

556 Series Pneumatic Analog Computers

Maintenance and Servicing

Fault Location (Troubleshooting)

If computer appears to be malfunctioning, complete the following steps. For Principle of Operation, refer to Technical Information TI 37-55a.

1. Check air supply pressure.
2. Check input signal lines for leaks.

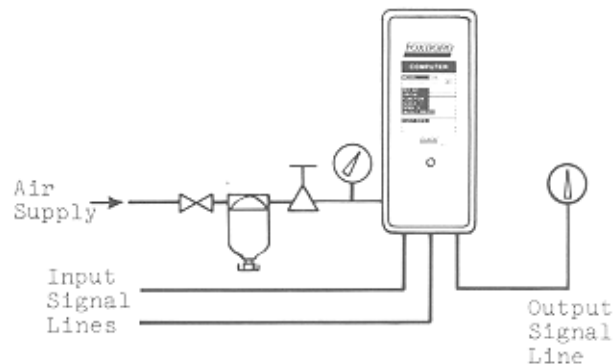


Figure 1.

3. Clean restrictors.
4. Disconnect output signal line from computer; connect pressure gauge to read output signal.
5. If output signal is correct value, check transmission line and receiver for leaks.
6. If output signal is incorrect value:
 - a. Check calibration (see MI 017-285).
 - b. Check computer for damage or leaks.
 - c. Install new relay ("To Install New Relay" on page 3).
7. If output is incorrect at midrange calibration points:
 - a. Check for partially plugged nozzle. To do this, first check that nozzle clearance is correct by completing "Nozzle Adjustment" on page 6. Then push flapper toward each nozzle in turn and observe output pressure. When flapper touches one

nozzle, output pressure should increase rapidly. When flapper touches other nozzle, pressure should drop to zero; if it does not, loosen clamp screw and setscrew and remove nozzle tube assembly. Insert a No. 76 (0.020-inch diameter) drill or equivalent wire through nozzle. To clean nozzle under main flexure, lift flexure with fingers and insert a bent wire (approximately 0.025-inch diameter) through nozzle. Reinstall nozzle tube and repeat “Nozzle Adjustment” procedure.

- b. Use soapsuds to check for leaks around base of relay. If leaks are detected, tighten the two large relay mounting screws. If leaks persist, install new switch plate using Steps 2 and 3 of “To Change Computer Function” on page 5.

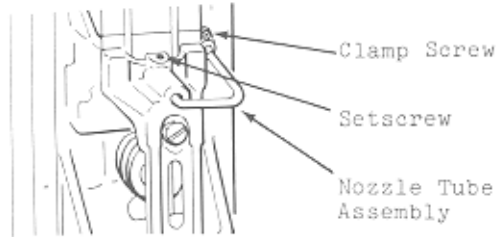


Figure 2.

8. If computer has either square or square-root function, clean stabilizing hole as follows:
 - a. Remove relay and switch plate (located behind base of relay).
 - b. Insert a No. 80 (0.013-inch diameter) drill or equivalent wire through stabilizing hole (small hole in unpainted area of base).
 - c. Reinstall relay and switch plate using Steps 2 and 3 of “To Change Computer Function” on page 5.

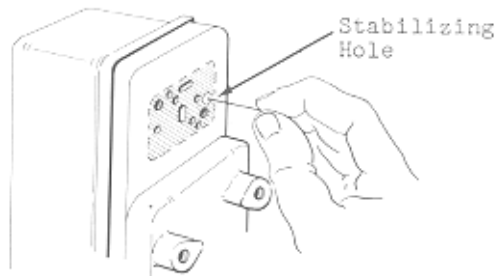


Figure 3.

General Maintenance

Supply Air Filter

1. Blow Filter out at least once a day. .



Figure 4.

To Clean Reducing Tubes

1. Unscrew restrictors from casting.



Figure 5.

2. Clean restrictors by inserting a 0.005-inch diameter wire (or Foxboro cleaning wire, Part No. 0042527) through orifice.

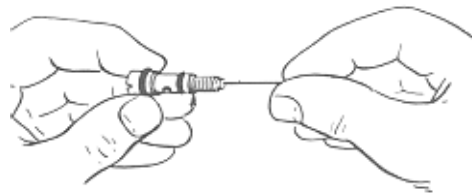


Figure 6.

3. Before reinstalling restrictors, apply a thin film of Vaseline or similar lubricant on O-rings.

To Install New Relay

To remove relay, remove the two large screws and pry off gently. For servicing details see MI 011-493, obtainable from Invensys. Do **not** use gasket supplied with replacement relay.

Reinstall relay and switch plate using Steps 2 and 3 or “To Change Computer Function” on page 5.

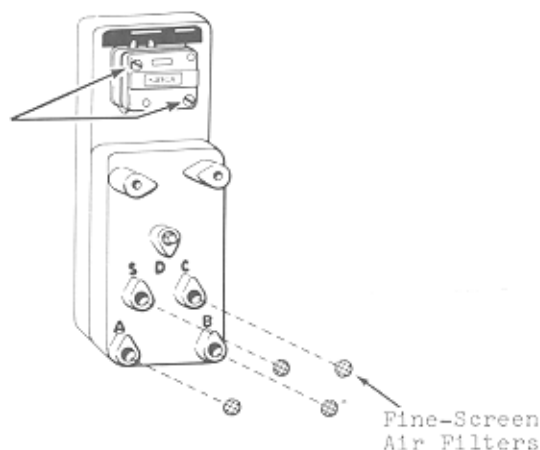


Figure 7.

To Install New Screen Filters

If fine-screen air filters become clogged, remove with pointed tool and install new filters.

Servicing the Manifold

If clean, dry air is not used to operate the computer, it may eventually be necessary to remove the piped manifold for cleaning.

1. Remove the three computer mounting screws. Remove the piped manifold and the rubber gasket.
2. Rinse the piped manifold with trichloroethylene or similar solvent, making sure to clean the fine-screen air filters in the air connection holes. Dry manifold with compressed air.
3. When reassembling, the gasket hole with flat must fit over the manifold boss with flat.

NOTE

Do not use grease on the manifold gasket

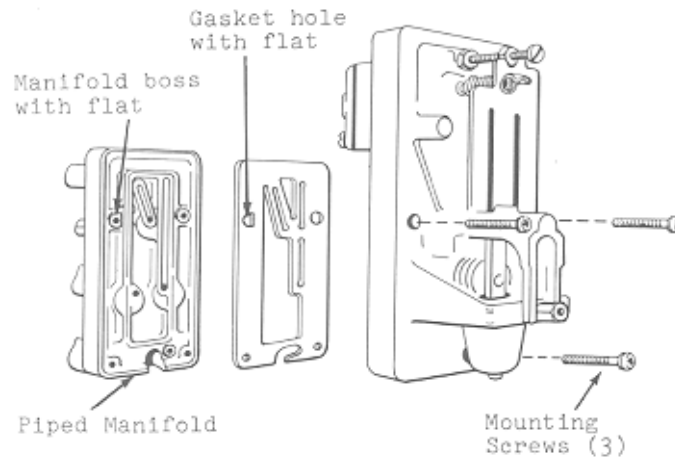


Figure 8.

To Change Computer Function

The computer function can be changed by repositioning the switch plate and, if required, the relay.

1. Remove relay mounting screws and remove relay.

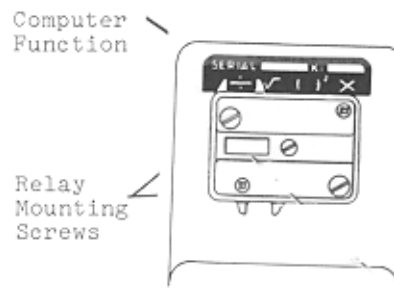


Figure 9.

2. Reposition switch plate (by either rotating or turning over) so that symbol of desire function ($\div$, $\sqrt{\quad}$, $()^2$, or $\times$) is contained within brackets of switch plate.

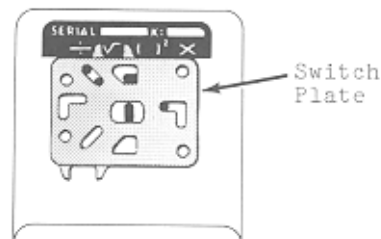


Figure 10.

3. Reinstall relay in position corresponding to desired function, see Figure 11, for relay positions for Style C computers.

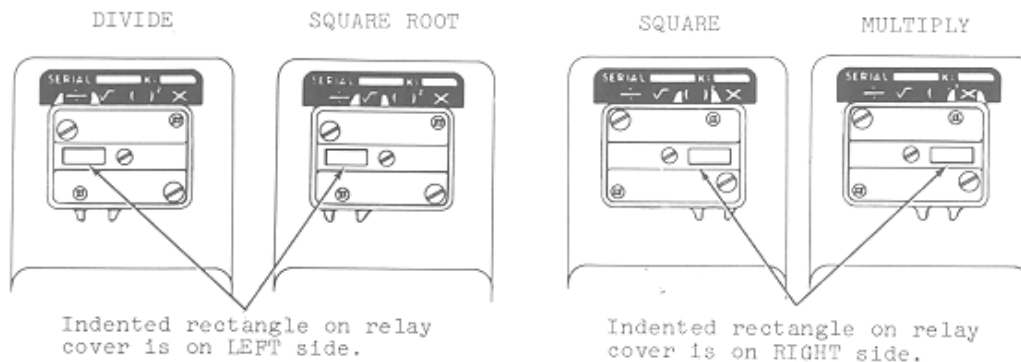


Figure 11.

4. Check calibration using applicable procedure in MI 017-285.

Nozzle Adjustment

The flapper-nozzle relationship is a factory setting and normally does not require adjustment. If flexure, force bar, or nozzle is replaced, nozzle spacing must be adjusted.

1. With 5/64-inch hex-key wrench, loosen setscrew holding nozzle.
2. Insert 0.18 mm (0.007 in) feeler gauge between nozzle and flapper.
3. Lightly depress nozzle tube assembly while retightening setscrew.

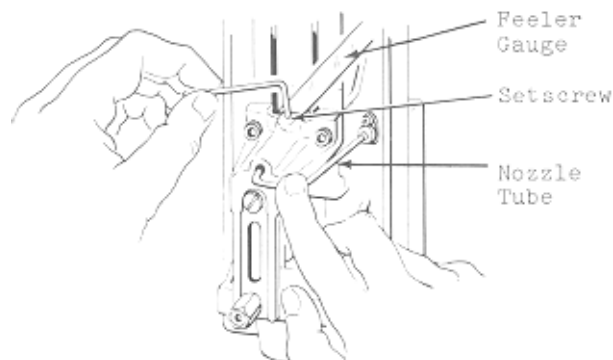


Figure 12.

To Change the Scaling Factor, “f”

— NOTE —

To determine the correct scaling factor value, consult Invensys.

1. Refer to Table 1 on page 8. If old and new values of “f” fall within the same range, proceed to Step 6. If old and new values of “f” fall within different ranges, proceed to Step 2.
2. Obtain the “A” bellows necessary to change the model number from the present suffix to the desire suffix. Refer to Table 1 on page 8.

3. Remove old bellows as follows:
 - a. Remove mounting screw from “A” bellows.
 - b. Compress bellows slightly, and slide out washer.
 - c. Lift bellows from bottom and slide it out sideways.

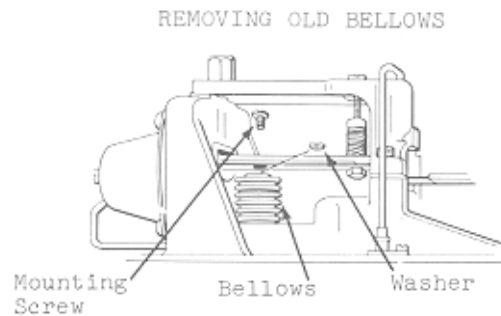


Figure 13.

4. Lubricate O-ring of new bellows with a thin film of Vaseline or similar lubricant.
5. To install new bellows, rest bottom of bellows (end with O-ring) on rim of bellows mounting hole in casting; compress bellows just enough so that it can be slid between casting and force bar, and insert into mounting hole. Check that bellows is correctly seated in hole. Insert washer between bellows and force bar, and reinstall mounting screw.

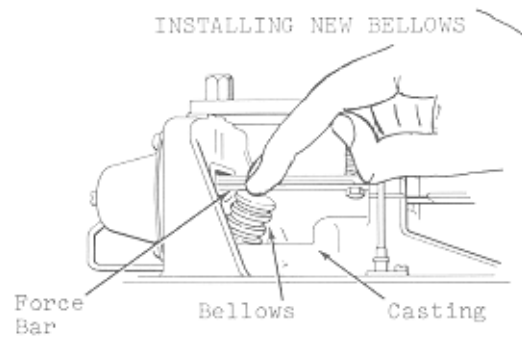


Figure 14.

6. Complete calibration procedure in MI 017-285.

Table 1.

First Digit of Model No. Suffix	Scaling Factor “f”	Part Number of “A” Bellows
-3	0.750 - 1.000	U0118FR
-4	1.001 - 1.280	U0118KN
-5	1.281 - 1.600	U0118KT
-6	1.601 - 2.050	U0118KZ
-7	2.051 - 2.420	U0118LE
-8	2.421 - 3.500	U0118LK

Example:

A multiplier has a scaling factory of 1.185 and model number 556-8-40. The desired scaling factor is 1.326. From Table 1, the new model is 556-8-50, and a new “A” bellows, Part No. U0118KT, must be installed.

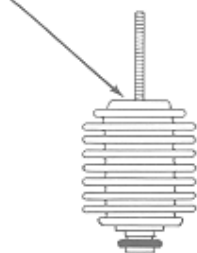
To Change the Span Value, S

— NOTE —

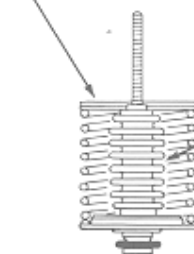
To Determine the correct span value, consult Invensys.

1. Refer to Table 2. If old and new values of “S” fall within the same range, proceed to Step 4. If old and new values of “S” fall within different ranges, proceed to Step 2.
2. Obtain the “C” bellows assembly necessary to change the model number from present suffix to desired suffix. If present suffix is 0 and desire suffix is 1, 2, 3, or 4, a spring assembly, Part Number U0118LZ, is required; refer to Table 2 on page 9 and Figure 15.

C bellows assembly
U0118EE for model
suffix 0



Spring assembly U0118LZ for
model suffixes 1 to 4



C bellows assembly for
model suffixes 1 to 4

Figure 15.

3. Install the new “C” bellows assembly by completing “General Disassembly” on page 9 procedures, omitting Steps 11 and 12 unless other parts are being replaced.
4. Complete calibration procedure in MI 017-285.

Table 2.

Second Digit of Model No. Suffix	Span Value "S"	Part Number of "C" Bellows Assembly	Part Number of Spring Assembly
0	0.625 - 1.000	U0118EE	Spring not used
1	0.486 - 0.624	U0118LW	U0118LZ
2	0.286 - 0.485	U0118ME	
3	0.169 - 0.285	U0118MM	
4	0.050 - 0.168	U0118MS	

Example 1:

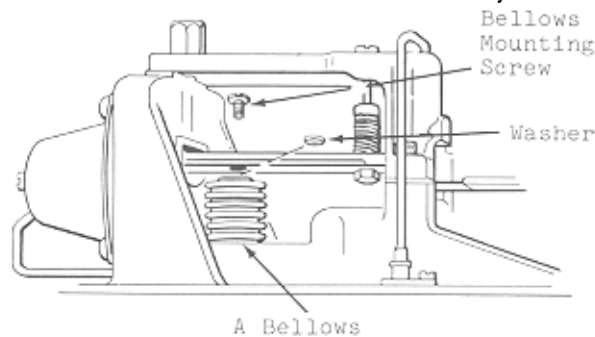
A divider has a present span value of 0.820 and model number 556-9-30. The desired span value is 0.441. From Table 2, the new model number is 556-9-32. A new "C" bellows assembly, Part No. U0118ME, and a spring assembly, Part No. U0118LZ, must be installed.

Example 2:

A multiplier has a present span value of 0.583 and model number 556-8-41. The desired span value is 0.256. From Table 2, the new model number is 556-8-43. A new "C" bellows assembly, Part No. U0118MM, must be installed. The spring assembly, Part No. U0118LZ, can be removed from the old "C" bellows assembly and used with the new "C" bellows assembly.

General Disassembly

1. Remove the "A" bellows as follows:
 - a. Remove bellows mounting screw.
 - b. Compress bellows slightly, and slide out washer.
 - c. Lift bellows from bottom and slide it out sideways.

*Figure 16.*

2. Loosen nozzle tube assembly clamp. Loosen nozzle setscrew with a 5/64-inch hex-key wrench. Remove nozzle tube assembly.

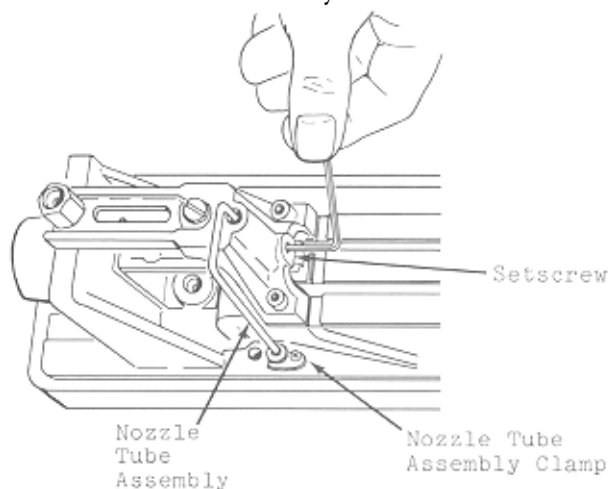


Figure 17.

3. Remove “B” diaphragm as follows:
 - a. Turn B-zero screw counterclockwise until it is disengaged from spring (screw is disengaged when clicking sound can be heard with each additional turn).
 - b. Remove the four mounting screws from diaphragm cover, and remove cover.
 - c. Remove large O-ring.

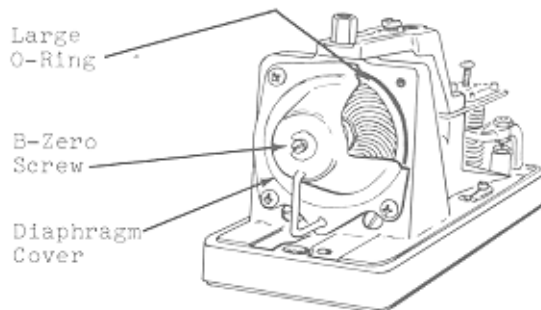


Figure 18.

- d. While holding hex socket screw under force bar with a 3/32-inch hex-key wrench, turn hex nut on end of spring assembly counterclockwise until spring assembly is removed.

! CAUTION

Do not twist force bar when unscrewing spring assembly.

- e. Remove diaphragm. Clean diaphragm cavity and end of force bar.

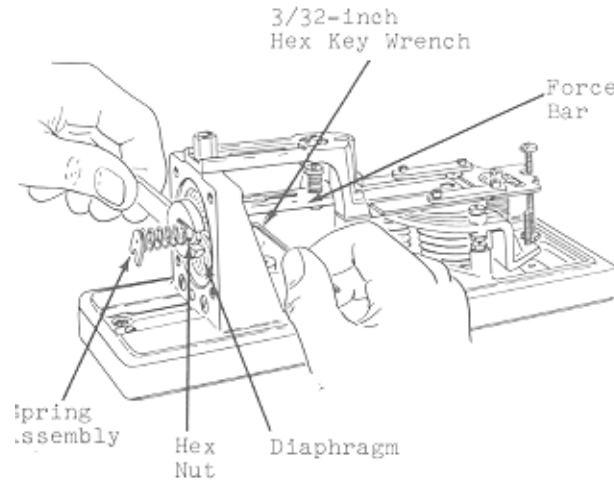


Figure 19.

4. Loosen flexure stop screw locknut. Hold flexure stop nut with wrench, and unscrew flexure stop screw from casting.
5. Turn C-span screw until tabs on spring seat are threaded one-half way up length of spring. Turn C-zero screw counterclockwise until bottom of spring touches bellows bracket, then turn C-span screw until spring seat becomes unthreaded from spring.
6. Unscrew spring guide post from C-bellows bracket.

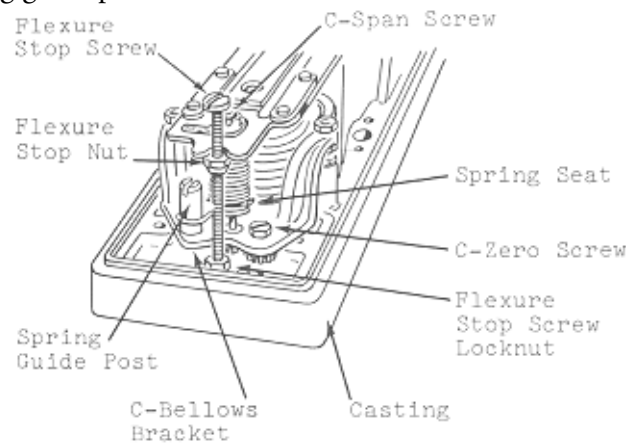


Figure 20.

7. Remove the two wire flexure nuts.

! CAUTION

Any relative motion between the two hex nuts on the wire flexure assembly can twist and damage the flexure.

Hold both nuts with a thick (approximately 5 mm [0.2 in]) wrench while unscrewing each wire flexure nut.

8. Remove column. Remove the two flexure assembly mounting screws.

9. Unseat large bellows from casting. Raise flexure and force bar assembly and move it to one side.

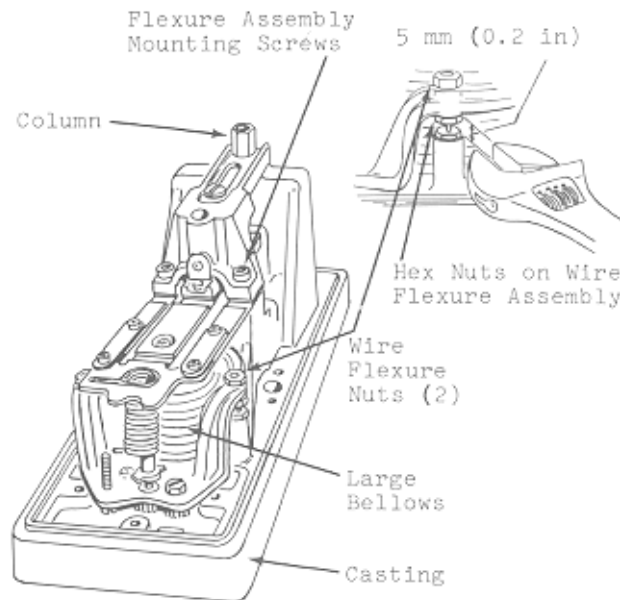


Figure 21.

10. Unseat “C” bellows from casting, being careful not to distort wire flexures. Lift “C” bellows and bracket assembly straight up from casting.
11. Examine the wire flexures. If a wire is distorted, unscrew wire flexure assembly and install new assembly.

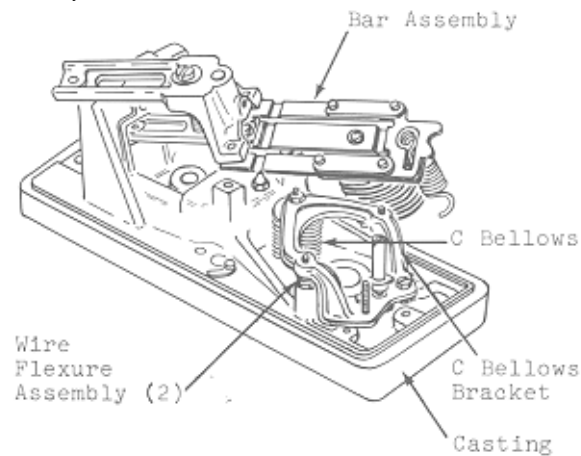


Figure 22.

12. If large bellows is deformed, remove mounting screw and install new bellows.

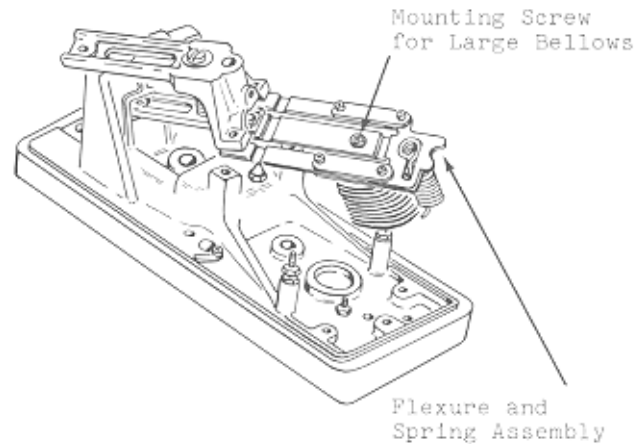


Figure 23.

13. If flexure and spring assembly is deformed, install new assembly as follows:
 - a. Remove large bellows (see Step 12).
 - b. Turn A-zero screw counterclockwise until it is free from spring.
 - c. Remove bracket assembly from casting.
 - d. With a 3/32-inch hex-key wrench, remove the two force bar attachment screws. Remove flexure and spring assembly.
 - e. Install new flexure and spring assembly on force bar. Align flexure with force bar and tighten force bar attachment screws.

- f. Insert pin located on bracket assembly through slotted tab located on spring, and reinstall bracket assembly. Turn A-zero screw until it engages threads in spring assembly; then continue to turn screw an additional 18 turns clockwise.

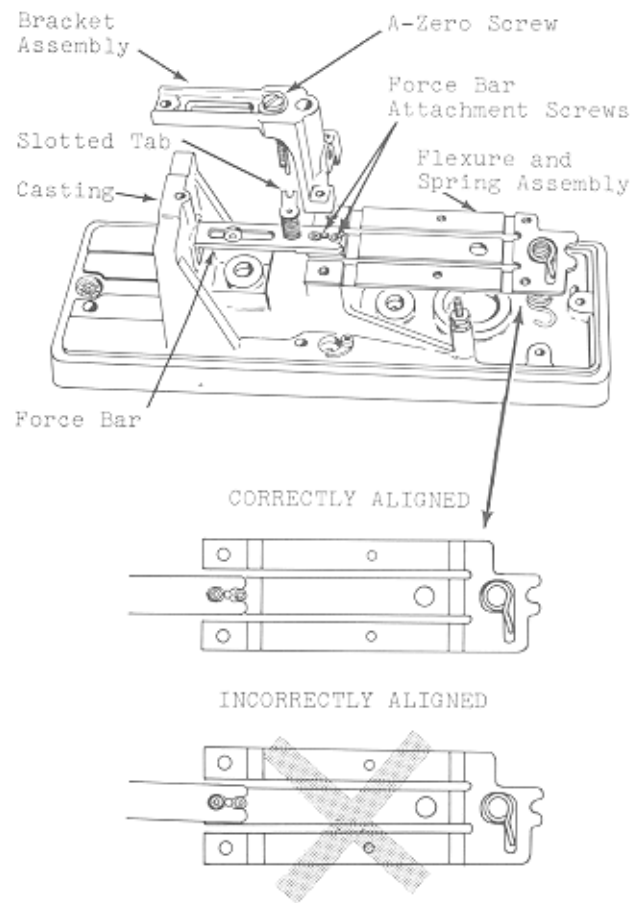


Figure 24.

14. Remove locknut from “C” bellows assembly. Using a 0.050-inch hex-key wrench in bellows screw, unscrew assembly from bracket.

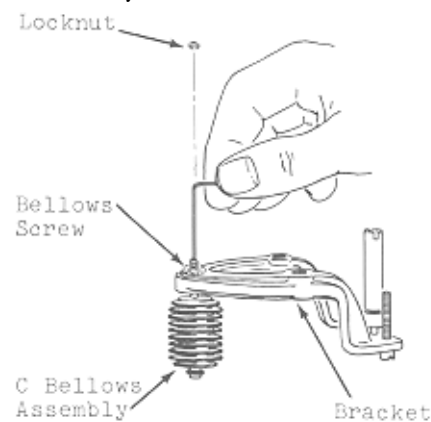


Figure 25.

15. Install desired “C” bellows assembly (and spring assembly, if C-span value is between 0.050 and 0.624) on bracket. Use the hex-key wrench to tighten screw; do not turn bellows by hand.

BELLOWS WITH SPRING ASSEMBLY

Screw in bellows until spring assembly touches bracket.

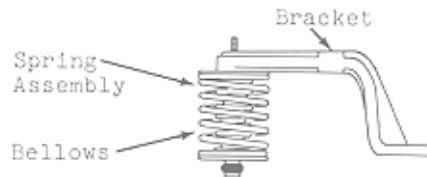


Figure 26.

BELLOWS WITHOUT SPRING ASSEMBLY

Allow approximately 1.3 mm (0.05 in) clearance between bellows and bracket. Hex-key wrench used to tighten bellows can be used as feeler gauge to position bellows.

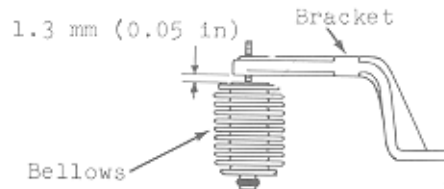


Figure 27.

16. Install locknut. When tightening locknut, insert the 0.050-inch hex-key wrench in bellows screw to prevent bellows assembly from turning.
17. Lubricate bellows O-ring with Vaseline or similar lubricant. Return bracket to its position on wire flexure assemblies and plug bellows into casting. Avoid exerting pressure on wire flexures.

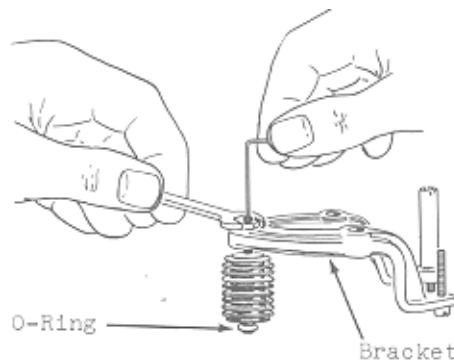


Figure 28.

18. Reinstall the two wire flexure nuts.

— **! CAUTION** —

Hold both hex nuts on wire flexure assembly with a thick (approximately 5 mm; 0.2 in) wrench when tightening each flexure nut to avoid damaging wire flexures.

19. Lubricate O-ring on large bellows with Vaseline or similar lubricant. Move flexure and force bar assembly back into position and guide the spring down over the C-span screw. Keep the spring as nearly vertical as possible, to avoid damaging wire flexures. Seat large bellows in casting by gently pressing down on lower convolutions of bellows.

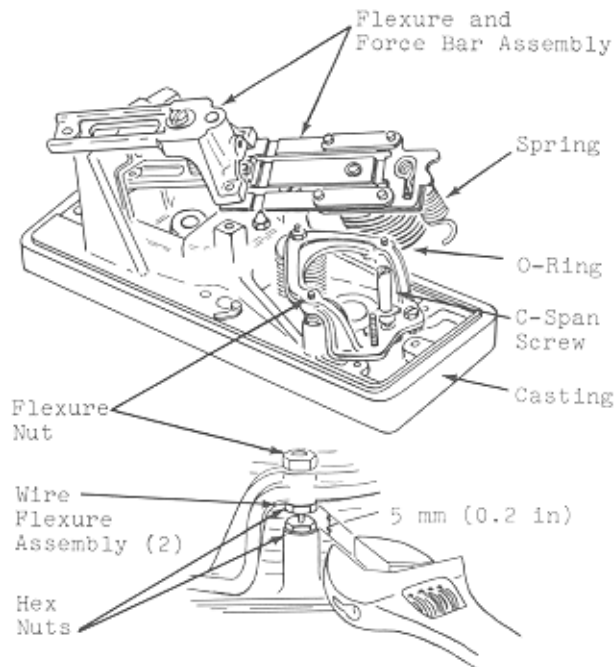


Figure 29.

20. Reinstall and tighten the two flexure-assembly mounting screws so that end of force bar is in same plane as diaphragm seating surface (in casting). Check surfaces along two diameters, approximately 90 ° apart, with a straightedge. Straightedge should be approximately 48 mm (1.9 in) long. Reinstall column

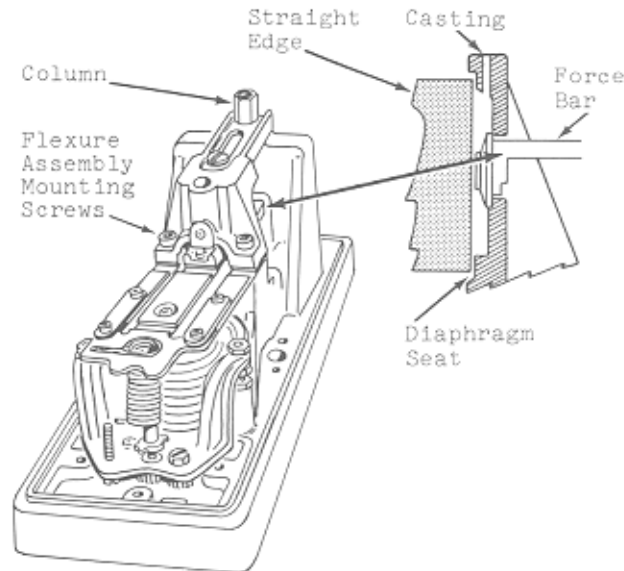


Figure 30.

21. Reinstall sprint guide post. When tightening post, protect wire flexures by holding bracket with one hand to keep it from moving; do not tighten post excessively.

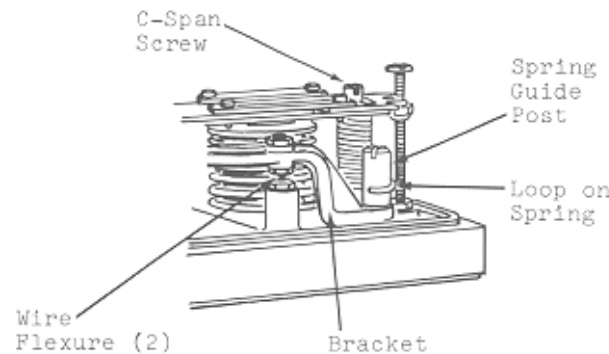


Figure 31.

22. Tabs on spring seat should be about 10 mm (0.4 in) above bracket; if they are not, turn C-span screw until they are. Then turn C-span screw so that higher of two tabs on spring seat is to right of loop on bottom of spring. Pull loop down just enough so that higher tab threads into spring when C-span screw is turned clockwise. Turn span screw clockwise until both tabs are threaded about two coils into spring.
23. Put a thin film of silicone grease on both sides of center portion of diaphragm.
24. With a 3/32-inch hex-key wrench, insert diaphragm mounting screw through hole in end of force bar and hole in diaphragm. Screw B-zero spring onto mounting screw.

Position spring so slot in end of assembly is between 5 and 10 ° left of vertical; tighten mounting screw with spring in this position.

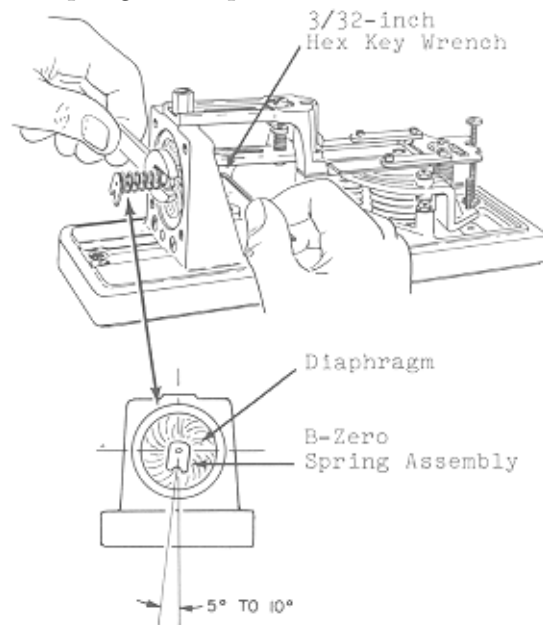


Figure 32.

25. Lubricate large O-ring with a graphite-base grease; reinstall O-ring on diaphragm.
26. To reinstall diaphragm cover, insert tube (located on side of cover, below B-zero screw) into slot in end of spring assembly. Reinstall the four mounting screws in cover; gradually tighten opposite pairs of screws so large O-ring is correctly seated.

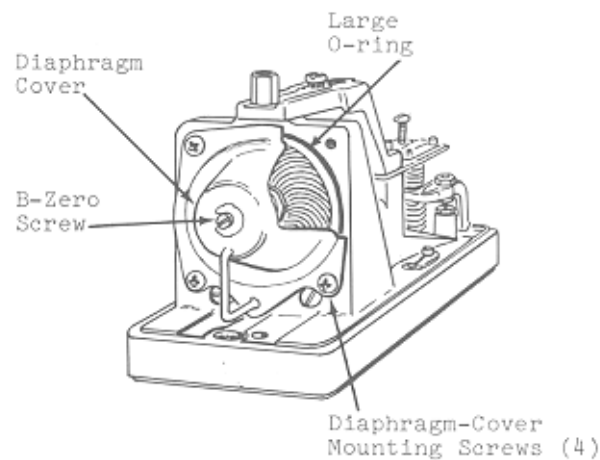


Figure 33.

27. Reinstall nozzle tube assembly; complete “Nozzle Adjustment” on page 6.

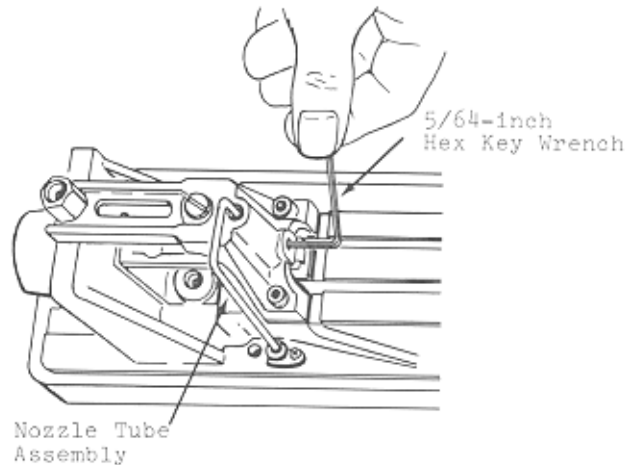


Figure 34.

28. Lubricate O-ring on “A” bellows with a thin film of Vaseline or similar lubricant.
29. Install “A” bellows as follows:
- Rest bottom of bellows (end with O-ring) on rim of its mounting hole in casting.
 - Compress bellows just enough to allow it to slide between casting and force bar, and insert it into mounting hole.
 - Insert washer between bellows and force bar and reinstall mounting screw.

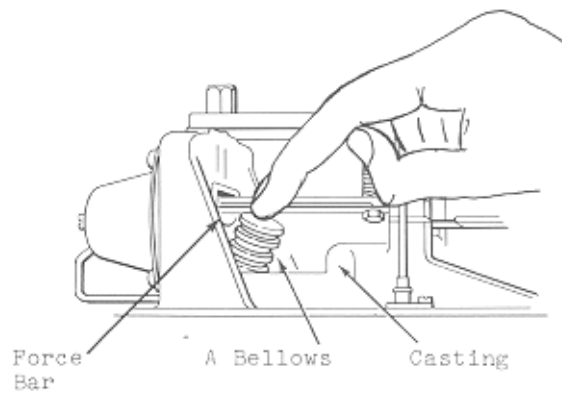


Figure 35.

30. Reinstall flexure stop screw. Adjust stops and check computer calibration using procedures in MI 017-285.

— **NOTE** —

If B-zero screw clockwise adjustability is insufficient for calibration, loosen the column and two flexures-mounting screws. Then retighten column and two screws. If B-zero screw counterclockwise adjustability is insufficient for calibration, loosen the column and the two flexure-mounting screws and push flexure towards diaphragm. While keeping end of flexure centered on flexure stop screw, retighten column and screws.

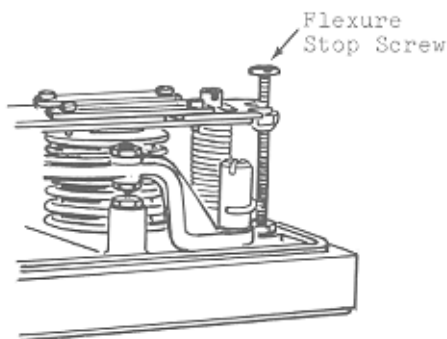


Figure 36.

ISSUE DATES

JUN 1966
NOV 1968
MAR 1973
FEB 1980
APR 2010

Vertical lines to the right of text or illustrations indicate areas changed at last issue date.

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