HAGAN 2-1/2 x 5 THRUST TYPE, SWIVEL MOUNTED PNEUMATIC POWER POSITIONER

Instruction Bulletin IB-102-202N Rev. 1

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HIGHLIGHTS OF CHANGES

Effective May, 1995 Rev. 1

PAGE	SUMMARY
3-0	Figure 3-1. Aded a callout regarding placement of positioner arm in relation to pilot valve.
3-1	Added paragraph 3-2. Mounting, regarding the correct positional relationship of the arm, calibration spring, and pilot valve.
6-1	Tables 6-1 and 6-2. Added "Maintenance Tool Kit" to both lists of recommended spare parts.

ROSEMOUNT WARRANTY

Rosemount warrants that the equipment manufactured and sold by it will, upon shipment, be free of defects in workmanship or material. Should any failure to conform to this warranty become apparent during a period of one year after the date of shipment, Rosemount shall, upon prompt written notice from the purchaser, correct such non-conformity by repair or replacement, F.O.B. factory of the defective part or parts. Correction in the manner provided above shall constitute a fulfillment of all liabilities of Rosemount with respect to the quality of the equipment.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES OF QUALITY WHETHER WRITTEN, ORAL, OR IMPLIED (INCLUDING ANY WARRANTY OF MERCHANTABILITY OF FITNESS FOR PURPOSE).

The remedy(ies) provided above shall be purchaser's sole remedy(ies) for any failure of Rosemount to comply with the warranty provisions, whether claims by the purchaser are based in contract or in tort (including negligence).

Rosemount does not warrant equipment against normal deterioration due to environment. Factors such as corrosive gases and solid particulates can be detrimental and can create the need for repair or replacement as part of normal wear and tear during the warranty period.

Equipment supplied by Rosemount Analytical Inc. but not manufactured by it, will be subject to the same warranty as is extended to Rosemount by the original manufacturer.

At the time of installation it is important that the required services are supplied to the system. Experience shows that systems installed and not supplied with services can be damaged either by the process or by the external environment and Rosemount will not accept any responsibility for this consequence.

PURPOSE

The purpose of this manual is to provide a comprehensive understanding of the Hagan 2-1/2 Inch x 5 Inch Power Positioner, components, functions, installation, and maintenance.

This manual is designed to provide information about the 2-1/2 x 5 standard and on/off type power positioners. We recommend that you thoroughly familiarize yourself with the Overview and Installation sections before installing your power positioner.

The overview presents the basic principles of the power positioner along with its performance, characteristics, and components. The remaining sections contain detailed procedures and information necessary for installation and servicing of the power positioner.

Before contacting Rosemount concerning any questions, first consult this manual. It describes most situations encountered in your equipment's operation and details necessary action.

DEFINITIONS

The following definitions apply to WARNINGS, CAUTIONS, and NOTES found throughout this publication.

WARNING

Highlights an operation or maintenance procedure, practice, condition, statement, etc., that if not strictly observed, could result in injury, death, or long-term health hazards of personnel.

CAUTION

Highlights an operation or maintenance procedure, practice, conditions, statement, etc., that if not strictly observed, could result in damage to or destruction of equipment, or loss of effectiveness.

NOTE

Highlights an essential operation procedure, condition, or statement.

NOTE TO USERS

The number in the lower right corner of each illustration in this publication is a manual illustration number. It is not a part number, and is not related to the illustration in any technical manner.

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SECTION I. OVERVIEW OF HAGAN 2-1/2 INCH X 5 INCH POWER POSITIONER

1-1. SCOPE. This manual gives information needed to install, operate, maintain and service all models of the Hagan 2-1/2 Inch x 5 Inch Thrust Type, Swivel Mounted Power Positioner.

1-2. PACKAGE CONTENTS. The power positioner comes completely assembled and carefully packaged to prevent damage in shipping. Inspect the packaging before removing the unit, and report any damage to the shipping agent.

Carefully pull the unit lengthwise out of the box. Find the packing list that is included in each shipment. Check the items received against the packing list to verify that the shipment is complete and correct. Make sure that the signal range stamped on the pilot valve is the one the packing list calls for. If a pivot base has been ordered, make sure it is attached to the unit. Check all items for damage.

1-3. EQUIPMENT DESCRIPTION.

a. Purpose. The Hagan Power Positioner is typically used to position the damper of a large volume boiler. To do this, the power positioner connects to a lever on the damper jackshaft. The jackshaft connects to the damper. When the power positioner moves, the lever moves the jackshaft, which moves the damper.

b. Operation. There are two types of power positioners available: the standard variable position pilot valve type, and the on/off standard option with a solenoid valve. Both use the same power components. In both types, power air pressure moves a piston in a cylinder. When air flow goes to the bottom of the cylinder the piston moves upward. When air flow goes to the top of the cylinder, the piston moves downward. As the piston travels, a clevis (attached to the piston rod) moves the damper lever.

The difference between the two positioner types is in the control power air system.

1. The Standard Power Positioner, Figure 1-1, uses a variable, low pressure control air circuit and a pilot valve assembly to control the single pressure power air. The higher the control air pressure, the farther the piston extends. With this type of equipment, boiler controls can move the power positioner to any point along its five inch stroke.

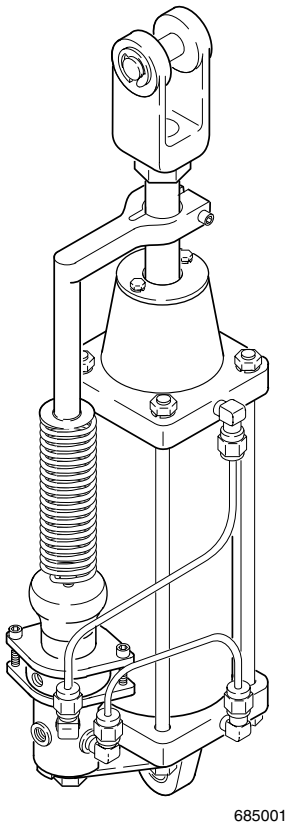


Figure 1-1. Standard 2-1/2 Inch x 5 Inch Power Positioner (Variable Position Pilot Valve Type)

2. The On/Off Standard Option, Figure 1-2, uses electrical signals and a solenoid valve to control power air. The piston stops travel only at fully extended or fully retracted positions. The power positioner stays in position until the solenoid valve is electrically shifted. This makes the on/off type the best choice in applications where the damper must stay in position during an electrical power failure.

See Section II, Theory of Operation, for detailed explanations of the operation of both power positioner models.

c. **Limit Switch Option.** Both the standard and on/off power positioners are available with limit switches. These limit switches signal the boiler control system when the power positioner is at the fully extended or fully retracted position. This option is available direct from the factory, or as a kit for field installation.

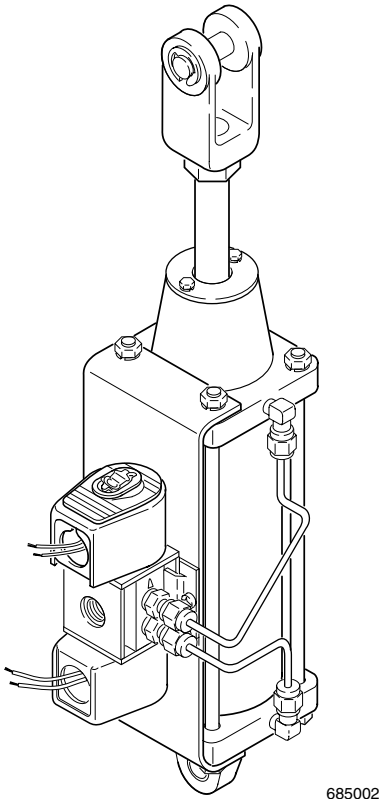


Figure 1-2. On/Off 2-1/2 Inch x 5 Inch Power Positioner (On/Off Standard Option, Solenoid Valve Type)

SECTION II. THEORY OF OPERATION

2-1. STANDARD UNIT.

a. General. Refer to Figure 2-1, Standard Power Positioner - Main Components. The piston assembly and power take-off clevis of the standard power positioner move away from the mounting pivot with an increase in control signal pressure. Movement of the piston, which is equipped with graphite impregnated teflon piston cups, begins when the increasing control signal at the pilot valve assembly causes the stainless steel stem to move downward from the neutral setting. The pilot valve assembly then directs power air through the bottom tubing assembly to the bottom of the aluminum cylinder and exhausts air at the other end of the cylinder to atmosphere. The resulting pressure difference across the piston moves it upward.

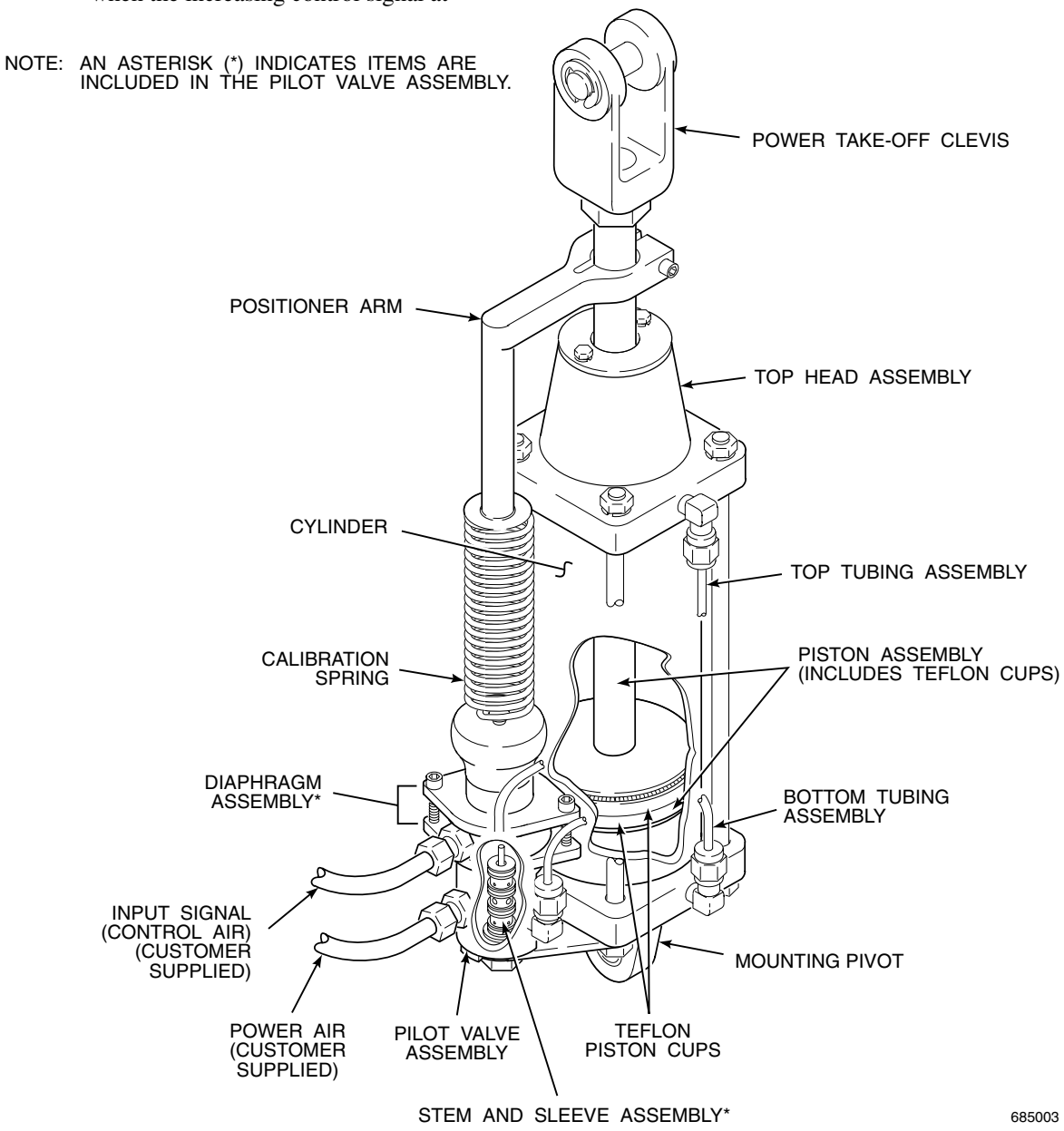


Figure 2-1. Standard Power Positioner - Main Components

As the piston moves upward, it raises the upper end of the calibration spring. Tension in the spring is the feedback force in the pilot valve assembly. Piston movement continues until the spring force equals the force from the control signal, restoring the pilot valve stem to the neutral position. This blocks the flow of power air to cylinder and prevents further piston movement until signal pressure changes again.

For each control signal pressure, the piston is at a particular distance from the bottom of the cylinder. At the minimum signal it is at the lowest point in the cylinder. At the maximum signal it is at the upper limit, a distance of 5 in. (127 mm) from the lowest point. At any other signal, the distance from the bottom of the cylinder is proportional to the signal pressure. Full stroke time is two seconds or less. Toggling of the piston rod at or near full stroke is prevented by the large area guide bearings which are set relatively far apart in the top head assembly. The guide bearings are made of sintered teflon.

b. **Pilot Valve.** The pilot valve is a force/balance device. The pilot valve makes use of an external calibration spring (connected to the positioner arm), an internal dual-diaphragm assembly, and a sleeve and stem assembly.

Pilot valve operation is determined by the interaction of two primary forces:

1. A downward force developed by the control signal as it acts upon the diaphragm assembly.

2. An upward force created by the tension of the calibration spring.

In operation, the pilot valve diaphragm assembly moves up or down and repositions the stem when the force of the calibration spring and the force due to the signal pressure are not in balance. Starting with the stem in the neutral position, an increase of the control signal pressure causes a downward movement of the pilot valve diaphragm assembly. This forces the stem downward, uncovering ports in a stainless sleeve which permit power air to flow into the lower end of the cylinder and the air in the upper end to exhaust to atmosphere. The piston moves upward, pulling on the calibration spring. Tension in this spring increases until it balances the force due to the control signal acting in the diaphragm assembly. The stem then returns to the neutral position and blocks the ports in the sleeve, preventing further movement of the piston.

With a decrease in control signal pressure, the opposite actions occur. In this case, the force due to the control signal becomes less than the force of the calibration spring. The spring then pulls the spring post and stem seat upward. The stem is pushed upward by the spring in the pilot valve assembly and uncovers ports which transmit power air from the pilot valve to the top of the cylinder and exhaust the bottom of the cylinder. The piston then moves downward, reducing the tension in the calibration spring until it balances the force due to the lower control signal. The pilot valve assembly stem will then be in the neutral position again and prevent further movement of the piston.

2-2. ON/OFF STANDARD OPTION.

a. **General.** On/off type power positioners, Figure 2-2, use the same cylinder and piston assembly as the standard type positioner. The on/off type, however, uses an electric solenoid assembly in place of a pneumatic pilot valve.

The solenoid assembly allows pressurized air to enter one end of the cylinder, while exhausting air from the opposite end to atmosphere. During operation, air pressure builds on one side of the piston, forcing the piston to move toward the low pressure side. Air from the low pressure side simultaneously exhausts through a fitting on the solenoid valve body.

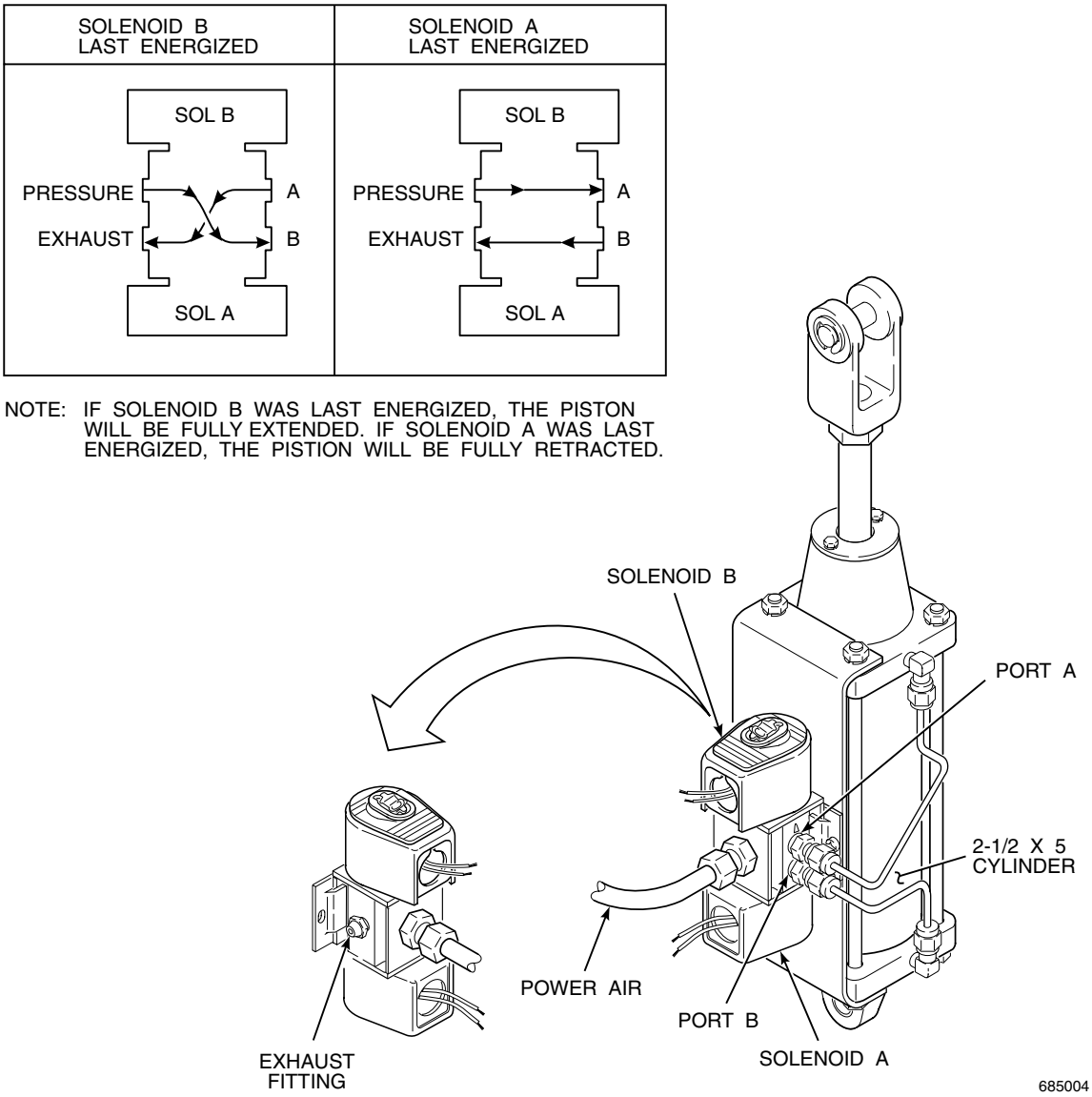


Figure 2-2. On/Off Power Positioner

b. **<u>On/Off Solenoid Valve</u>.** A solenoid operated, on/off valve controls air flow in the on/off standard option to the Rosemount power positioner. This system uses electrical impulses instead of pilot air pressure to control main air flow. There are only two positions for this type of equipment: piston fully out, and piston fully in. Once in a position, the piston stays in that position until the opposite solenoid is actuated. This means that if power fails, the piston stays in the same position. This feature makes the on/off type of valve the best choice in a system in which the damper must stay in place if power fails.

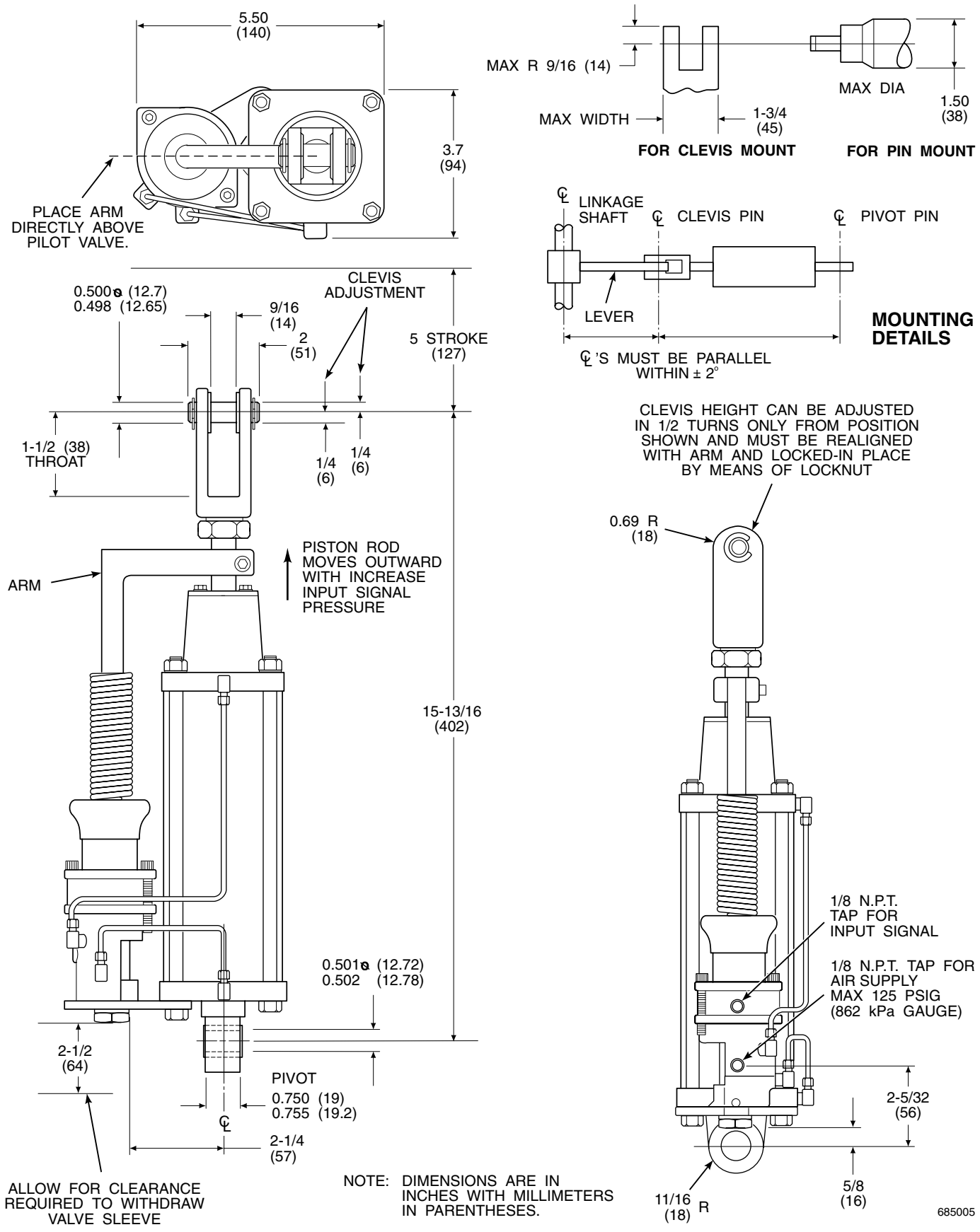


Figure 3-1. Installation Dimensions

SECTION III. INSTALLATION AND ADJUSTMENTS

3-1. **LOCATION.** The positioner should be located in a clean, dry area free of excessive shock and vibration, with a continuous ambient temperature between 0° and 170°F (-18° and 77°C). It should be easily accessible for servicing.

3-2. **MOUNTING.** Before installation, carefully note the clearance dimensions and other mounting information shown in Figure 3-1. As shown in this figure, the positioner may be either clevis or pin mounted.

The positioner may be installed in any direction: vertical, horizontal, or inverted, whichever is most convenient. The mounting pivot base assembly (P/N 371763) is shown in Figure 3-2.

The power take-off clevis (Figure 3-1) should be properly aligned in relation to the axis of the mounting pivot. The center lines of the mounting pivot pin, linkage clevis pin, and linkage shaft must be parallel within two degrees.

Ensure that the arm anchoring the top of the large calibration spring is placed directly above the pilot valve, and that the spring is not twisted in such a way that will allow the pilot valve stem to rub on the sides of the casting.

3-3. **AIR CONNECTIONS.**

a. **Standard Units.** Connect air to the pilot valve assembly. Control signal and power air connections, located in the pilot valve assembly, are 1/8 in. NPT taps. Refer to Figure 3-1. On the pilot valve the upper tap is for the input signal and the lower one is for the air supply. Copper tubing with 1/4 in. (6.35 mm) OD and 0.035 in. (0.89 mm) wall thickness is best. Note that the entire power positioner assembly moves when the piston extends. To keep this movement from stressing the copper air lines, coil each air line three turns near the unit.

A shutoff valve and air filter should be provided in the air supply line. The shutoff valve is necessary to isolate the positioner when servicing it. Recommended air supply pressure is 100 psi (689 kPa). Maximum air supply pressure is 125 psi (862 kPa). Minimum air supply pressure is 45 psi (310 kPa).

b. **On/Off Units.** Connect power air to the 0.25 in. NPT air tap on the valve body as shown in Figure 2-2. Copper tubing with a 1/4 in. OD and 0.035 in. wall thickness is best. Note that the entire power positioner assembly moves when the piston extends. To keep this movement from stressing the copper air line, coil three turns of the line near the unit.

A shutoff valve and air filter should be provided in the air supply line. The shutoff valve is necessary to isolate the positioner when servicing it. Recommended air supply pressure is 100 psi (689 kPa). Maximum air supply pressure is 125 psi (862 kPa).

3-4. **WIRING.** All wiring must comply with local and national electrical codes. Connections are designed for 0.50 in. conduit. Since the entire power positioner moves when the piston extends, use flexible conduit for all wiring. If the unit is likely to get wet, use liquid tight flexible conduit.

a. **Standard Units.** Wiring is not necessary on a standard unit with no limit switches.

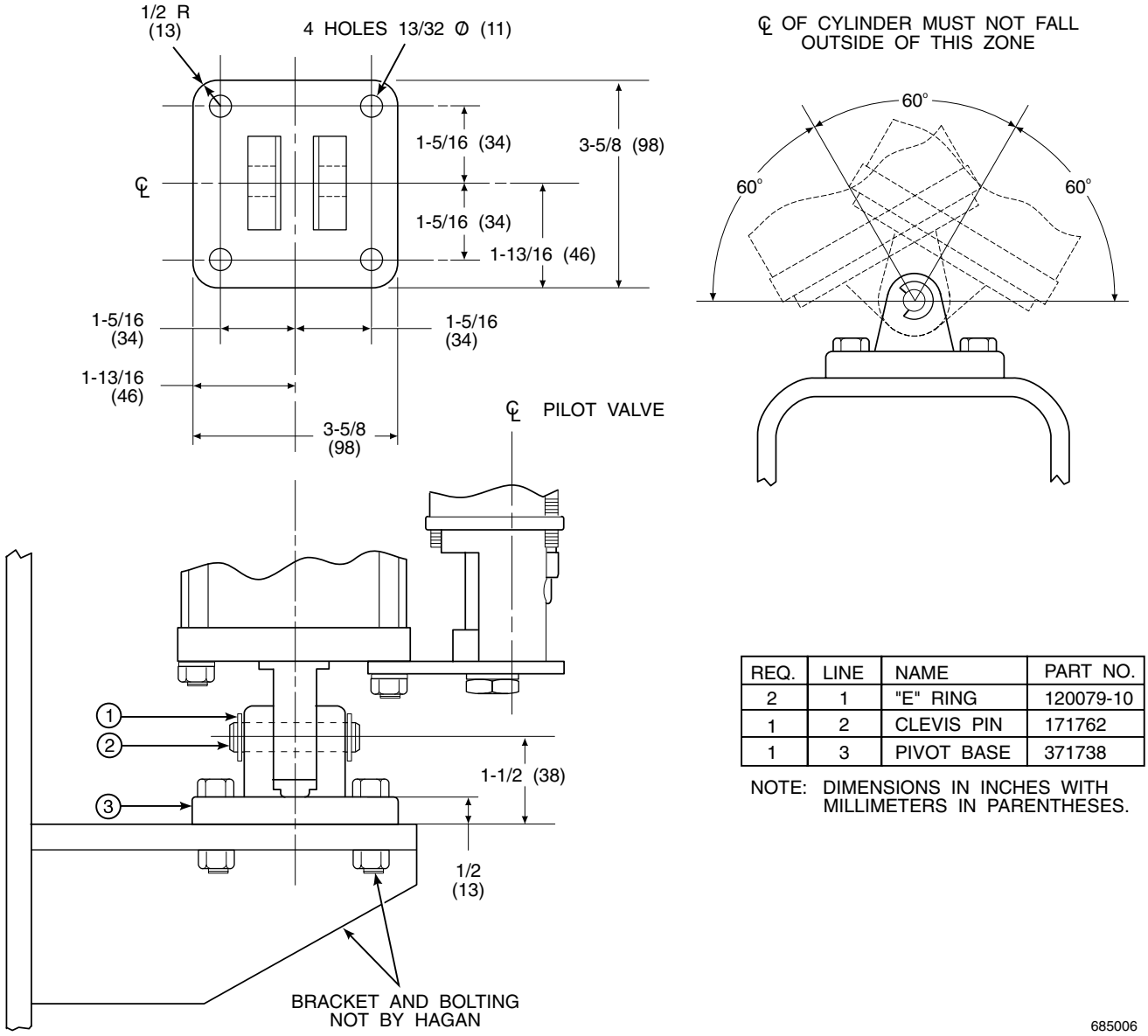
WARNING

Be careful when removing the retaining clip to wire the solenoid valve. The retaining clip will spring upward when it disengages. This could cause injury.

CAUTION

Make sure that the solenoids and the electrical source are the same type. AC and DC solenoids are different internally and will be damaged by the wrong electrical current.

b. **On/Off Units.** Remove metal retaining clip (1, Figure 5-2) and rotate solenoid backplate (8) to the necessary position. Make the wiring connections necessary for the control system. Then replace the housing and nameplate and reinstall the retaining clip.



REQ.	LINE	NAME	PART NO.
2	1	"E" RING	120079-10
1	2	CLEVIS PIN	171762
1	3	PIVOT BASE	371738

NOTE: DIMENSIONS IN INCHES WITH MILLIMETERS IN PARENTHESES.

Figure 3-2. Mounting Pivot Base Assembly (Part No. 371763)

c. **Limit Switches.** To wire limit switches on either type of unit, remove the cover plate that is held by two screws, and wire the limit switches to the system controls as necessary.

3-5. **ADJUSTMENT OF STANDARD UNITS.** The standard power positioner must be adjusted so the piston is at the lower limit when the control signal is at minimum pressure, and moves to the upper limit when the signal is increased to maximum pressure.

Refer to Figure 3-3 and use the following procedure to make the adjustment:

a. Disconnect the mechanical linkage from the clevis.

b. With the control (input) signal and power air supply lines disconnected from the pilot valve, clean the lines with high pressure air.

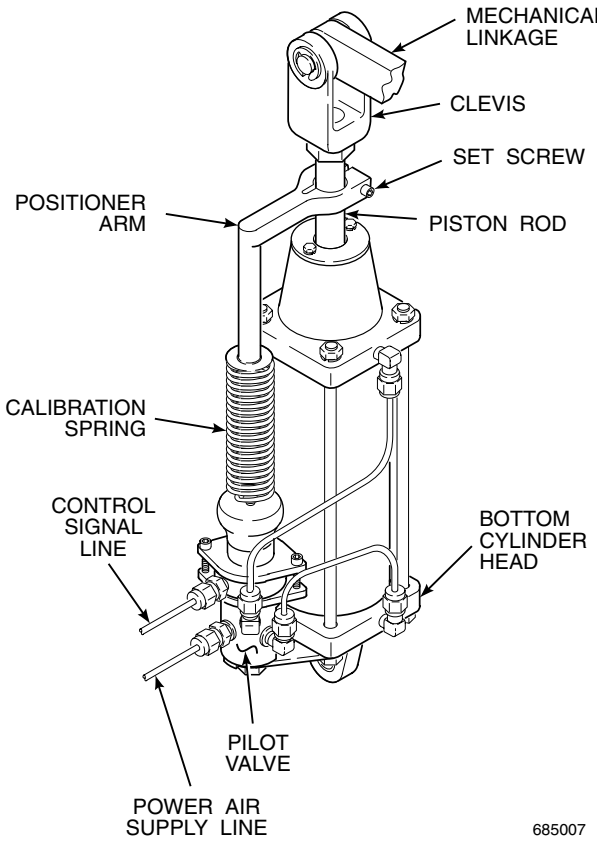


Figure 3-3. Standard Unit Adjustment

c. Open the air supply filter drain and blow out accumulated moisture and foreign particles.

d. Reconnect the control signal and power air supply lines. Adjust power air supply pressure to desired value.

e. Apply minimum control signal to the pilot valve. The piston should move to the lowest position, against bottom cylinder head. Check this in the following manner:

1. Maintain minimum control signal on the pilot valve.
2. Loosen the set screw on the positioner arm.
3. Move the positioner arm up until the piston moves to the bottom of the cylinder.
4. Move the positioner arm down until the piston begins to move upward.
5. Move the positioner arm down until the piston just returns to lowest position.
6. Lock this setting by tightening the set screw until the positioner arm binds to the piston rod.

f. With the piston at the bottom of the cylinder, place a mark on either the clevis or the 1/2-in. diameter chrome plated piston rod. The mark is for use in measuring the piston stroke. If the stroke is not correct, increase or decrease the number of active coils in the calibration spring. Active coils are those which are free of the positioner arm and which flex when under load.

Determine stroke by increasing control signal pressure slowly and observing travel of the mark (discussed in preceding paragraph).

1. If the piston moves to upper limit before the control signal reaches maximum pressure, the number of active coils must be decreased as described in step g.
2. If piston travel is less than desired when maximum signal is applied, the number of active coils must be increased as described in step h. Maximum travel is approximately 5 in. (127 mm).
3. If piston stroke is satisfactory, perform steps i, j and k.

g. To decrease the number of active coils, use the following procedure:

1. Reduce control signal to zero.
2. Count the active coils of calibration spring. Active coils are those which are free of the positioner arm and which flex when under load.
3. Determine the exact control signal pressure at which the piston reaches upper limit.
4. Determine the number of active coils required by using the following equation:

$$\frac{Pa}{Pm} \times Ca = \text{Number of active coils required}$$

Where:

Pa = Signal pressure at which piston reaches upper limit
Pm = Maximum control signal pressure to be used
Ca = Actual number of active coils

5. Reduce active coils to the number required by turning the calibration spring further onto the positioner arm.

6. Repeat step f to check the stroke again.

h. To increase the number of active coils, use the following procedure:

1. Reduce control signal to zero.

2. Count active coils of calibration spring. Active coils are those which are free of the positioner arm and which flex when under load.

3. Determine exact piston stroke by measuring amount of travel of the mark (on piston rod or clevis) when control signal is increased from zero to maximum pressure.

4. Determine the number of active coils required by using the following equation:

$$\frac{Sr}{Sa} \times Ca = \text{Number of active coils required}$$

Where:

Sa = Actual stroke
Sr = Required stroke
Ca = Actual number of active coils

5. Increase the number of active coils by turning spring off of the positioner arm.

6. Repeat step f to see if desired stroke is obtained.

i. Repeat step c to check minimum setting again.

j. Check mechanical linkage between the positioner and the damper or valve that the positioner positions. All links must be properly aligned.

k. Reconnect mechanical linkage to clevis.

3-6. ADJUSTMENT OF ON/OFF UNITS. There is no adjustment of on/off units.

3-7. ADJUSTMENT OF OPTIONAL LIMIT SWITCHES. Refer to Figure 3-4. Adjust the upper limit switch so the switch striker activates the switch when the piston reaches its fully extended limit. Adjust the lower limit switch so the striker activates the switch when the piston reaches its fully retracted limit. Adjust the switches as follows:

a. Observe the limit switches while running the power positioner. Each switch should activate just as the piston reaches its mechanical limit, and switch off as the piston begins to move in the other direction.

b. To adjust a limit switch, loosen the switch mounting screws to allow the switch assembly to slide on its bracket. Slide switch assembly as necessary, then retighten the screws. Watch the switch again while running the positioner. Readjust as necessary.

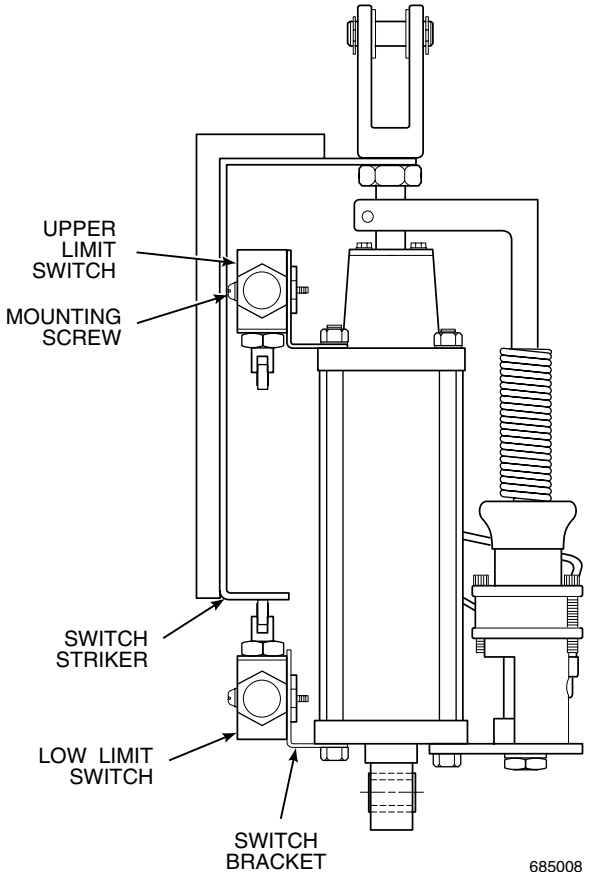


Figure 3-4. Limit Switch Option

SECTION IV. TROUBLESHOOTING

4-1. TROUBLESHOOTING STANDARD UNITS. The four most common causes of poor operation of the standard power positioner are listed below. Check if any of these conditions exist and make corrections, if necessary, before starting any repairs. If none of these conditions apply, Refer to Table 4-1, Standard Unit Troubleshooting.

a. Air supply pressure is below normal. Check for the following conditions:

1. Complete loss of air supply or less than normal air supply pressure.
2. Air supply to the positioner shut off at a valve or cut off due to a change or break in the piping.
3. Pressure reducing valves in the system incorrectly adjusted.
4. Air filters restricting flow due to dirty elements. Blow down all filters.

b. Plugged signal or air supply line. Check that all lines are clean. Clear out any foreign material which may be blocking them.

c. Leaks in signal lines, air supply lines and tubing assemblies. Go over each joint and connection in these lines with soap suds to check for air leaks. Stop any leaks found.

d. Excessive friction at mounting pivot, clevis and associated mechanical linkage. Check that these points are well oiled, not binding, or otherwise inhibited.

Table 4-1. Standard Unit Troubleshooting.

NOTE
Unless otherwise indicated, item numbers are in reference to Figure 4-1.

SYMPTOM	CAUSE	SOLUTION
1. Erratic operation along with one of the following:		
a. Piston moves in a jerky manner.	a. Sticky material on inside of cylinder wall.	a. Clean cylinder walls.
b. Piston fails to move to desired position quickly when signal changes.	b. Stem (15, Figure 5-1) sticking due to gummy deposits.	b. Clean stem and sleeve.
c. Power air [100 psi (689 kPa)] continuously blowing through exhaust ports of pilot valve assembly.	c. Stem (15, Figure 5-1) excessively worn.	c. Replace stem and sleeve.

Table 4-1. Standard Unit Troubleshooting (Continued).

NOTE
Unless otherwise indicated, item numbers are in reference to Figure 4-1.

SYMPTOM	CAUSE	SOLUTION
2. Piston does not move full stroke when maximum signal is applied and one of the following symptoms is present:		
a. No other symptoms.	a. Too few active coils in calibration spring (8).	a. Increase number of active coils in spring (8). Refer to paragraph 3.5.h.
b. Signal air [15, 30, or 60 psi (103, 207, or 414 kPa)] continuously leaking from exhaust ports of pilot valve assembly (27).	b. Broken diaphragm in pilot valve assembly.	b. Replace broken diaphragm.
c. Power air [100 psi (689 kPa)] blowing continuously through exhaust ports of pilot valve assembly (27).	c. Piston cups (22) worn.	c. Replace both piston cups.
3. Piston does not return to bottom of cylinder when signal is zero and one of the following symptoms is present:		
a. No other symptoms.	a. Positioner requires adjustment.	a. Perform Adjustments of Standard Units, paragraph 3-5.
b. Power air leaking past piston rod (5) at seal retainer (11).	b. Piston rod seal (12) worn.	b. Replace piston rod seal.
c. Power air continuously blowing out of exhaust ports of pilot valve assembly (27).	c. Piston cups (22) worn.	c. Replace both piston cups.

4-2. <u>TROUBLESHOOTING ON/OFF UNITS</u>. Refer to Table 4-2, On/Off Unit Troubleshooting, for a listing of possible symptoms, causes and solutions for problems with an on/off type power positioner. Cylinder and piston assembly parts are identical to those of the standard unit (Figure 4-1).

Table 4-2. On/Off Unit Troubleshooting.

NOTE

Unless otherwise indicated, item numbers are in reference to Figure 5-2.

SYMPTOM	CAUSE	SOLUTION
1. Erratic operation along with one of the following:		
a. Piston moves in a jerky manner.	a. Sticky material on inside of cylinder wall.	a. Clean cylinder walls.
b. Piston fails to move to desired position quickly when solenoid changes.	b. Core subassembly (12) sticking due to gummy deposits.	b. Clean core subassembly.
c. Power air [100 psi (689 kPa)] continuously blowing through exhaust ports of solenoid valve assembly.	c. Valve (18) or piston cups (22, Figure 4-1) excessively worn.	c. Replace worn components.
2. Piston does not move full stroke when solenoid is energized and one of the following symptoms is present:		
a. No other symptoms.	a. Open or burned out coil (6) in solenoid. Faulty control circuit.	a. Check continuity of coil. Replace if necessary. Energize solenoid; listen for metallic click. No click means no voltage.
b. Excessive leakage at solenoid valve.	b. Worn or damaged parts in solenoid valve assembly.	b. Replace solenoid valve assembly.
3. Piston does not return to bottom of cylinder when opposite solenoid is energized.	a. Open or burned out coil (6) in solenoid. Faulty control circuit.	a. Check continuity of coil. Replace if necessary. Energize solenoid. Listen for metallic click. No click means no voltage.

NOTE

Replacement parts for the solenoid valve assembly are available from ASCO Valves at the following address:

ASCO Valves
Automatic Switch Co.
Florham Park, NJ 07932

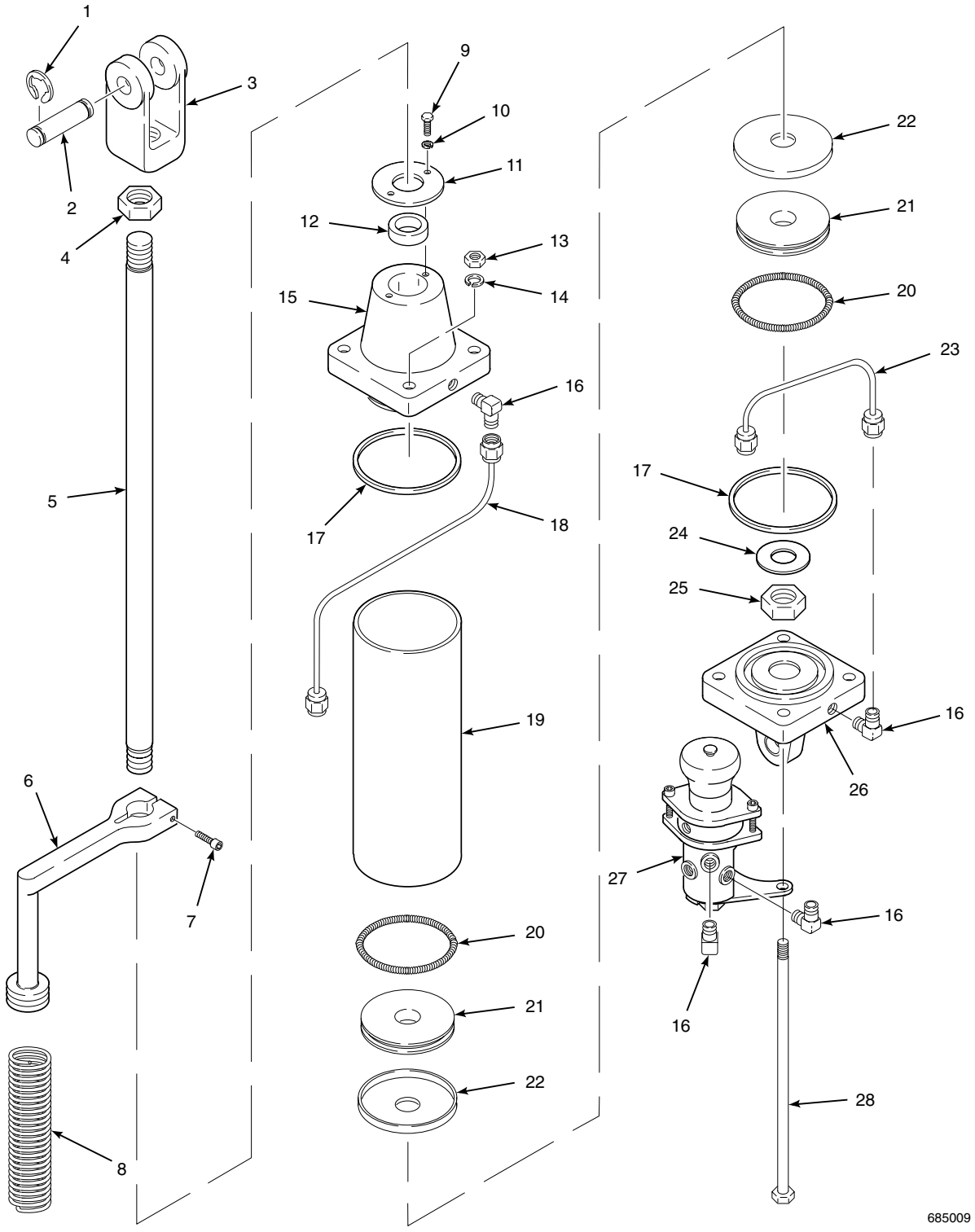
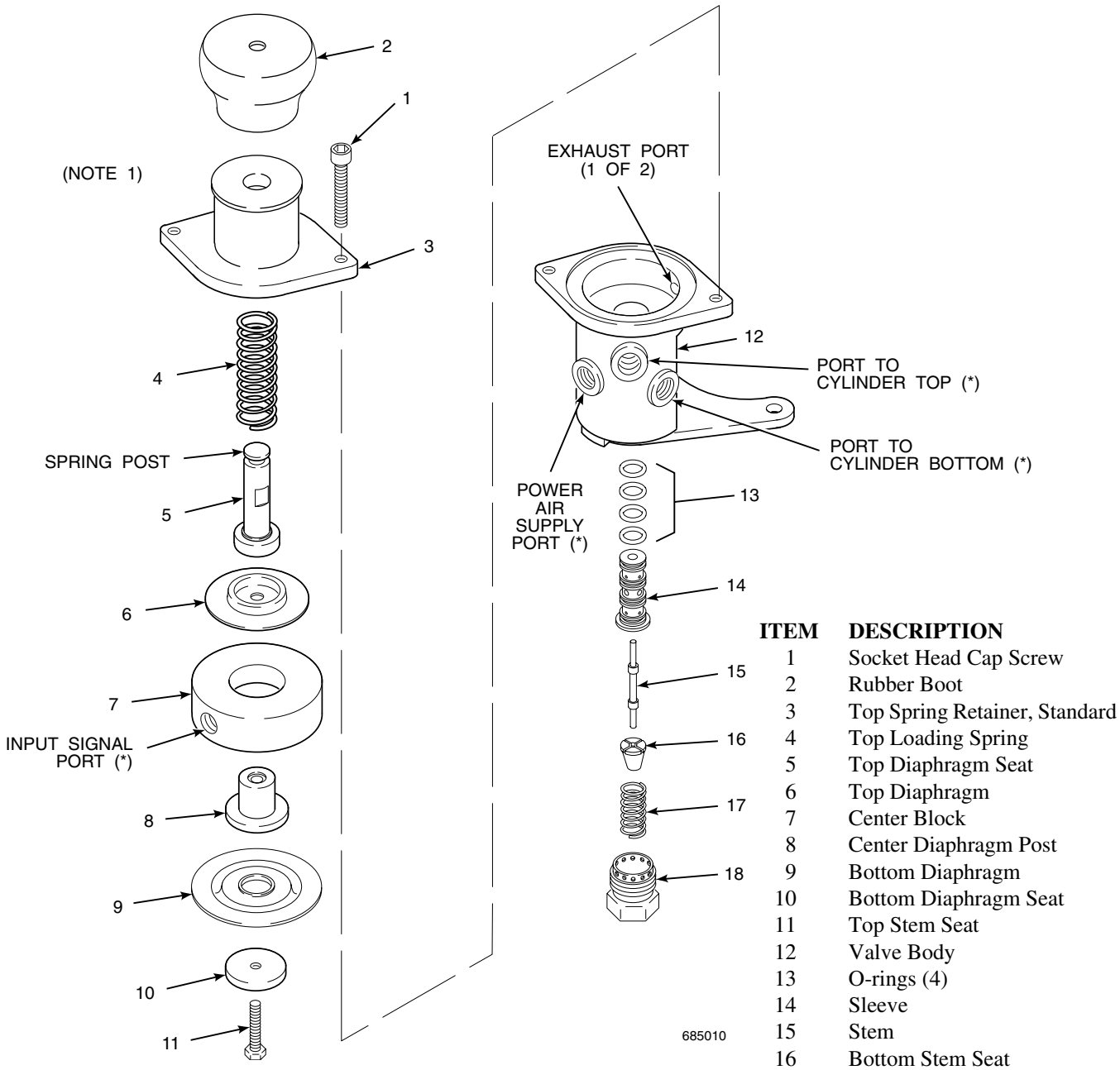


Figure 4-1. Standard Unit, Exploded View

LEGEND FOR FIGURE 4-1

ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	Retaining Ring	15	Top Head Assembly
2	Clevis Pin	16	Elbow Fitting
3	Clevis	17	Cylinder Head Gasket
4	Hex Nut	18	Top Tubing
5	Piston Rod	19	Cylinder
6	Positioner Arm	20	Garter Spring
7	Socket Head Cap Screw	21	Piston Cup Follower
8	Calibration Spring	22	Piston Cup
9	Cap Screw	23	Bottom Tubing
10	Lock Washer	24	Washer
11	Seal Retainer	25	Elastic Stop Nut
12	Seal	26	Bottom Cylinder Head
13	Hex Nut	27	Pilot Valve Assembly
14	Lock Washer	28	Tie-Rod



ITEM	DESCRIPTION
1	Socket Head Cap Screw
2	Rubber Boot
3	Top Spring Retainer, Standard
4	Top Loading Spring
5	Top Diaphragm Seat
6	Top Diaphragm
7	Center Block
8	Center Diaphragm Post
9	Bottom Diaphragm
10	Bottom Diaphragm Seat
11	Top Stem Seat
12	Valve Body
13	O-rings (4)
14	Sleeve
15	Stem
16	Bottom Stem Seat
17	Bottom Loading Spring
18	Sleeve Retainer

NOTE 1: 2-1/2 X 5 POWER POSITIONERS USING AN EPT REQUIRE A MODIFIED TOP SPRING RETAINER AND A TOP DIAPHRAGM COVER IN PLACE OF ITEM (3). IN THE STANDARD PILOT VALVE ASSEMBLY A TOP DIAPHRAGM COVER IS NOT USED.

NOTE 2: AN ASTERISK (*) INDICATES A 1/8 NPT TAPPED PORT.

NOTE 3: NOT ALL ITEMS IDENTIFIED ARE AVAILABLE FOR INDIVIDUAL SALE. SEE SECTION VI, REPLACEMENT PARTS, FOR A LIST OF AVAILABLE PARTS.

Figure 5-1. Pilot Valve Assembly - Exploded View

SECTION V. SERVICE AND NORMAL MAINTENANCE

5-1. SCHEDULED MAINTENANCE OF STANDARD UNITS. Design and construction of the standard power positioner greatly reduces routine maintenance. Only the following components need routine maintenance:

a. Air Supply. Drain the air line moisture trap daily. Clean or replace the air filter as necessary, depending on humidity, dust, and filter manufacturer's specifications.

b. Linkage Components. Lubricate clevis pin (2, Figure 4-1), customer-supplied mount pin, and linkage between the positioner and the component it controls every six months. Use a few drops of light oil.

c. Sleeve and Stem. For normal operating conditions in which a clean and dry supply of compressed air is used, the pilot valve sleeve and stem require inspection and cleaning every six months.

The same procedure is necessary if the stem is sticking. A sticking stem is indicated when the piston fails to move quickly to the required position during control signal changes. A worn stem must also be replaced. It is indicated by power air continuously blowing through the exhaust ports in the pilot valve body. Refer to Figure 5-1.

To clean and inspect the pilot valve, use the following procedure:

1. Shut off power air supply to pilot valve assembly.

2. Reduce control signal to zero.

NOTE

Many parts are small and may be easily lost or misplaced.

3. Unscrew sleeve retainer (18, Figure 5-1). Remove bottom loading spring (17) and bottom stem seat (16). Be careful not to lose stem, bottom stem seat and bottom loading spring.

4. Allow the stem to fall from pilot valve assembly on its own. Be careful that it does not fall on a hard surface. If stem will not fall out on its own, remove sleeve and stem as an assembly. The two can be separated on a bench without much danger of bending the stem.

5. Wash stem and sleeve with clean solvent. Do not use any abrasive or sharp edged tools. Dry sleeve with compressed air and wipe off stem with a clean lint free cloth.

6. Check stem for straightness by rolling it on a flat surface. If not perfectly straight, replace the stem and the sleeve.

7. Insert stem into bore of sleeve. (Since stem is symmetrical, it may be installed with either end up.)

8. Check stem in bore of sleeve. Stem must fall freely through sleeve by its own weight (when both stem and sleeve are dry, clean, and free of oil).

NOTE

Stem and sleeve must be replaced as a complete assembly if stem is bent or if either is worn.

9. Check that O-rings (13) on sleeve (14) are in good condition. Install new ones if necessary.

10. Install sleeve in pilot valve assembly.

11. Insert stem in sleeve and replace pilot valve bottom stem seat (16), bottom loading spring (17), and sleeve retainer (18). Turn sleeve retainer in until it hits bottom of sleeve and holds it firmly in place.

12. Turn on air supply pressure and reapply control signal. Power positioner is then ready for operation.

5-2. SCHEDULED MAINTENANCE OF ON/OFF UNITS. The on/off type power positioner requires very little maintenance. Only the following three components need scheduled maintenance:

a. Air Supply. Drain air line moisture trap daily. Clean or replace the air filter as necessary, depending on humidity, dust, and filter manufacturer's specifications.

b. Linkage Components. Lubricate clevis pin (2, Figure 4-1), mount pin and linkage between the positioner and the component it controls every six months. Use a few drops of light oil.

c. Solenoid Valve. If the air supply is clean and dry, inspect and clean solenoid valve (18, Figure 5-2) every six months, or if leaky, noisy or sluggish. To do this, follow this procedure:

1. Depressurize valve (18) and turn off electrical supply. Disconnect piping if that makes access to the valve easier.

> **WARNING**
>
> Be careful when removing retaining clip. It is spring loaded and will spring upward when released. This could injure personnel.

2. Prevent retaining clip (1) from springing away. Remove the retaining clip from each side of the valve. Then remove each entire assembled solenoid enclosure (items 3 through 8) from the solenoid base subassembly.

3. Disassemble each solenoid by removing bonnet screws (22), bonnet plates (9 and 23), solenoid base subassembly (11), and body gasket (17).

4. Slide core subassembly (12) toward cylinder port B side of valve body. Remove detent (19) and detent washer (20) from core subassembly. Remove core subassembly through cylinder port A side of valve body.

5. Remove discs (13), sleeve (14), and quad ring gasket (15) from core subassembly.

6. Inspect all parts. Replace solenoid valve assembly if worn or damaged.

7. Clean metallic parts with solvent and a stiff non-metallic brush. Do not scratch parts or remove any material.

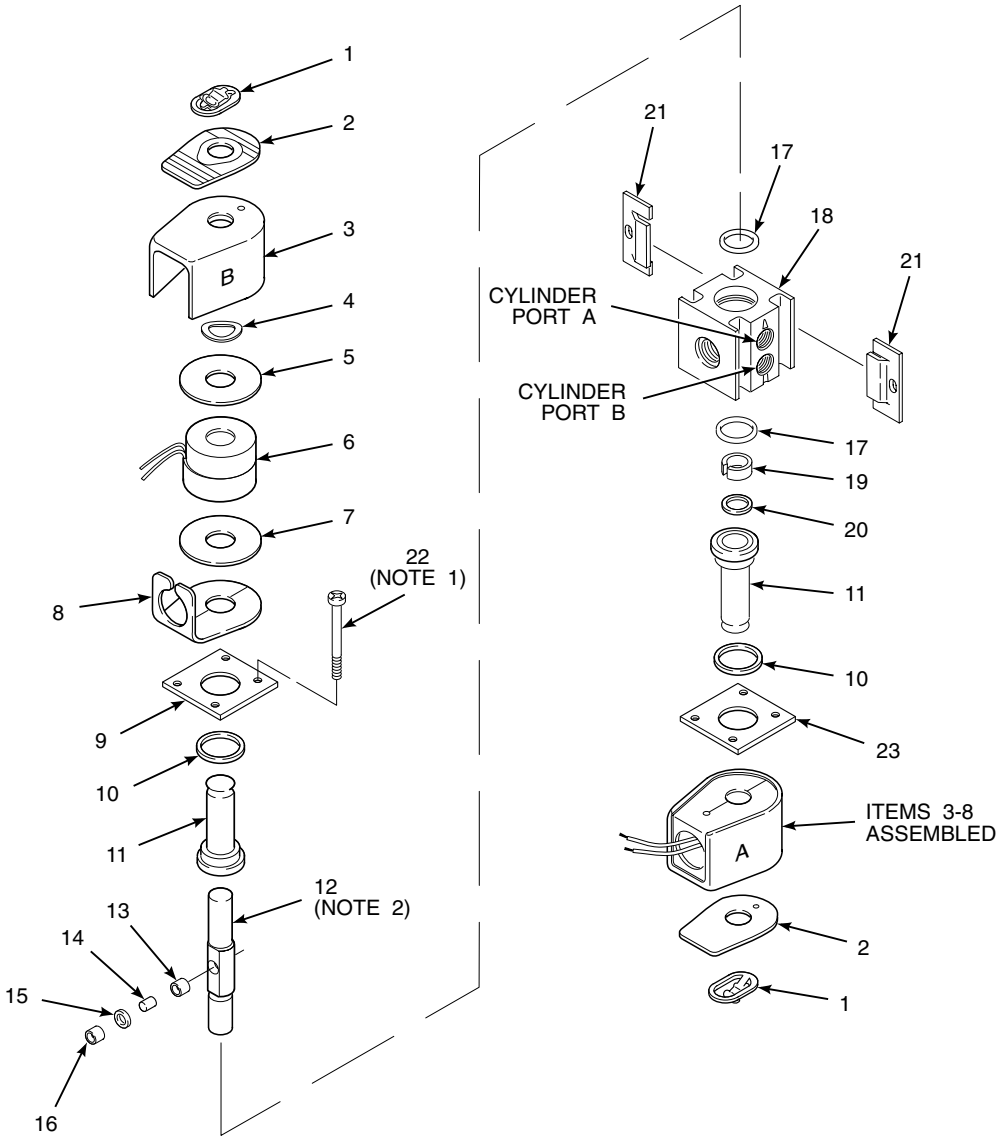
8. Reinstall discs (13), sleeve (14), and quad ring gasket (15) in core subassembly (12).

9. Lubricate inside walls of valve body and solenoid base subassemblies with high grade silicone grease. Carefully observing notes on Figure 5-2, slide core subassembly into cylinder port A side of valve body.

10. Push core subassembly far enough toward cylinder port B side to install detent (19) and detent washer (20). Then install each body gasket (17), solenoid base subassembly (11), upper bonnet plate (9), lower bonnet plate (23) and bonnet screws (22).

11. Reinstall both assembled solenoid enclosures (items 3 through 8). Put on nameplates (2) and secure each assembly with a retaining ring (1).

12. Operate the valve a few times to make sure it is working properly before returning power positioner to service.



NOTE 1: TORQUE TO 20T O 25 IN-LBS (2 TO 3 N•M).

NOTE 2: GROOVED END OF ITEM (12) MUST FACE SOLENOID "A" WITH DETENT. ITEM (12) MUST BE INSERTED FROM PORT A-SIDE OF ITEM (18). THE PASSAGEWAY IN ITEM (12) MUST BE ORIENTED WITH THE PORTS OF ITEM (18).

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ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	Retaining Clip	8	Baseplate	17	Body Gasket
2	Nameplate	9	Upper Bonnet Plate	18	Valve Body
3	Housing	10	Washer	19	Detent
4	Spring Washer	11	Solenoid Base Subassembly	20	Detent Washer
5	Insulating Washer (Not on all units)	12	Core Subassembly	21	Mounting Bracket
		13	Disc	22	Bonnet Screw
6	Coil	14	Sleeve	23	Lower Bonnet Plate
7	Insulating Washer (Not on all units)	15	Quad Ring Gasket		
		16	Disc		

Figure 5-2. Solenoid Valve Assembly - Exploded View

5-3. REPAIRS TO CONTROL SYSTEM.

a. Replacement of Pilot Valve Diaphragms. Refer to Figure 5-1. Diaphragms (6 and 9) in the pilot valve assembly must be replaced if they are soft and spongy, hard and brittle, or broken. A broken diaphragm shows up as erratic operation of the power positioner with the piston not moving to the upper limit when the maximum signal is applied to the pilot valve. If the break is large, considerable signal air will be noticed continuously leaking from the pilot valve assembly.

Use the following procedure when inspecting and replacing diaphragms.

1. Shut off air supply.
2. Reduce control (input) signal to positioner to zero and disconnect input signal line at pilot valve assembly.
3. Disconnect calibration spring from top diaphragm seat spring post (5, Figure 5-1).
4. Remove socket head cap screws (1). Remove items (2) through (11) as an assembled unit.

NOTE

Top stem seat (11) unthreads from top diaphragm seat (5), allowing both diaphragms (6 and 9) to be removed.

5. Remove top stem seat (11).

CAUTION

Excessive clamping pressure produced by exceeding torque valve will damage diaphragms. Do not exceed specified torque valves.

6. Replace diaphragms if broken, hard and brittle, or soft and spongy. Reassemble diaphragm assembly with Loctite™ sealant on threads of top stem seat (11). Torque assembly to 1 to 1-1/2 ft-lbs (1 to 2 N•m).
7. Reassemble items (1) through (11) to valve body (12). Only tighten screws (1) by hand at this time.
8. Apply and maintain 10 psi (69 kPa) air pressure between diaphragms through signal input port.
9. Turn screws (1) alternately and in stops to a torque of 2 ft-lbs (3 N•m).
10. Remove input signal air pressure.
11. Turn screws (11) alternately and in steps to a torque of 4 ft-lbs (5 N•m).
12. Connect the calibration spring to spring post.
13. Remove the 10 psi (69 kPa) line and reconnect the control signal line to pilot valve assembly. Turn on air supply pressure. Power positioner is then ready for operation.

b. Repairs To On/Off Control System. There are no repairs authorized on the on/off control system other than cleaning the solenoid valve (paragraph 5-2c).

5-4. REPAIRS TO CYLINDER ASSEMBLY (Standard and On/Off).

a. Replacement of Piston Rod Seal. Refer to Figure 4-1. Excessive air leakage from the top head assembly (15, Figure 4-1) past the piston rod (5) indicates that the silicone seal (12) is worn and must be replaced. The instructions below apply to both standard and on/off type units. Where there is a difference between the units, be sure to follow instructions for the specific unit used. To replace piston rod seal proceed as follows:

1. Move piston to bottom of cylinder by either reducing control signal to zero (standard units) or actuating solenoid A. Then shut off air supply.
2. Disconnect linkage at clevis (3, Figure 4-1).
3. On standard units only, mark the location of positioner arm (6) on piston rod (5). Disconnect lower end of calibration spring (8) from pilot valve spring post.

4. On standard units, loosen clamping screw (7) in arm (6).

5. Hold clevis and loosen locknut (4) with a wrench. Unscrew clevis and locknut, and remove the arm from the piston rod.

6. Unscrew cap screws (9), and remove lockwasher (17), and seal retainer (11) to expose seal (12).

7. In order to ease removal of seal, place one layer of plastic electrical-type tape over piston rod threads. Start tape at outer end of piston rod and overlap it with raised edges facing the same direction the seal is to be removed. The tape should also be lubricated with a coating of McLube™ MOS_2-200 grease.

8. Slip seal off piston rod.

9. Before installing new seal, remove tape installed in step 7. Retape threads in opposite direction. Tape should be overlapped, with raised, sharp edges facing downward so that they will not scratch seal as it is pulled down piston rod. Tape should also be lubricated with a light coating of McLube™ MOS_2-200 grease.

10. Install a new seal after lubricating it with McLube™ MOS_2-200 grease.

11. Reassemble power positioner, using preceding steps in reverse order. Clevis and arm must be properly aligned and located. Use the mark made in step 3 when reassembling arm (6) on standard units.

12. After reassembling unit, perform steps in paragraph 3-5, Adjustment of Standard Units. The positioner will then be ready for operation.

b. **<u>Replacement of Piston Cups.</u>** If the piston moves in a jerky manner, it is usually an indication of an accumulation of sticky material on the inside walls of the cylinder (19, Figure 4-1). For the positioner to operate properly, the cylinder walls must be clean.

If graphite impregnated teflon piston cups (22) wear to the extent that air leaks past the piston, they should be replaced. This is indicated by power air blowing continuously through the exhaust openings of the pilot valve.

Before cleaning the cylinder walls or replacing the piston cups, make sure there is no problem in the control system. Both standard and on/off units can operate like there is a piston cup problem when their control system is dirty. Before replacing piston cups, follow cleaning procedures in paragraph 5-1.c. or 5-2.c. If this does not solve the problem, proceed as follows:

NOTE

Unless otherwise indicated, item numbers refer to Figure 4-1.

1. Shut off all air supply. Disconnect electrical power to on/off units.

2. Disconnect power and control air supply lines to pilot valve assembly (27, Figure 4-1) or solenoid valve assembly (Figure 5-2). Disconnect mechanical linkage at clevis (3, Figure 4-1).

3. Remove pivot pin through bottom cylinder head (26) and place positioner on a work bench.

4. On standard units, disconnect calibration spring (8) from pilot valve.

5. Disconnect tubing connections from bottom cylinder head (26).

6. Remove hex nuts (13), lockwashers (14), and four steel tie-rods (28).

7. For on/off units, remove bottom cylinder head (26).

8. On standard units, remove pilot valve assembly (27) and bottom cylinder head (26).

9. Invert the remaining positioner assembly and support it vertically by clamping clevis (3) in a vise.

10. Remove cylinder (19) from piston assembly by slowly turning the cylinder clockwise while pulling it upward, away from top head assembly (15).

11. Clean out bore of cylinder with a cloth soaked in a solvent. Do not scrape with sharp tools or use abrasive materials such as emery cloth.

12. Inspect piston cups (22). If worn, creased, or scratched, they must both be replaced.

13. If piston cups require replacement, remove locknut (25) and washer (14) from rod (5). Two piston cup followers (21) and piston cups may then be slipped off the end of the piston rod.

CAUTION

Be careful that piston cups are not creased or scratched during assembly. Damaged piston cups will impair positioner performance.

14. Reassemble piston assembly and insert it into cylinder in the following manner:

    (a) Assemble parts of piston on end of piston rod, except outer garter spring (20) and outer piston cup.

    (b) Turn locknut (25) until only finger tight.

    (c) Check that gasket (17) is in place at top head assembly and then slip cylinder down over the piston assembly until washer (24) is about 1/4 in. (6 mm) from end of cylinder.

    (d) Remove locknut (25), washer (24), and outer piston cup follower (21). Install outer piston cup (22), outer piston cup follower (21) and garter spring (20); reassemble entire piston. Tighten locknut (25).

    (e) Hold top head assembly and pull cylinder back over piston assembly until piston is approximately half way into cylinder.

15. Remove positioner from vise. Pull top head assembly along piston rod until it hits the end of the cylinder. Reassemble positioner by installing control system assembly and bottom cylinder head at lower end of cylinder and installing studs, lockwashers and nuts.

16. Connect tubing assemblies to bottom cylinder head.

17. On standard units, connect calibration spring to pilot valve assembly.

18. Mount positioner and connect linkage to clevis. Connect power air supply and either control air signal lines or electrical lines to control system. Open control signal air or close electrical power switch.

19. Turn on power air supply pressure. The positioner is now ready for operation.

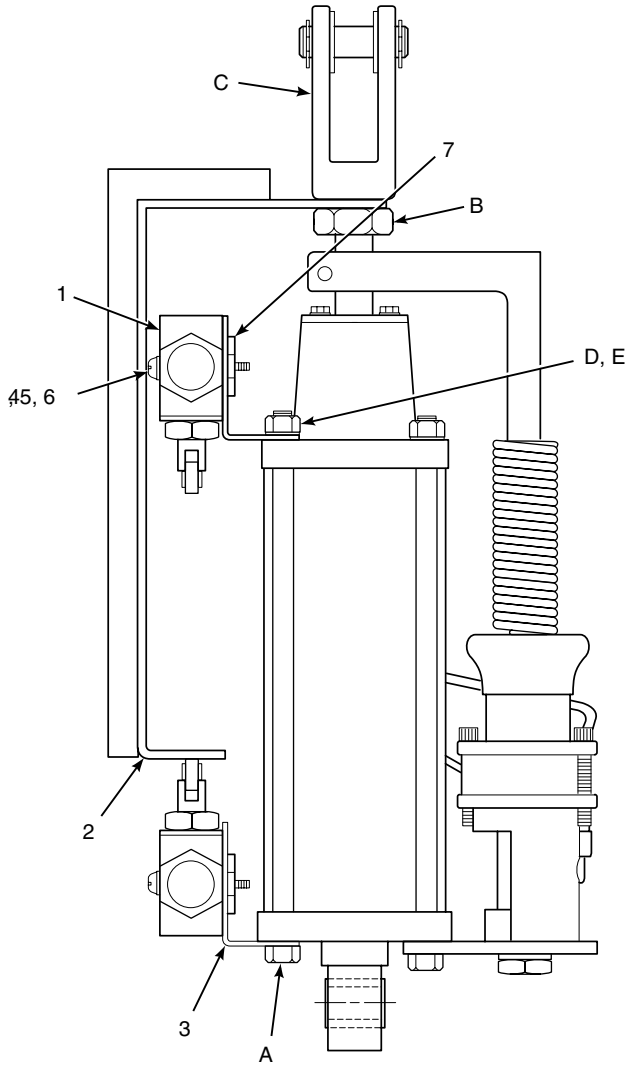
5-5. INSTALLATION OF LIMIT SWITCHES. The following instructions cover the installation of a limit switch kit onto either a standard or on/off type power positioner.

a. Check parts kit items against those of Figure 5-3.

WARNING

Shut off all air pressure and electricity to power positioner, and remove and block mechanical load before beginning this procedure. Failure to do this could allow the power positioner to move. This could injure personnel or damage equipment.

b. Orient power positioner as shown in Figure 5-3. Clevis must be up, and pilot valve or solenoid valve to the right.



NOTE: LETTER DESIGNATIONS REFER TO NON-KIT ITEMS MENTIONED IN INSTALLATION TEXT, PARAGRAPH 5-5.

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LIMIT SWITCH KIT ITEMS		
ITEM	DESCRIPTION	QTY
1	LIMIT SWITCH	2
2	SWITCH STRIKER	1
3	SWITCH BRACKET	2
4	P AN HEAD SCREW	4
5	FLAT WASHER	4
6	LOCKW ASHER	4
7	NUT PLA T	2

Figure 5-3. Limit Switch Installation

c. Assemble limit switches (1, Figure 5-3) and brackets (3), using nut plate (7), flat washers (5), lockwashers (6) and screws (4). Orient limit switches as shown. Slide limit switches to outermost point in slots. This is to prevent damage from switch striker (2) before adjustment.

d. Remove two tie-rods (A) from left side of cylinder.

e. Install bottom bracket (3) on tie-rods (A) and insert tie-rods through cylinder heads. Install top bracket, lockwashers (D) and nuts (E) on top of tie-rods (A) and torque to 8 to 12 ft-lbs (11 to 16 N•m).

f. Loosen nut (B) under clevis (C); remove clevis. Install switch striker (2); reinstall clevis. Retighten nut under clevis, making sure switch striker lines up with switch actuator rollers.

g. Connect wiring to limit switches as the boiler controls require. Remove cover to get to terminal screws. Because the entire power positioner moves while in service, use Greenfield™ flexible conduit. If the unit is likely to get wet, use liquid-tight flexible conduit.

h. Adjust limit switches so that they switch as the piston reaches the fully extended and fully retracted positions.

1. Observe limit switches while running power positioner to both limits. Each switch should switch on just as the piston reaches its mechanical limit, and switch off as the piston begins to go in the other direction.

2. To adjust switch, loosen screws (4, Figure 5-3) until switch assembly will slide. Slide switch assembly as necessary, then retighten screws. Watch switch again while running piston. Readjust as necessary.

SECTION VI. RECOMMENDED SPARE PARTS

The following tables give listings of replacement parts for standard and on/off 2-1/2 inch x 5 inch power positioners, and for the standard pilot valve assembly.

Table 6-1. Recommended Spare Parts for the Standard Power Positioner.

FIGURE and INDEX NUMBER	PART NUMBER	DESCRIPTION	QTY
4-1, 12	152507-001	Seal	1
4-1, 17	4847B17H01	Cylinder Head Gasket	2
4-1, 22	170857	Piston Cup	2
5-1, 14 and 15	173283	Stem and Sleeve Assembly (Matched Set)	1
(Not Shown)	3D39395G07	Maintenance Tool Kit	1

Table 6-2. Recommended Spare Parts for the On/Off Power Positioner.

FIGURE and INDEX NUMBER	PART NUMBER	DESCRIPTION	QTY
4-1, 12	152507-001	Seal	1
4-1, 17	4847B17H01	Cylinder Head Gasket	2
4-1, 22	170857	Piston Cup	2
5-2	ASCO #8340A2	Solenoid Valve Assembly	1
(Not Shown)	3D39395G07	Maintenance Tool Kit	1

NOTE

Order replacement parts for the solenoid valve assembly directly from ASCO at the following address:

ASCO Valves
Automatic Switch Co.
Florham Park, NJ 07932

Table 6-3. Recommended Spare Parts for the Standard Pilot Valve Assembly.

FIGURE and INDEX NUMBER	PART NUMBER	DESCRIPTION	QTY
5-1, 11	171323	Bottom Diaphragm	1
5-1, 8	170960	Top Diaphragm	1

NOTE

Table 6-4, Bill of Material for the 2-1/2 x 5 Power Positioner, includes part numbers and descriptions that are keyed to figure and index number references. The table covers all basic positioner parts. Refer to Tables 6-1, 6-2, and 6-3 for recommended spare parts.

Table 6-4. Bill of Materials for the 2-1/2 x 5 Power Positioner.

FIGURE and INDEX NUMBER	PART NUMBER	DESCRIPTION	QTY
4-1, 1	120079-010	Retaining Ring	2
2	170924	Clevis Pin	1
3	170925-002	Clevis	1
4	120036-014	Hex Nut, 0.625-18	1
5	4847B25H01	Piston Rod	1
6	4513C25H02	Positioner Arm	1
7	120090-250125	Socket Head Cap Screw, 0.250-20 x 1.25 long	1
8		Calibration Spring (1 of 3 tensions)	1
	170952	0 - 30 lb Spring	-
	171267	3 - 15 lb Spring	-
	171266	3 - 27 lb Spring	
9	163792-1932038	Cap Screw	2
10	120114-017	Lockwasher, #10	2
11	170949	Seal Retainer	1
12	152507-001	Seal	1
13	120026-019	Hex Nut, 0.312-24	4
14	120114-029	Lockwasher	4
15	4847B35G01	Top Head Assembly	1
16	771B867H01	Elbow Fitting	4
17	4847B17H01	Cylinder Head Gasket	2
18	3D39399H05	Top Tubing, 18" long, 1/8" 304 S.S.	1
19	4847B29H01	Cylinder	1
20	170941	Garter Spring	2
21	170942	Piston Cup Follower	2
22	170857	Piston Cup	2
23	3D39399H02	Bottom Tubing, 9" long, 1/8" 304 S.S.	1
24	120110-005	Washer, 0.500 Plain	1
25	120171-002	Elastic Stop Nut	1
26		Bottom Cylinder Head (1 of 2 Designs)	1
	4846B57G02	Bottom Cylinder Head, G05 Group	-
	4847B34G01		-
27	3D39398	Bottom Cylinder Head, G06/G08 Groups	1
5-1, 1			2
2	4847B19H01	Pilot Valve Assembly	1
3	4847B55H02	Socket Head Cap Screw	1
	4844B16H01	Rubber Boot	1
	173217-001	Top Spring Retainer, Standard	1
4	170964	Top Spring Retainer, EPT Option	1
		Top Diaphragm Cover, EPT Option	
		Top Loading Spring	

Table 6-4. Bill of Materials for the 2-1/2 x 5 Power Positioner (Continued).

FIGURE and INDEX NUMBER	PART NUMBER	DESCRIPTION	QTY
5-1, 5	4847B82H01	Top Diaphragm Seat	1
6	170960	Top Diaphragm	1
7	4847B20H01	Center Block	1
8	4847B22H01	Center Diaphragm Post	1
9	171323	Bottom Diaphragm	1
10	170959	Bottom Diaphragm Seat	1
11	4847B21		1
12	3D39396H02	Top Stem Seat	1
13			4
	173283	Valve Body	1
14			1
15		O-rings	1
16	170955		1
17	170958	Stem and Sleeve Assembly	1
18	170968		1
4-1, 28	174080-003	Sleeve	4
5-3, 1	8741-001		2
2	3535B04G01	Stem	1
3	3535B01H01		2
4	70001DAJ4B	Bottom Stem Seat	4
5	70500BD30C		4
6	70510CR10G	Bottom Loading Spring	4
7	3535B09H01		2
	3534B98	Sleeve Retainer	1
5-2	ASCO #8340A2		1
		Tie-Rod, 0.312-24 x 9.38 long	
		Limit Switch	
		Switch Striker	
		Switch Bracket	
		Pan Head Screw, 0.138-32 x 1.25	
		Washer, #6 Flat	
		Lockwasher, #6 Split	
		Nut Plate, 0.138-32 Thread	
		Instructions, Limit Switch Kit	
		Solenoid Valve Assembly (On/Off Units only)	

SECTION VII. RETURNING EQUIPMENT TO THE FACTORY

7-1. RETURN PROCEDURE. If factory repair of defective equipment is required, proceed as follows.

a. Secure a return authorization from a Rosemount Analytical Sales Office or Representative before returning the equipment. Equipment must be returned with complete identification in accordance with Rosemount instructions or it will not be accepted.

In no event will Rosemount be responsible for equipment returned without proper authorization and identification.

b. Carefully pack defective unit in a sturdy box with sufficient shock absorbing material to insure that no additional damage will occur during shipment.

c. In a cover letter, describe completely:

1. The symptoms which indicate that the equipment is faulty.
2. The environment in which the equipment has been operating (housing, weather, vibration, dust, etc.).
3. Site from which equipment was removed.
4. Whether warranty or nonwarranty service is requested.
5. Complete shipping instructions for return of equipment.

d. Enclose a cover letter and purchase order, and ship the defective equipment according to instructions provided in Rosemount Return Authorization, prepaid to:

American

Rosemount Analytical Inc.
R.M.R. Department
1201 N. Main Street
Orrville, Ohio 44667

European

Rosemount Ireland
Equipment Return Repair Dept.
Site 7 Shannon Industrial Estate
Co. Clare
Ireland

7-2. REPAIR TERMS.

a. If warranty service is requested, the defective unit will be carefully tested and inspected at the factory. If failure was due to conditions listed in the standard Rosemount warranty, the defective unit will be repaired or replaced at Rosemount's option, and an operating unit will be returned to the customer in accordance with shipping instructions furnished in the cover letter.

b. For equipment no longer under warranty, the equipment will be repaired at the factory and returned as directed by the purchase order and shipping instructions.

INDEX

This index is an alphabetized listing of parts, terms, and procedures having to do with the 2-1/2 Inch x 5 Inch Power Positioner. Every item listed in the index refers to a location in the manual by page number or numbers.