

Instruction Manual

CURRENT-TO-PNEUMATIC TRANSDUCER MODELS 443A/445A



MODEL 445A

With Integral Pneumatic
Booster



MODEL 443A

NOTICE

This instrument should be read completely and retained in a secure place for future reference.



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**P-2380
REV. C**

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Section I — DESCRIPTION

1.1 General

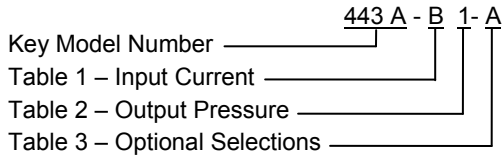
The Models 443A and 445A Current-Pneumatic Transducers convert a DC-current signal to a proportional pneumatic signal. Used with pneumatic devices, they permit the complete utilization of the speed of electronic transmission, reduce the time-distance considerations, and broaden the scope of pneumatic instrumentation.

The Model 443A is designed to be used where load volume is small, as in gages, bellows, receivers, etc. The Model 445A, which is a Model 443A with a pneumatic booster added, is used where load volume requirements are high. Both instruments are designed for use in explosive atmospheres and may be calibrated for either direct or reverse operation.

1.2 Model Identification

Identify instrument models in accordance with the description and variations listed in each table.

- * Standard Models 443A-B1 or 445A-B1
- Optional Models
- Select from tables (allow additional delivery time – contact factory)



Key Model Number

Model Number	Description
*443A	I-P Transducer, delivers 0.13 SCFM output air
*445A	I-P Transducer, delivers 8.0 SCFM output air

NOTE: Place (-) between Model No. and Table 1.

Table 1 – Input Signal

Designation	Description
A	1-5 mA DC, 2100 ohms.
*B	4-20 mA DC, 135 ohms.
C	10-50 mA DC, 26 ohms.
E	Voltage input 8 VDC span, temperature compensated (R=800 ohms, I=10 mA)
F	Voltage input 10 VDC span, temperature compensated (R=1,000 ohms, I=10 mA)

Table 2 – Output Pressure

Designation	Description
*1	3 to 15 psig output (20 psi air supply)
2	3 to 27 psig output (32 psi air supply)
3	6 to 30 psig output (35 psi air supply)
11	15 to 3 psig output (20 psi air supply)
12	27 to 3 psig output (32 psi air supply)
13	30 to 6 psig output (35 psi air supply)

Table 3 – Optional Selections

Designation	Description
†A	High Accuracy, ±.25% linearity

† Available on Models 443A-(A, B, C) -1 only.

Accessory Items

New Part No.	Description
85762-A1	U-bolt for mounting on 2" pipe.

Section II — SPECIFICATIONS

2.1 Environmental

Ambient Temperature Range..... -40°F to 120°F
-40°C to 49°C

Enclosure Classification.....All model variations are Factory Mutual Approved for Explosion-Proof Outdoor Use, Class I, Division 1, Groups C and D, Class II, Division 1, Groups E, F, & G.

Models 443A/445A-B (1,2,3)-A only are CSA Approved for Intrinsically Safe Use for Classes, Divisions and Groups as specified on Robertshaw Interconnection Drawing (see Figure 3-4).

2.2 Electrical and Pneumatic

Current Input Ranges:

Input Current:	Input Resistance:
1-5 mA DC	2100 ohms
4-20 mA DC	135 ohms
10-50 mA DC	26 ohms
0-10 VDC	1000 ohms (10 mA span)
0-8 VDC	800 ohms (10 mA span)

Pressure Output Ranges:

3 to 15 psig	Standard
15 to 3 psig	Available
3 to 27 psig	Available
27 to 3 psig	Available
6 to 30 psig	Available
30 to 6 psig	Available

Pressure Supply:

For 3-15 psig instruments	20 psig
For 15-3 psig instruments	20 psig
For 3-27 instruments	32 psig
For 27-3 psig instruments	32 psig
For 6-30 psig instruments	35 psig
For 30 to 6 psig instruments	35 psig

Air Consumption:

For Model 443A	6 scfh (average)
For Model 445A	12 scfh (average)

2.3 Performance

Calibration Accuracy:

For 3-15 psig range $\pm 1/2\%$ of span
(limited by linearity) or $\pm 0.25\%$ (special order accuracy)
For 3-27 or 6-36 psig range $\pm 1.5\%$ of span

Repeatability: 0.1%

Maximum Overload: 100 psig

Sensitivity: 0.1%

Temperature Variation: Less than 1% of span
and 1% of zero with an ambient temperature variation
of 75°F.

Supply Pressure Variation: 1% for 20% supply
pressure change (18-22 psi).

Minimum Load Value: 1.5 cubic inches for
Model 443A only.

Maximum Air Flow:

Model 443A 10 SCFH for exhaust, 8 SCFH for supply.
Model 445A 8 SCFM for supply and exhaust.

Transient Response: 1.8 seconds for a Model 445A
driving a 144 square-inch valve top at 1 1/2 inch stroke
for 98% completion of stroke.

Frequency Response Data: Available upon request.

Section III — INSTALLATION

WARNING

These installation instructions are for use by qualified personnel only. To avoid injury and electric shock, do not perform any operation other than those contained in these operating instructions, unless qualified.

The instrument may be mounted on a flat surface using the two holes in the mounting pad or it may be mounted on a pipe or angle iron using the same two holes and a special U clamping bolt (Part No. 85762-A1 that can be ordered from the factory).

3.1 General

Examine Model 443A/445A Current-to-Pneumatic Transducer for possible shipping damage. IMPORTANT: If for any reason it is determined that parts should be returned to the factory, please notify the nearest Robertshaw Controls Co. sales representative prior to shipment. Each unit must be properly packaged to prevent damage. Robertshaw assumes no responsibility for equipment damaged in shipment due to improper packaging.

Choose the location in accordance with good instrument practices, avoiding extremes of temperature, humidity and vibration (see Specifications, Section II).

All units are factory calibrated and should not require recalibration. However, if a check on calibration is necessary, use Calibration Procedure in Section V (Maintenance) of this manual.

3.2 Mounting

Mounting dimensions are shown in Figure 3-1 (Model 443A) and 3-2 (Model 445A).

For outdoor installations, consideration must be given to protecting the interior of the housing from contamination by moisture. To accomplish this, the instrument must be mounted vertically as indicated by the "up" arrow on the nameplate.

For indoor installations, the unit can be mounted in any position. If it is mounted to any position other than that prescribed for outdoor installations, it will be necessary to make a slight adjustment to the Zero in order to bring the unit into calibration (see Calibration Procedure in Section V).

3.3 Electrical Connections

The electrical terminal strip is accessible when the instrument cover is removed by unscrewing in a counterclockwise direction. A 1/2-inch NPT female port is provided in the base for conduit connection.

CAUTION

The electrical installation of this unit must be performed in accordance with the current edition of the National Electrical Code.

NOTE

A shorting wire (Part No. 38130-A1) is installed between the + and - terminals for shipping purposes and must be removed prior to making wiring connections to the unit.

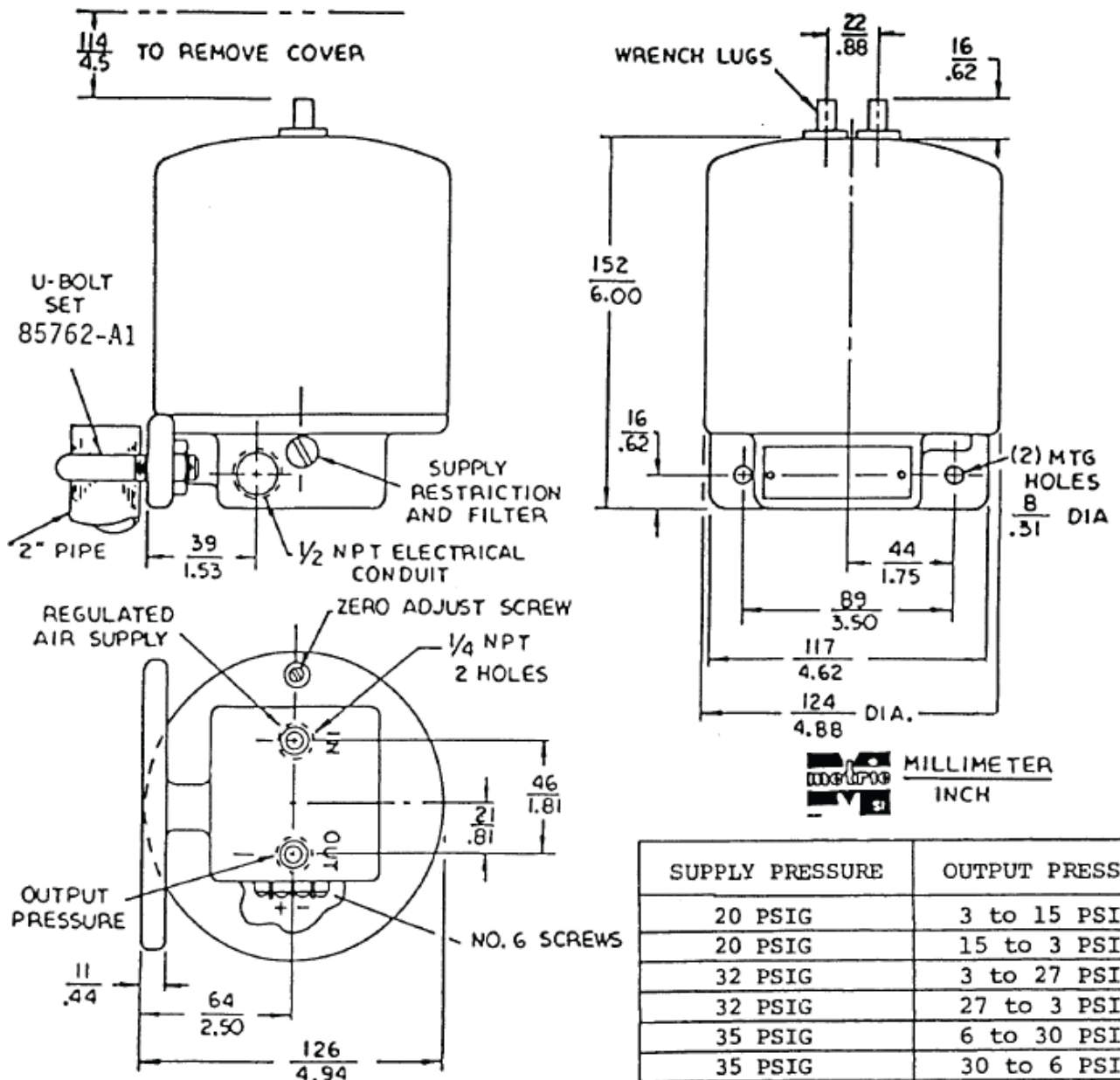
NOTE

This instrument is a series connected instrument and will not function correctly if any current device is connected in parallel with the input connections.

Details for making the proper electrical connections are shown in Figure 3-3. Note the Capacitor C1 is used only on the 443A-A () and 445A-A () models. Instructions for correctly connecting this capacitor are shown in Figure 3-3. The instructions and requirements for making an Intrinsically Safe Installation are shown in Figure 3-4.

3.4 Pneumatic Connections

See Figures 3-1 and 3-2 for making the proper air connections to the unit. Two 1/4 -inch NPT female ports are provided. The port marked "IN" is for the supply air and the port marked "OUT" is for the output air.



NOTE: AVAILABLE WITH "U" BOLT SET 85762-A1 FOR MOUNTING TO 2" PIPE

Figure 3-1. Mounting Dimensions and Pneumatic Connections for Model 443A.

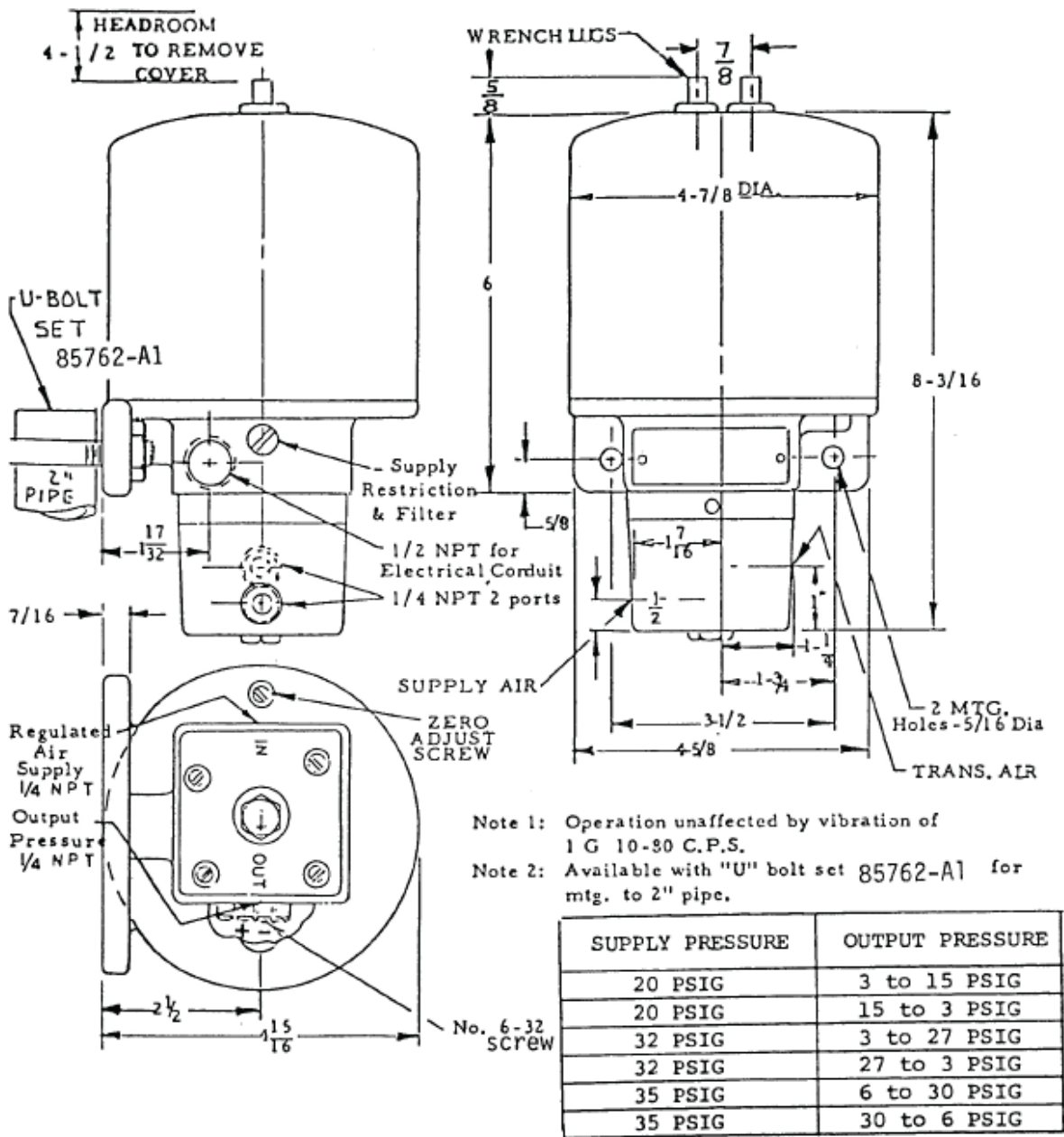


Figure 3-2. Mounting Dimensions and Pneumatic Connections for Model 445A.

FOR ALL UNITS (CURRENT OR VOLTAGE INPUTS)

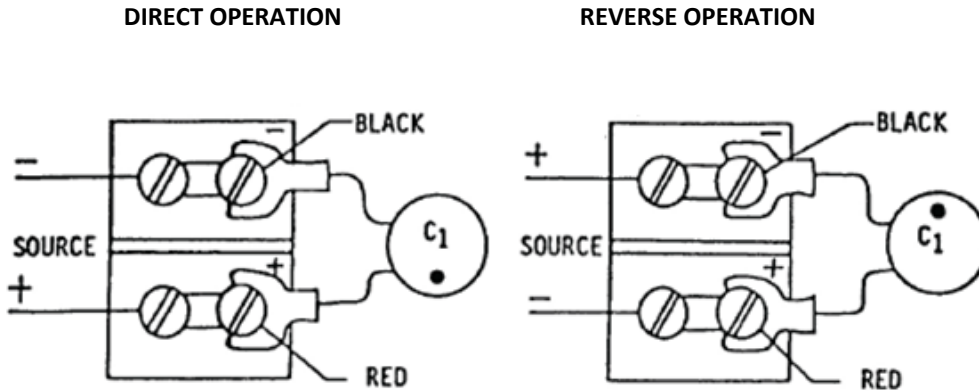


Figure 3-3. Electrical Connections for Models 443A and 445A.

NOTE

1. Capacitor C1 is used on Models 443A-A()-() and 445A-A()-() only.
2. Color dot indicates (+) side of Capacitor C1.

Connecting Wire Considerations

NOTES:

1. Current Inputs: Combined resistance of connecting wires may not exceed the following values:

Input Range	Max. Line Resistance
1-5 mA	400 ohms
4-20 mA	500 ohms
10-50 mA	275 ohms

2. Voltage Inputs: (current required = 10 mA max.)
Units are factory calibrated for listed voltage at unit.
Connecting line losses subtract voltage as shown.

(A) $E_T = E_0 - E_L$ Where E_0 = source voltage

E_L = line losses

E_T = resultant voltage to the unit

(B) $E_L = 0.01 (R_L)$ Where R_L = total line resistance

Example: Let $R_L = 5$ ohms

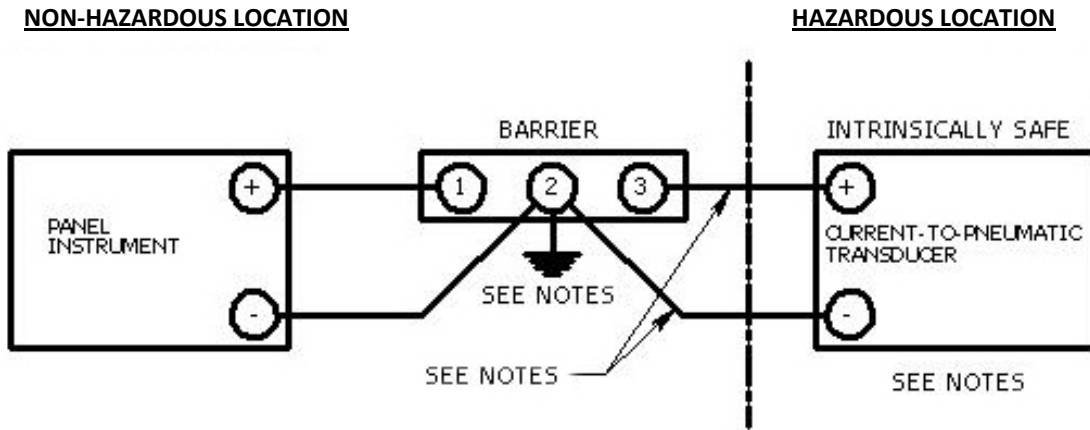
$E_L = 0.01 (5) = 0.05$ volts

$E_T = 10$ volts $- 0.05$ volts = 9.95 volts

Voltage input units are temperature compensated (see specifications and product data).

No compensation is provided for temperature effects on connecting wires.

**Figure 3-4
INTRINSICALLY SAFE
INSTALLATION INSTRUCTIONS**



NOTES:

CSA approved as Intrinsically Safe for Class I, Div. 1, Groups A, B, C, and D when connected to an R. Stahl Inc., Model 8901/33-293/000/79 barrier as shown on this drawing.

Robertshaw Electro-Pneumatic Relay, Models 443A-B(1,2,3), 443A-B1-A, 445A-B(1,2,3) and 445A-B1-A.

R. Stahl Inc., Model 8901/33-293/000/79 Positive-Potential DC-Resistive Barrier, 28.IV, 470 ohms, with Intrinsically safe terminals 2 (ground) and 3. Barrier must be mounted and grounded outside the hazardous location in accordance with the Instructions packed with barrier. Potential to ground must not exceed 250V rms (360V peak).

For a CSA Intrinsically Safe installation, all wiring between the barrier and the Current-To-Pneumatic Transducer must be installed in rigid metal conduit.

Section IV — OPERATION

4.1 Principle of Operation (See Figure 4.1)

The coil, which is mounted on a beam, is suspended in the magnetic field of a permanent magnet. Current flow through the coil creates a force which moves the coil through the magnetic field varying the beam position with respect to the nozzle.

In direct action, an increase in input current to the coil moves the beam in the direction of the nozzle, allowing less air to bleed through it and thereby increasing output pressure. The beam moves until the force produced by the input current is equalized or rebalanced by the force produced by air pressure acting through the nozzle area against the beam. In reverse action, increasing input current decreases output air pressure. Reverse action can be obtained by reversing the DC current input wires and re-zeroing the instrument.

Zero adjustment deflects the zero spring to vary the force balance on the beam to obtain the desired zero setting. Span is proportional to the flux density of the magnetic field surrounding the coil and is varied by the adjustment of the magnetic shunt.

On the Model 445A, with the pneumatic booster, the output from the nozzle circuit is fed directly into the input chamber of a 1:1 (pressure ratio) force balance volume booster. On increasing pressure, the diaphragm assembly moves downward pushing the poppet valve off the supply seat. This allows the air to flow until the output pressure matches the input pressure. When the pressures are equal, the poppet valve reseats, closing off the supply pressure.

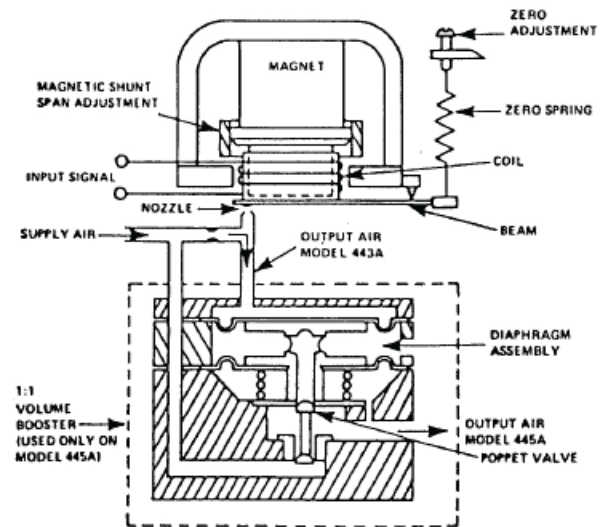


Figure 4-1. DIAGRAM OF OPERATION

The output pressure is then maintained at its new value. When the inlet pressure decreases, the diaphragm assembly moves the exhaust seat off of the upper part of the poppet and allows air to flow out the exhaust port until the output pressure matches the input pressure. When the output pressure again matches the input pressure, the upper part of the poppet is seated in the exhaust port and output pressure remains at its new value.

Section V — MAINTENANCE

WARNING

These maintenance instructions are for use by qualified personnel only. To avoid injury and electrical shock, do not perform any operation other than those contained in these operating instructions, unless qualified.

5.1 Calibration

All units are factory calibrated and should not require recalibration. However, if a check on calibration is necessary, use the procedure presented below.

5.1.1 Calibration Adjustments

a. SPAN — The span of the instrument is determined by the

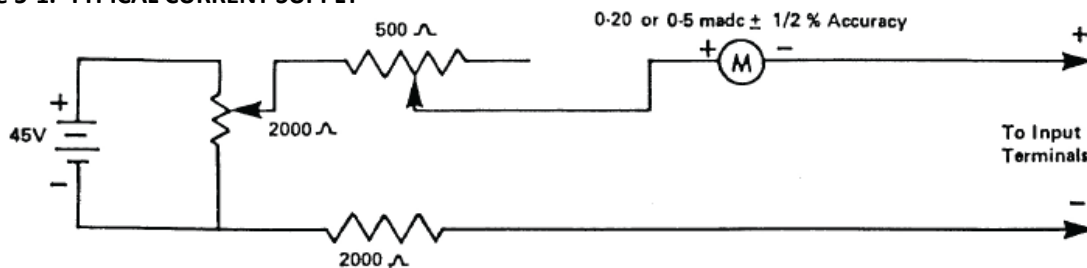
adjustment of the Span Adjusting Screw shown in Figure 5-2. The Span Locking Screws must be loosened before adjustment and tightened after adjustment.

b. ZERO — The zero of the instrument is determined by the adjustment of the Zero Adjustment Screw shown in Figure 5-2. This screw is covered by metal tab with "ZERO" stamped on it. This tab must be moved aside to gain access to the Zero Adjustment Screw.

5.1.2 Calibration Procedure

Connect the correct input supply pressure (see Section II, Pressure Supply) to the "IN" port of the unit. A manometer or accurate ($\pm 1/2\%$) pressure gage should be used to check the output air pressure at the "OUT" port. A current supply similar to the one shown below must be connected to the unit as directed in the following procedures.

Figure 5-1. TYPICAL CURRENT SUPPLY



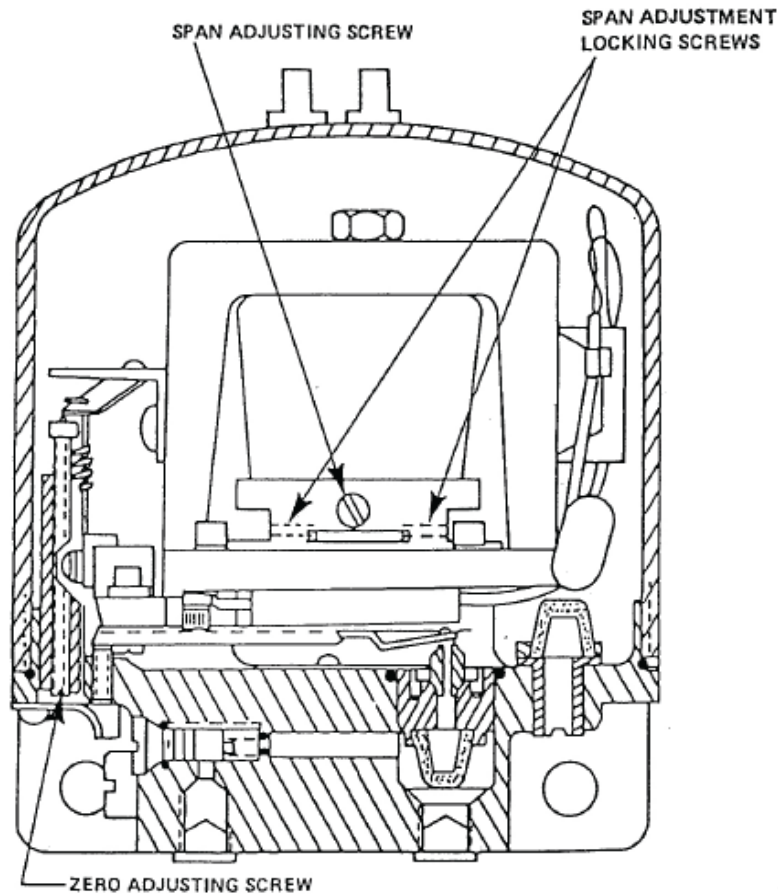


Figure 5-2. CALIBRATION ADJUSTMENTS

5.1.2.1 Calibration of Direct Action Instruments

- a. Connect the positive (+) terminal of the current supply to the input terminal marked (+) on the unit. On 1-5 mA units, connect capacitor C1 as shown in Figures 3-1 and 3-2.
- b. Apply the minimum current signal 1 mA, 4 mA, 10 mA, or 0 volts as appropriate.
- c. Adjust the Zero Adjust Screw until the output air pressure is 3.0 psig or 6.0 psig as appropriate. Clockwise rotation decreases output pressure.
- d. Apply the maximum current signal 5 mA, 20 mA, 50 mA, 8 volts, or 10 volts as appropriate.
- e. Output pressure should increase to 15, 27, or 30 psig as appropriate. If it does not, adjust Span as follows: Loosen the two Span Locking Screws and adjust the Span Adjusting Screw until the proper output pressure is obtained. The output span increases as the magnetic shunt ring is moved away from the magnet. Retighten the two Span Locking Screws after the proper output pressure has been obtained.
- f. If the Span was adjusted in Step (e), it will be necessary to repeat Steps (a) through (e) until the calibration is within limits, as the adjustment of Span has a small effect on the minimum output pressure.

5.1.2.2 Calibration of Reverse Action Instruments

- a. Connect the positive (+) terminal of the current supply to the input terminal marked (-) on the unit. On 1-5 mA DC units, connect capacitor C1 as shown in Figures 3-1 and 3-2.
- b. Apply the minimum current signal 1 mA, 4 mA, 10 mA, or 0 volts as appropriate.
- c. Adjust the Zero Adjust Screw until the output air pressure is 15, 27, or 30 psig as appropriate. Clockwise rotation decreases output pressure.
- d. Apply the maximum current signal 5 mA, 20 mA, 50 mA, 8 volts, or 10 volts as appropriate.
- e. Output pressure should decrease to 3 psig or 6 psig as appropriate. If it does not, adjust Span as follows: Loosen the two Span Locking Screws and adjust the Span Adjusting Screw until the proper output pressure is obtained. The output span increases as the magnetic shunt ring is moved away from the magnet. Retighten the two Span Locking Screws after the proper output pressure has been obtained.
- f. If the Span was adjusted in Step (e), it will be necessary to repeat Steps (a) through (e) until the calibration is within limits, as the adjustment of Span has a small effect on the minimum output pressure.

5.2 Troubleshooting

Any troubleshooting procedure should start with a visual inspection of the equipment for mechanical defects or faulty electrical connections. The following is a list of possible malfunctions that may occur with some recommended checks to isolate the cause. Any unit that cannot be diagnosed by this section and be repaired using the parts shown in the parts list (see Section VI) should be returned to the factory for repair.

- a. *Errors in Calibration:*
Changes in calibration will occur if input supply air is not at the proper value. See "Pressure Supply" specifications in Section II.
- b. *Excessive Nonlinearity:*
Check for dirty supply filter Item 3, Figure 6-1.
- c. *Large air consumption and low or no output pressure on the 445A only:*
Check for loose screws among the four screws fastening the booster to the body.
- d. *Cannot achieve maximum output pressure:*
Check for shorted input coil. Resistance of input coil should be correct for the particular input range being used (see Section III).
- e. *No current indication on supply source:*
Check continuity of input coil. Resistance of input coil should be correct for the particular input range being used (see Section II).

5.3 Removal and Replacement of Parts

CAUTION

Do not loosen and/or move any part or subassembly under the cover of this instrument. To do so may require factory recalibration using special jigs and test fixtures.

5.3.1 General

It is obvious how to remove and replace all the parts listed in the parts list in Section VI except as explained below.

5.3.1.1 Removal and Replacement of Restrictor Orifice (Item 4, Figure 6-1) and Supply Air Filter (Item 3, Figure 6-1).

- a. Remove Plug (Item 1) and pull out felt Supply Air Filter (Item 3). The Restrictor Orifice (Item 4) can now be removed by inserting the proper size screwdriver into the slot on the restrictor and rotating counterclockwise.
- b. Replacement is the reverse of removal except take special care with restrictor since poor seating of this part will cause air leakage around it and make proper calibration impossible. Make certain the threads are clean before inserting into the base and screw the restrictor snugly against the aluminum base.

Section VI — PARTS LIST

6.1 General

Listed below are the parts and subassemblies that can be replaced without returning the instrument to the factory for repair.

Item No.	Description	Robertshaw Part No.	Used on Model No.
1.	Plug	38138-A1	All Models
2.	O-Ring (For Plug)	36240-N0010	All Models
3.	Filter	38111-B1	All Models
4.	Restrictor	38086-A1	All Models
5.	O-Ring (For Restrictor)	36240-N0006	All Models
6.	Cover	85756-A1	All Models
7.	O-Ring (For cover)	36240-N0157	All Models
8.	Capacitor (C1)	035KB147-04	443A/445A-A()-()
9.	Circuit Board (8 VDC Span)	85753-A1	443A/445A-E()-()
10.	Circuit Board (10 VDC Span)	85753-A2	443A/445A-F()-()

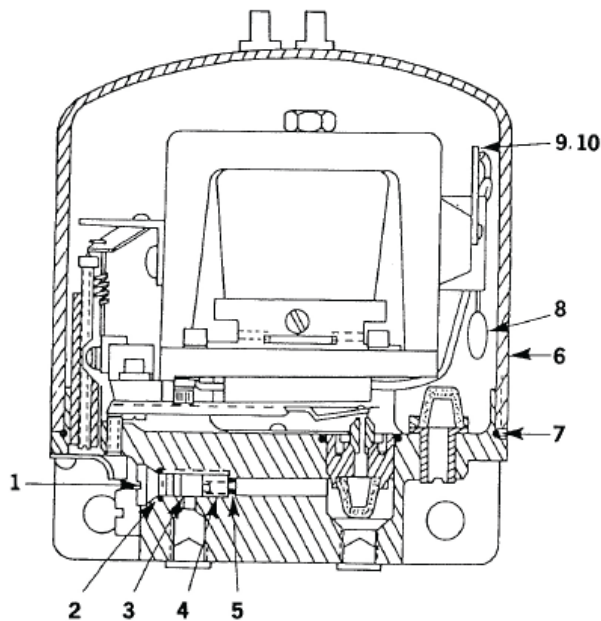


Figure 6-1. REPLACEMENT PARTS ILLUSTRATION



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