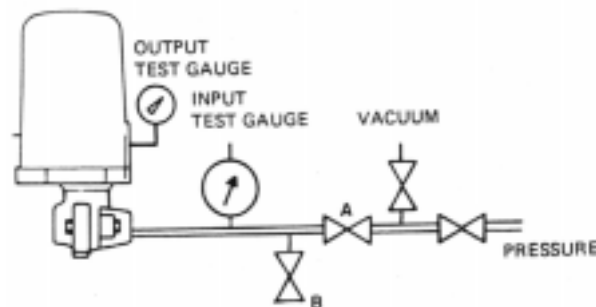
Calibration is required if the transmitter has been taken apart for cleaning or for parts replacement, if a change of range is desired, or if the amount of zero elevation or suppression (if transmitter is so equipped) is changed substantially.

If the capsule was removed or the flexure cap screw loosened, before calibrating, make the flexure cap screw adjustment above.

The transmitter may be calibrated to the SI (20 to 100 kPa) or the customary (3 to 15 psi) signal pressure range. These two ranges are not exactly equivalent; therefore, the transmitter must be calibrated to the same signal pressure range as the receiver with which it is used.

Calibration Equipment

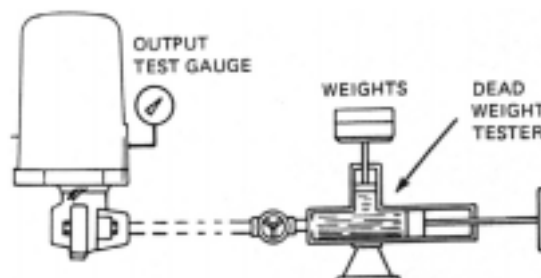
Pneumatic



Lock in desired pressure or vacuum with valve A. Reduce by bleeding at B.

Hydraulic

For safety, do not use air pressures above 3.5 MPa (500 psi) for calibrating pressures.



Increase pressure with crank until pressure supports an accurately known weight. Accurate test gauge may be used with hydraulic pump in a similar setup.

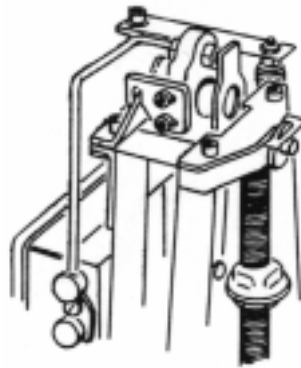
Overrange Stop Adjustment

The overrange stop prevents damage to both the flapper nozzle and the dashpot. Before calibrating, check that the stop is correctly adjusted.

—  **CAUTION** —

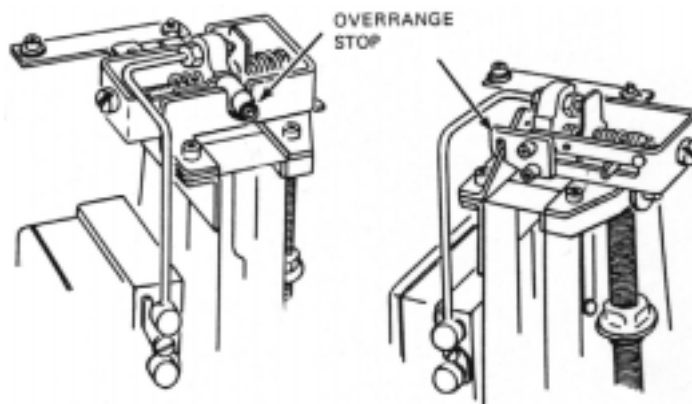
Do not move the force bar if the overrange stop is loose or disconnected.

1. Turn on air supply. Apply pressure to transmitter so that output is stabilized at a value between 20 and 100 kPa or 3 and 15 psi.
2. Clearance between both sides of overrange stop (U-shaped bracket) and plate must be sufficient to permit sliding piece of paper between them. If it is not, loosen screws with 3/32-inch hex key wrench and reposition stop to get correct clearance. Retighten screws.



TRANSMITTER WITH
ELEVATION KIT

TRANSMITTER WITH
SUPPRESSION KIT

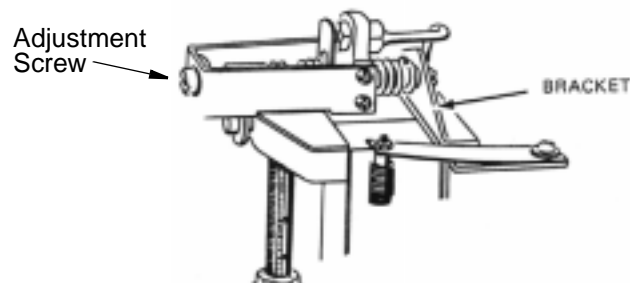


With elevated zero, loosen lock screw with 3/32-inch hex key wrench. Hold eccentric pin in correct position with open end wrench and tighten lock screw.

Calibration Procedure

Steps 2 and 5 in procedure below pertain only to transmitters equipped with elevation or suppression kits; illustrations for these steps show suppression kit. If transmitter has elevation kit, location of the two screws mentioned is reversed. If transmitter has neither elevation nor suppression kits, skip these steps.

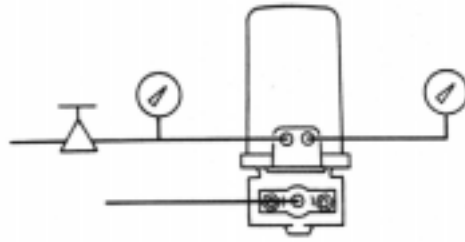
1. Set up calibration equipment as shown page 12. Check overrange stop adjustment (see page 13).
2. If transmitter has elevated or suppressed zero, disconnect spring from force bar as follows:
 - a. Remove screw from end of spring.



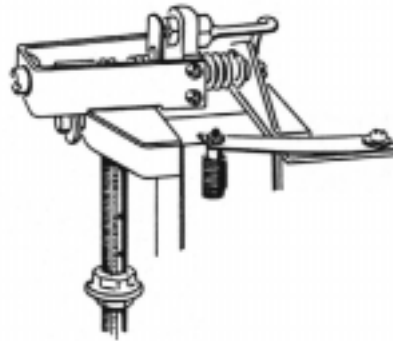
- b. Turn adjustment screw clockwise until spring is clear of bracket. Spring must not bind against flapper or casting.
3. With no pressure on transmitter, adjust zero screw so that output on test gauge reads 20 kPa or 3 psi.
If screw was removed in Step 2a, replace it.



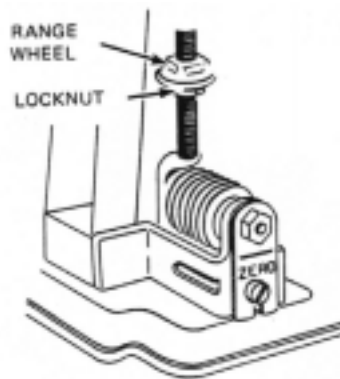
4. With elevated or suppressed zero, set calibrating pressure equal to lower range value.



5. Turn adjustment screw so that output is 20 kPa or 3 psi.



6. Set calibrating pressure equal to upper limit. The output should be 100 kPa or 15 psi.
7. If output is incorrect, loosen locknut and adjust range wheel for correct output. Turning range wheel down increases output. Retighten locknut after each adjustment.



8. Repeat Steps 4 through 7 (**with** elevated or suppressed zero), or Steps 3, 6, and 7 (**without** elevated or surpassed zero) until desired accuracy is obtained. Tighten range wheel locknut securely.
9. Make zero adjustment on page 5.

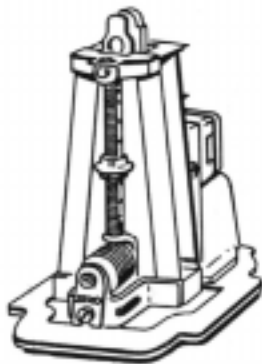
In-Line Calibration

The transmitter is equipped with a vernier-type range adjustment which permits you to read the position of the range wheel on the range bar with high accuracy. This enables you to recalibrate the transmitter quickly, without disconnecting any piping or using any calibrating equipment.

If the transmitter is calibrated (see page 14) to several desired ranges, and the reading of the position of the range wheel is noted for each calibration, the transmitter can be recalibrated, with 0.5% of span accuracy, by repositioning the range wheel to its associated position. See example below.

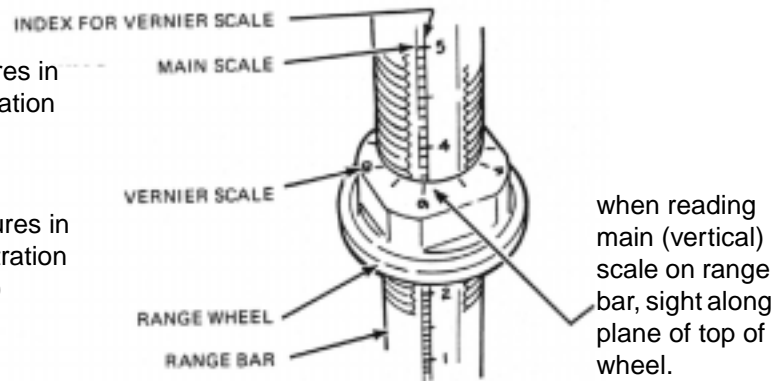
Example: Range wheel set to position 3.658

See enlarged detail at right.



(for first 2 figures in reading; illustration shows 3.6)

(for last 2 figures in reading; illustration shows 0.058)



NOTE

If range wheel is being repositioned to specific reading, after positioning wheel at desired location, slightly tighten locknut to wheel with wrench. Locknut must be securely tightened before putting transmitter into operation.

Further Disassembly

Normal servicing of the transmitter does not require the removal of any parts other than those already mentioned. Further disassembly is not recommended because of possible loss of accuracy or damage to the transmitter. The following procedures are described for emergency use only.

Dashpot Removal

1. Remove flexure locking screw (26), and loosen the two dashpot clamp screws (28). Lift out dashpot assembly. Disconnect flexure (25) by unscrewing dashpot nut (31).

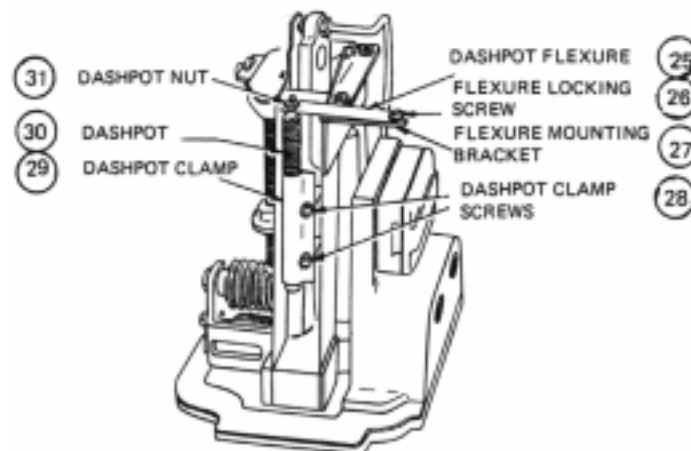
— CAUTION —

In removing and replacing dashpot nut, keep dashpot (30) from turning by putting a thin, open-end wrench across flat sections of dashpot just under flexure.

2. To replace assembly, position narrow slotted hole of flexure on dashpot stud. Put washer on stud and loosely screw on nut (31). Slide dashpot into clamp. Position flexure laterally so that slotted hole in free end is approximately centered on tapped hole under it. Tighten nut (31).
3. Adjust height of dashpot until free end of flexure just touches flexure mounting bracket (27). Tighten the two clamp screws (28). Loosely insert flexure locking screw (26) and its washer in place.

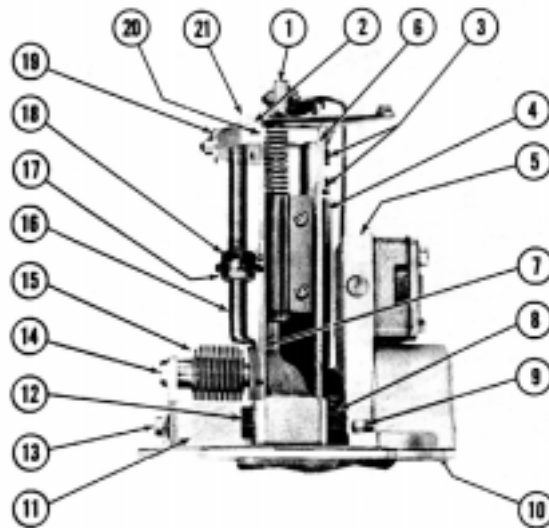
Dashpot Alignment

1. With air supply on, there must be some output from transmitter.
2. Loosen flexure locking screw (26) just enough to allow free vibration of adjacent parts. Put a finger on dashpot nut (31) and gently move dashpot assembly back and forth (total travel is about 1 m (0.05 in)) in line of flexure. When assembly is in middle of its travel, tighten flexure locking screw (26). Flexure must be flat and horizontal.



To Remove Feedback Bellows (15) and Zero Spring (Behind Zero Screw (13))

1. Carefully pry out **feedback** O-ring connection at relay (see “To Clean Nozzle Assembly” on page 7).
2. Remove the two 7/16-inch cap screws (12) holding the bracket (11).
3. Unscrew the zero adjustment screw (13) completely to release the zero spring. Bracket (11) and feedback bellows (15) may now be removed.
4. Remove nut (14) to disconnect feedback bellows from bracket.
5. Remove zero spring by unscrewing it from range bar (16). Be careful not to change alignment on the spring clamp.
6. Reverse this procedure to reassemble, making sure that the post on the bracket is within zero spring alignment clamp. Tighten zero adjustment screw until about 6 mm (0.25 in) of thread remains exposed. When replacing feedback connection, apply a thin film of Vaseline or similar lubricant to O-ring.
7. Check calibration (see page 14).



To Remove Relay Mounting Assembly (5)

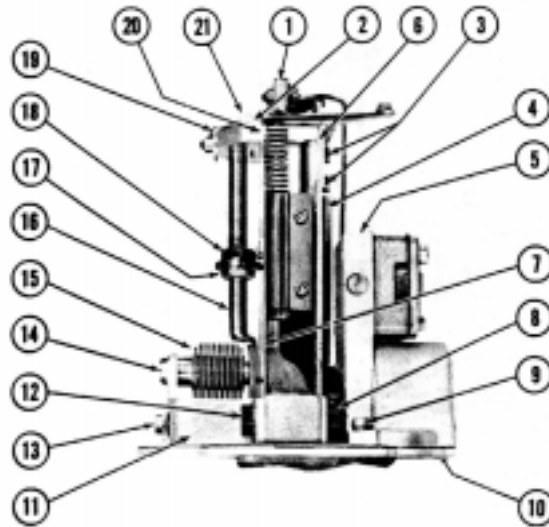
1. Carefully pry out nozzle and feedback O-ring connections at relay (see “To Clean Nozzle Assembly” on page 7).
2. Remove relay mounting assembly by unscrewing the two screws (9) above mounting plate and small screw (10) beneath mounting plate.
3. Reverse this procedure to reassemble. When replacing O-ring connections, apply a thin film of Vaseline or similar lubricant to O-rings.

To Remove Front Flexure (6)

1. If transmitter has optional range elevation or suppression attachment, remove this assembly.
2. Disconnect dashpot flexure from arm (see page 17).
3. Carefully pry out both feedback and nozzle O-ring connections at relay and remove nozzle tubing from casting (1) (see page 7).
4. Remove relay mounting assembly (5) (see procedure above).
5. Using a 3/32-inch hex key wrench, remove top plate (2) by removing two plate screws (21).
6. Using a 9/64-inch hex key wrench, remove force bar screws (3).
7. Remove cap screws and plates (8) and lift front flexure (6) off dowel.
8. Reverse this procedure to reassemble. If force bar has been removed or force balance unit loosened from body, top of front flexure should be visually lined up with casting (1), so that there is no twist evident in flexures. Then tighten plate screws (12). Do not tighten cap screws (8).
9. Loosen cap screws (12) and force bar screws (3). Apply 1 MPa or 150 psi to transmitter. Tap body lightly and tighten all screws.
10. Check dashpot alignment (see page 17) and check calibration (see page 14).

To Remove Force Balance Unit

1. Remove relay mounting assembly (5) (see page 18).
2. Remove bellows capsule (see page 9).
3. Using a 3/16-inch hex key wrench, remove the three socket-head screws holding force balance unit to body. In removing screws, be careful not to damage flexures (6) and (7). Withdraw force balance unit from body.
4. Reverse this procedure to reassemble. When tightening screws removed in Step 3, follow procedure on page 21 to maintain original factory accuracy. Replace O-ring that fits around force bar on top of body.
Apply a thin film of Vaseline or a similar lubricant to the O-ring.
5. Calibrate transmitter (see page 14).



To Remove Force Bar (4)

1. Remove force balance unit (see above).
2. Using a 9/64-inch hex key wrench, remove the two force bar screws (3). Force bar (4) can now be removed through bottom. This unit should not be further disassembled; if its diaphragm seal is removed from force bar, leaks are likely to occur after reassembly. If either force bar or its seal requires replacing, they both should be replaced as a unit.
3. Reverse this procedure to reassemble. Replace O-ring at force bar seal. Before inserting force bar into topworks, lubricate O-ring and top of force bar with Vaseline or similar lubricant. Carefully ease force bar into O-ring recess to avoid damaging O-ring.
4. When this is reassembled, loosen the four cap screws (8) and (12) and two force bar screws (3). Apply 1 MPa or 150 psi to transmitter. Tap body lightly and tighten all screws.
5. Calibrate transmitter (see page 14).

To Remove Back Flexures (7)

Unless front flexure has already been removed, 3/32-inch hex key wrench used in Step 2 must be cut down to fit into screws (2).

1. Remove 0.188-inch cap screws (12) holding bracket (11).
2. Using a 3/32-inch hex key wrench, remove two screws and plates (20) holding back flexures to plate (2), and remove back flexures.
3. Reverse this procedure to reassemble. Do not tighten cap screws (12).
4. Loosen cap screws (8) and force bar screws (3). Apply 1 MPa or 150 psi to transmitter. Tap body lightly and tighten all screws.
5. Calibrate transmitter (see page 14).

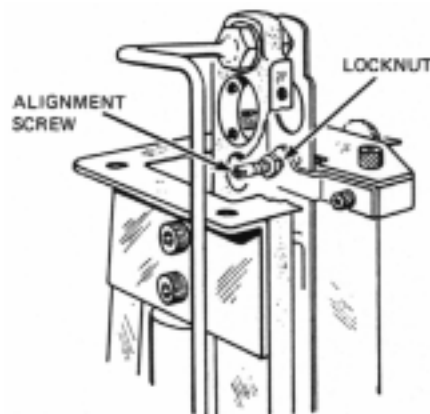
Flapper Alignment

The flapper is aligned at the factory; a realignment is required only if the force balance unit has been disassembled. This alignment procedure requires a 5.31 mm (0.209 in) diameter spacing tool, Part F0105MB, a 1/8-inch open-end wrench, and a small screwdriver. (The wrench and screwdriver are included in tool kit, Part F0101AA.)

! CAUTION

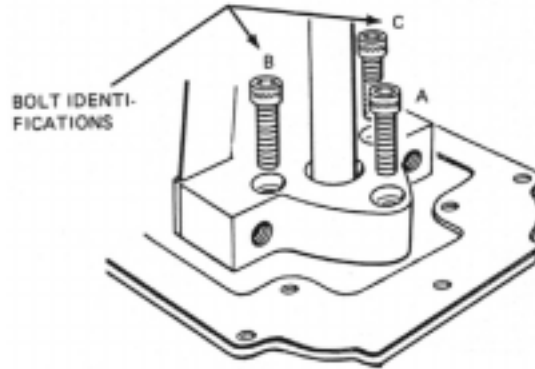
Use care in turning thin flexure alignment screw to prevent shearing.

1. If transmitter has optional range elevation or suppression attachment, remove this assembly.
2. Connect an air supply regulated at a fixed pressure between 140 and 170 kPa or 20 and 25 psi to input, and a 0 to 140 kPa or 0 to 25 psi test gauge to output.
3. Loosen flexure cap screw at bottom of force bar (see page 11).
4. Turn range wheel on top of range bar.
5. Using spacing tool, as feeler gauge, insert tool at lower end of range bar between threaded surface and machined casting surface. Adjust zero screw to get correct spacing for tool.
6. Loosen flapper alignment screw locknut and adjust screw so that output is 20 kPa or 3.0 psi.
7. Repeat Step 5. If output is not between 23 and 33 kPa or 3.4 and 4.8 psi, repeat Steps 5 and 6 until output is within these limits.
8. Retighten flapper alignment screw locknut. Reinstall optional elevation or suppression attaching. Tighten flexure locknut and check calibration.



Bolt Tightening Procedure - Force Balance Unit

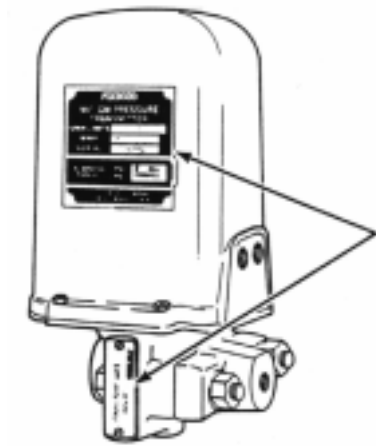
When reinstalling the three socket-head bolts that hold the force balance unit to the transmitter body (see Step 3 in procedure to remove force balance unit, page 20), follow the bolt tightening procedure below.



Step Number	Bolt	Torque	
		(N · m)	(lb · in)
1	A	0.5	5
2	B	0.5	5
3	C	0.5	5
4	A	1.5	15
5	B	3.0	25
6	C	3.0	25
7	B	4.0	35
8	C	4.0	35
9	A	4.5	40
10	B	5.5	50
11	C	5.5	50
12	B	7.5	65
13	C	7.5	65
14	A	5.0	45

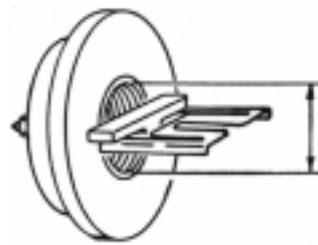
Transmitter and Capsule Identification

Transmitter Identification



In any correspondence with foxboro always include instrument model and serial numbers stamped on data plate on cover or tag plate on body.

Capsule Identification



Dimension		Capsule
mm	in	
19	0.75	A
13	0.50	B
10	0.38	C
6	0.25	D
4	0.17	E

Capsule is identified by designation (A, B, C, D, and E) stamped on face, or by dimension indicated.

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