VacuComp™ Series 150/160 Angle and In-Line High Vacuum Valves Installation and Service Manual

HPS Division
MKS INSTRUMENTS, INC.
5330 Sterling Drive
Boulder, CO 80301
Phone (303) 449-9861
Fax (303) 442-6880

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FIGURES, INSTALLATION AND SERVICE MANUAL

INSTALLATION AND SERVICE MANUAL

FOR HPS SERIES 150 AND 160

ANGLE AND IN-LINE VALVES

1. SCOPE

This manual covers installation, service, trouble shooting, return to factory for service, and warranty for HPS Series 150 and 160 angle and in-line poppet type valves.

2. GENERAL DESCRIPTION OF SERIES 150 AND 160 VALVES

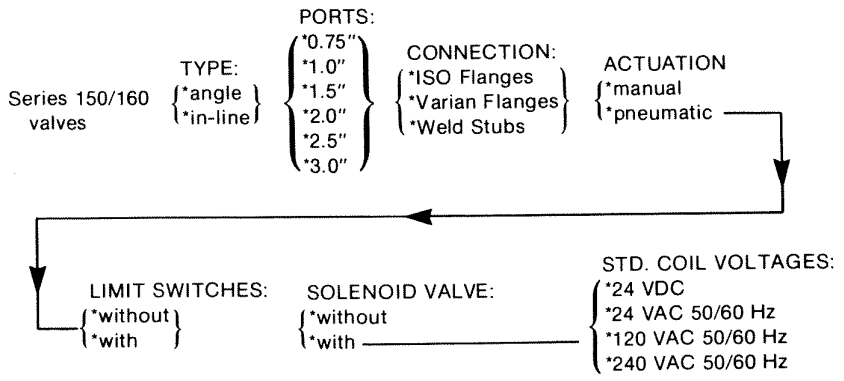
Series 150 designates angle valves, and Series 160 in-line valves with bellows stem seals.

Manual valves are actuated by hand rotation of a fluted knob. The stem mechanism uses a coarse pitched acme thread to minimize the number of turns required to travel from full open to full closed. It also incorporates a positive stop for upward travel so that there is no possibility of over-compressing the bellows when opening the valve. Downward travel ends when the valve is sealed.

Pneumatic valves have an actuating cylinder attached directly to the body flange of the valve. The valve is opened when air is supplied to the bottom of this cylinder. When the air is vented, the valve is closed by an internal spring. The advantage of a spring closed design as compared to a double acting cylinder is that the valve fails closed upon removal of either power or air.

When limit switches are provided for the remote indication of the open and closed positions, they are mounted on the top of the cylinder. The switches are directly actuated by a cam on the upper end of the stem. They are protected by an aluminum cover.

Figure 1 illustrates the standard options available in Series 150 and 160 valves.



NOTE: Valves with port sizes 2.0", 2.5", and 3.0" can also be provided with ASA flanges. Solenoid coils are available with a wide variety of voltage ratings on special order. For information, contact the Sales Department of HPS Corporation.

Fig. 1 Standard options for Series 150 and 160 valves.

3. OPERATING PRINCIPLES

3.1 Operating Principles--Manual Valves

Refer to Fig. 2 which shows the manual valve. To understand the operation of this valve, first assume that the valve is closed. Rotating the Knob (16) attached to Screw (13) counter clockwise causes the Screw to withdraw from the Stem Guide (14). The valve Stem (8) passes through the Screw (13) which is free to rotate on the Stem. Note that the upper end of the Screw, within the counter bore in Knob (16), is held on the Stem by Retaining Ring (15). Thus, as the Screw rotates and withdraws, it lifts the Stem with it. This motion is transmitted by the Stem to the Nosepiece (7), and the valve is opened. Travel in the upward direction is limited when the upper surface of Thrust Bearing Assembly (11) reaches the lower surface of the Stem Guide (14). This feature prevents overcompressing and damaging the Bellows (5). Once resistance from the positive stop is felt, it is important not to continue applying opening torque to the Knob. Excess torque applied to an open valve may cause Retaining Ring (15) to come off and damage the retaining ring groove. As the valve is opened, the flexible Bellows (5) serves as a hermetic seal while permitting Nosepiece travel.

To close the valve, the Knob (16) and attached Screw (13) are rotated clockwise. As the Screw moves inward, the motion is transferred to the Nosepiece (7) via Thrust Bearing Assembly (11) and Spacer (10). The Thrust Bearing is important in preventing any torque from the closing action from reaching the Bellows. Downward travel ceases when the Nosepiece O-ring (9)

reaches the Seat (2), and the O-ring is compressed. If the valve does not seal with reasonable closing torque, the seal and/or seat may be faulty and should be examined rather than continuing to torque the knob.

3.2 Operating Principles--Pneumatic Valves

Refer to Fig. 3 which shows the components of the pneumatic valve equipped with the limit switch option. This discussion of operation also starts from the initially closed position, with the admission of compressed air to the pneumatic cylinder by the 1/8" NPT port in the cylinder flange. The path from the air inlet to the cylinder interior is through a small hole which serves as a flow restrictor to help determine the valve opening/closing time. When the air pressure acting on Piston (20) reaches a value sufficient to overcome the force of the Closing Spring (11), the Piston starts to rise. The Stem (9) is attached to the Piston with Nut (22) and Warning Washer (21). At the lower end of the Stem, the Nosepiece (8) is fastened to the Stem, and it carries the Nosepiece O-ring Seal (10) in a trapezoidal groove. The Bellows (6) forms a flexible hermetic seal between the Nosepiece and the fixed elements of the Body Assy. (1), permitting upward travel for the full stroke. Note also that when a valve is fully open, the Stem protrudes above the cylinder by a distance ranging from 0.9-1.8" depending upon valve size. On valves fitted with the optional limit switches, the stem protrudes above the Limit Switch Shield Can (42) by about .25". This provides visual indication of valve position.

As the Stem travels upward, the Closing Spring is compressed further, which requires a greater force, which must be supplied by the air acting upon the piston. Thus, there is a range of air pressures between the value where the valve starts to open, and that for which the valve is fully open. SPECIFICATIONS in the HPS Series 150/160 catalog specify minimum air pressure needed for full opening.

To close the valve, the cylinder is vented via the 1/8" NPT port. As the air pressure falls below the value for full opening, the Nosepiece starts to descend. As venting continues, the Nosepiece with its seal reaches the seat and the valve is closed. Full seal force is reached when the pressure in the cylinder is equal to the atmospheric pressure.

3.3 Limit Switch Actuation

When valves are equipped with limit switches, the limit switch assembly

shown in Fig. 5 is mounted on top of the pneumatic cylinder. When the valve is closed, the lever of switch (31a) is depressed by Actuating Washer (28) fastened to the top of the Stem. When the valve is in the full open position, the washer activates the lever of switch (31b). Observing that the closed position Limit Switch (31b) is actuated does not necessarily tell that the valve is sealed leak tight. There might be some small fiber or particulate contamination on the seat which prevents complete sealing. It does confirm that the valve and its control obeyed the command to move to the closed position.

To provide visual indication of position in valves with limit switches, Screw (30) which serves to retain the Actuating Washer on the stem protrudes through the top of the Shield Can (42) when the valve is fully open.

4. SPECIFICATIONS

Page 7 in the HPS Series 150/160 catalog summarizes specifications related to operating conditions of the valves. These specifications with the column headings and notes are self-explanatory. There are several other items related to specifications which should be mentioned.

4.1 Operating Position

Series 150 and 160 valves may be installed in any position.

4.2 Allowed Stress or Torque Coupled from Attached Piping

The bodies of Series 150/160 valves are very rugged, and they would be difficult to deform in any normal piping arrangement used in vacuum systems. But it is also clear that tremendous forces could result from thermal expansion, or from a long run of pipe cantilevered from a fixed valve. Where there is any possibility of such a situation, it is necessary to provide stress relief for the valve by interposing a short bellows, and supporting the attached piping other than by the valve.

4.3 Temperature Extremes

The valve body is rated bakeable to 150°C and the actuator cylinder to 70°C. These temperature ratings are high enough to insure reliable operation of the valves in any normal ambient. It is suggested that 0°C be taken as the suggested minimum, again because of the elastomers, lubricants, and the steel Closing Spring used in the valve. To bake a valve on a system, wrap a heating tape around the valve body only, and monitor the temperature of

the cylinder to insure that it does not exceed 70°C.

4.4 Maximum Cycling Rate

Individual valves on test have been cycled for millions of cycles at rates as fast as 10 seconds per cycle. If cycled continuously at rates in excess of this, the life may be shortened because of local heating.

4.5 Solenoid Duty Cycle

The solenoid coils supplied with valves equipped with control valves are rated for continuous duty. Further, solenoid valves are provided with viton seals, so that the heat of continuously operated solenoids will not cause deterioration and failure.

4.6 Maximum Internal Pressure

The specification sheet shows that all Series 150/160 valves are rated at a maximum internal pressure of 30 psia. This subject is worth a little more discussion.

If an increasing pressure is applied to the Nosepiece Port with the Body Port under vacuum, at some pressure between 40 psia and 70 psia, depending upon the valve size and tolerances of the particular valve, the Nosepiece will lift as in a pressure relief valve, and gas will blow by the Nosepiece. This causes no harm to the valve, but could be important to other elements of the system.

If similar pressures are applied to the body port with the Nosepiece port under vacuum, there will be no leakage at pressures up to 50 psia. At higher pressures, the thin material of the Bellows could be permanently damaged.

4.7 Opening With a Pressure Differential

The valve may be opened with a pressure differential of 15 psi in either sense without harm to the valve.

4.8 Closing With Internal Pressure

The valve will close and seal at any internal pressure allowed in the specifications. At some pressures in excess of that allowed, the force resulting from an internal pressure acting on the bellows area will exceed the closing force of the spring and the stem will not descend.

5. INSTALLATION INFORMATION

5.1 Dimensions

The outline dimensions for all Series 150 and 160 valves are given in the HPS Series 150/160 catalog. Note that these tables give the clearance required for withdrawal of the internal components of the valve with the body in place.

5.2 Electrical Connections

In electropneumatic valves, connections must be made to the solenoid coil leads, and to the Limit Switches when this option is present. All wiring should be done properly to insure safe and reliable operation. Two entries with grommets have been provided to the Limit Switch Shield Can so that a 7-wire cable as Beldon 9430, which contains seven 22-gauge wires, can be brought in through one grommet, the solenoid pigtail leads through another, and the space within the can used as a junction box. It is important to keep the space on the switch side of the Limit Switch Block free of wires so the stem cannot rub on the wires. The recommended wiring arrangement is shown in Fig. 7. Note the use of the stress relief clamps provided. The ground lug on the Limit Switch Block should be used when connecting the wiring.

Care must be used when soldering leads to the terminals of the Limit Switches. A soldering iron with thermostatically controlled tip should be used, and it should not be in contact with the terminal for longer than 10 seconds.

To make it easy to remove a valve for service, a male and female connector could be put on the cable, as shown in Fig. 7. A suitable connector is the 17D series, as available from Amphenol or others. Figure 8 gives full part numbers, and shows a suggested wiring arrangement.

5.3 Air Supply

Building air supplies often contain foreign material including rust, metal particles, oil, and water. The particulate contamination may be removed by a simple in-line filter in series with the supply for each valve, or the supply for an entire system. The Series 150 and 160 valve catalog lists a filter suitable for this use.

The cylinder on Series 150 and 160 valves may be rotated, if necessary, to provide access to the 1/8" NPT air inlet or solenoid. Valves with

nominal 0.75 to 1.5 inch ports can be indexed in 4 positions and nominal 2.0 to 3.0 inch ports in 6 positions. Only the Cylinder (24), not the whole Internal Assembly (14), should be rotated because of the vent channels in the bottom of the Stem Guide (15). See section 6.3.3, noting points 6 through 9.

The exhaust vents on the solenoid valves orginally provided with HPS valves are internally tapped to accept fittings for a vent manifold if desired. The solenoid on nominal 0.75 to 1.5 inch ports is tapped 10-32 UNF and 5/16-18 UNC on nominal 2.0 to 3.0 inch ports. If desired, a coarse exhaust filter can be fitted to the valves to help reduce the exhaust noise. Care should be taken to see that the filter does not restrict the exhaust flow and prevent the valve from closing completely by trapping air in the cylinder.

The valve Actuating Cylinder is lubricated, so "dry" air may be used without harm to the valve. However, the life of the solenoid control valve is considerably longer when the air supply contains traces of moisture or water, than when it is absolutely dry.

SPECIFICATIONS for Series 150 and 160 valves in the HPS Series 150/160 catalog show the allowed air pressure range. Where there is a pressure regulator for an installation, it is suggested that it be set at 65 psig.

5.4 Clean Installation

Valves are shipped with a plastic snap-on cover over the ports. This cover should be left in place until the moment when the valve is to be installed in the piping. A single fiber or bit of lint on an O-ring seal is enough to prevent leak tight sealing. The usual clean techniques customary in vacuum practice should be observed in installing Series 150 and 160 valves.

5.5 Flange Care

Care should be taken not to damage the flanges, especially when handling, installing, or removing the valve. To help protect the flanges, the plastic caps supplied with the valve should be left on until installation and replaced when the valve is removed from a system. A small scratch on the flange seal surface of an elastomer sealed valve is enough to prevent a leak tight seal. On valves with Varian type flanges, if the knife edge is scratched or dented, the flange may not seal. Since the flanges are

integral with the body, a defective flange will probably necessitate a new body or return to the factory for rework.

When installing the valve, adequate clearance should be allowed between adjacent components so there is no sliding of seal surfaces against each other. Flanges that have been assembled for some time may have a tendancy to stick together. They should be gently separated and any prying on metal seals to separate them should be gentle. Also, do not set the valve down on the flange seal surfaces unless they are protected.

6. VALVE SERVICE

6.1 Work Area

Vacuum components must be kept free of both particulate contamination and of all foreign materials which would have a significant vapor pressure. Before starting the repair of a vacuum valve it is necessary to prepare a clean work station in a dust-free area. Tools used should be clean, degreased, and devoted to precision assembly.

6.2 Manual Valve Repair, Angle and In-line Valves

6.2.1 Breakdown Into and Inspection of Sub Assemblies

These instructions refer to Fig. 4, Manual Valve, Exploded View:

1--open valve slightly by rotating Knob (16) CCW.

2--remove the four 10-32 socket head capscrews (18) and washers (19) in valves with nominal 0.75 to 1.5 inch ports, and the six screws in larger valves.

3--withdraw the complete Internal Assembly (4) from the valve.

4--put the Bellows Flange O-ring (12) aside.

5--inspect the Seat (2) for scratches, other damage or contamination that could prevent sealing. If components such as the Body (1) are clean and will not require cleaning before assembly, place them in clean polyethylene bags for protection.

6--inspect the Nosepiece O-ring (9) carefully. If it is scratched or if there is imbedded foreign material, this O-ring must be replaced.

6.2.2 Repair of Sub Assemblies

1--The Nosepiece O-ring (9) should be removed only if a new replacement is available. To remove the old O-ring, insert a sharp pointed tool,

such as a machinist's scribe obliquely into the ring. The sharp point must not pass through the seal or the surface of the groove will be damaged. Lift the seal out with the scribe.

2--To replace the seal, position the Nosepiece so that the groove faces upward. Be sure that the bottom of the groove and surfaces of the new O-ring are clean and free of scratches. If necessary, a suitable solvent may be used to clean the groove. Particulate contamination may be blown off with Dust-Off® or dry nitrogen. Place the proper O-ring on top of the groove. Place the two thumbs on the O-ring at points 180° apart, and push the O-ring into the groove. Avoid twisting the O-ring as it is pushed in. Then push in the opposite intermediate points, and so on, until the ring is uniformly in place.

6.2.3 Assembly of Major Sub Assemblies and Testing of Valve

1--Place the Bellows Flange O-ring (12) onto the Bellows Flange.

2--Invert the Body, and place it over the Bellows Assembly. The vent grooves on the lower side of the Stem Guide (14) must be aligned with the vent grooves in the Body Flange (3). If the Nosepiece has been advanced while out of the Body, it must be retracted until it does not touch the Seat (2) when the Stem Guide and Body Flange are mated.

3--Turn the valve over and install the 10-32 x 0.625 Socket Head Screws (18) and Washers (19). They must be tightened a little at a time to pull the pieces together uniformly.

4--Before returning the valve to service it should be leak tested. Note that helium admitted to the vent holes simultaneously tests the Bellows and the Bellows Flange Seal.

6.2.4 Rebuilding of Sub-Assemblies

6.2.4.1 Disassembly and Inspection of Manual Valve Internal Assembly

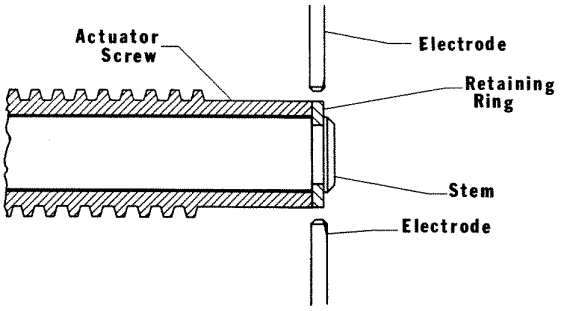
1--Loosen the Set Screw (17) in the Knob (16), and remove Knob.

2--On valve sizes 2.0 inch and larger, standard external retaining rings are used, which may be removed with ordinary retaining ring pliers.

Dust-Off® is a registered trademark of Falcon Safety Products, Inc., Mountainside, New Jersey.

On sizes 0.75 to 1.5 inch, it has been necessary to use a very strong retaining ring that is not removable with retaining ring pliers. These rings are very difficult to remove and install. THEY SHOULD NOT BE REMOVED UNLESS IT IS ABSOLUTELY NECESSARY TO DO SO. Also, do not install the ring until all internal parts are installed properly and in the correct order (See Fig. 4). CAUTION: When trying to remove these rings, never attempt to force the ring out of its groove by prying or pushing it upward. This could permanently damage the edges of the groove so the retaining ring may accidently come out during use of the valve.

To facilitate removal of this type of ring, we suggest first annealing the ring. One way to anneal the old ring is with a suitable spot welder. The ring should be clamped across its diameter, staying away from the actuator screw, (see below), between the electrodes of the spot welder.



With the ring held between the electrodes, apply power so that the ring briefly glows a dull orange. Alternately, the heat may be applied for a longer time, making the ring brittle and easy to remove. After the ring has been heated, it is possible to grab the ring with pliers and spread it until it can be removed from the groove.

3--Lift off Screw (13) with Stem Guide (14).

4--By inverting the Bellows Assembly, allow the Thrust Bearing Assembly (11), and Spacer (10) to fall into the hand, noting their order. Also note that the Thrust Bearing Assembly (11) consists of three parts--a caged roller or ball assembly that is sandwiched between two washers.

5--If a leak was suspected in the Bellows Assembly (4), it may now be leak tested. To pinpoint a leak, the interior of the bellows assembly should be evacuated on the leak detector and helium carefully sprayed on the external surfaces. To prevent collapse under atmospheric load

with consequent damage to the Bellows, means must be used to prevent overcompression. It is possible to place the bellows with the Bellows Flange O-ring in the body and evacuate the body for the leak test. This uses the body as a fixture to prevent damage, but, a leak cannot be pinpointed. This method will just indicate whether the bellows or the O-ring seal is leaking.

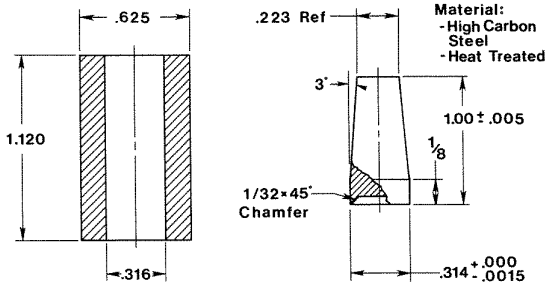
6--When a Bellows Assembly is cleaned by vapor degreasing, it must be completely dry before proceeding to assembly.

6.2.4.2 Assembly of Manual Valve Internal Assembly

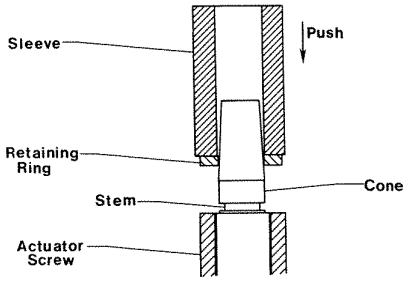
1--Assembly is the reverse of disassembly. The Thrust Bearing (11) and the portion of the Stem (8) interior to the Screw (13), and the threads of the Screw, should be lubricated with a molybdenum disulphide grease. It is important that these parts be installed in the correct order or the valve will not work correctly and retain its positive stop feature.

2--The retaining ring on sizes 2.0 inch and larger can be installed with retaining ring pliers. The retaining ring used is Waldes Truarc No. 5160-42.

On sizes 0.75 to 1.5 inch ports, Waldes Truarc retaining ring No. 5560-31 is used. To install this ring, it is necessary to have the following tool:



This tool is used as follows to expand the ring and push it on the stem.



With the retaining ring "loaded," the sleeve piece is then pushed, expanding the ring on the cone and then down on to the stem until it springs into the groove.

3--The Set Screw retaining the knob should be located in the depression at the top of the actuator screw when reassembling the valve.

6.2.4.3 Correcting Damage to Body

1--Damage to the Body other than minor scratches or pits on the Seat (2) will require replacement with a new Body.

2--Minor scratches or pits on the Seat can often be removed by chucking the Body in a lathe, and polishing the Seat with a fine abrasive paper mounted on a wooden tool. All marks on the Seat must be circumferential.

6.3 Pneumatic Valve Repair, Angle and In-line Valves

6.3.1 Breakdown into and Inspection of Sub Assemblies

These instructions refer to Fig. 5, Electropneumatic Valve, Exploded View:

1--Vent both sides of valve.

2--Remove all electrical power to the valve.

3--Remove the air connection to the valve.

4--When the Limit Switch option is present, remove the Shield Can (42). It is retained by two 6-32 pan-head screws. Remove the 8-32 Socket Head Cap Screw (30) at the top of the stem, and with it the Spacer (29) and the Limit Switch Actuating Washer (28). Be careful not to bend the Limit Switch Actuating Levers.

5--Remove the 10-32 Socket Head Cap Screws (25) and washers from the Body Flange.

6--Lift the Actuating Cylinder (24) away from the Body. The Internal Assembly (4) should come away with the Actuator Cylinder. If it does not, it can usually be removed by gently pulling on the stem. Remove the Bellows Flange O-ring (13) and put it aside.

7--Grasp the Nosepiece (8) and pull the Cylinder (24) off the piston. Put The Cylinder O-ring (23) aside. Do not contaminate components internal to the Valve Body with Cylinder lubricant. NOTE: The Nosepiece Seal (10) can be replaced without separating the cylinder from the Internal Assembly. The procedure is given in section 6.2.2.

8--When the valve has operated for a long time the Cylinder lubricant will be dirty and should be replaced. Clean the old grease from the Cylinder interior and the Piston. The valve is now stripped to the major sub assemblies.

6.3.2 Repair or Exchange of Major Sub Assemblies

6.3.2.1 Internal Assembly (4)

1--The Nosepiece Seal may be replaced as described in section 6.2.2.

2--The entire Internal Assembly (4) is available as a spare part for those wishing to make a fast repair. Nearly all wearing parts of the Valve are in this assembly, including Nosepiece Seal, Bellows, Stem Seal, Stem, and Piston. In normal use, the life of all these items is similar, so replacing the group is reasonable.

WARNING: Do not remove Piston Nut (22) securing the Piston on this assembly without following the instructions given in section 6.3.4.1. This assembly contains a strong spring.

6.3.3 Reassembly of Major Sub Assemblies

1--Place the Bellows Flange O-ring (13) over the Bellows Flange.

2--Invert the Valve Body over the Internal Assembly to put these assemblies together without risk to the O-ring. Then re-invert them while holding them together.

3--Lubricate the inside of the Cylinder with a moderately thick film of grease supplied with the Internal Assembly. When a substitute grease is required, suitable greases include Silglyde®, available from many automotive and hardware stores, white Lubriplate®, or petroleum jelly.

4--Put a thick film of grease as above into the concave outer surface of the Piston.

5--Put the Cylinder O-ring (23) onto the outer shoulder of the Stem Guide (15) upper surface, or if more convenient because of valve position, into the counter bore in the Cylinder.

6--Align the vent channels in the Stem Guide adjacent to the vent channels in the upper surface of the Body Flange.

Silglyde® is a registered trademark of American Grease Stick Company, Muskegon, Michigan.
Lubriplate® is a registered trademark of Fiske Brothers Refining.

7--Locating the bolt holes and the air inlet, push the Actuator Cylinder (24) over the Piston (20), and down as far as possible.

8--Because putting the Cylinder in place may have rotated the Stem Guide, causing misalignment of the vent channels, recheck this point. These vent channels serve both to equalize the pressure of the Bellows interior and for leak testing the Bellows.

9--Insert the 10-32 Socket Head Cap Screws (25), with Washers (26) and tighten. These screws must be tightened a little at a time to pull the Cylinder down uniformly. Failure to do so may damage the valve.

10--If the Solenoid Control Valve was removed, replace the Solenoid Valve. The complete Valve is now ready for function and leak testing.

6.3.4 Rebuilding of Sub Assemblies

6.3.4.1 Disassembly and Inspection of Internal Assembly (4)

WARNING: The Internal Assembly of the pneumatic valve contains a strong spring. Instructions below must be followed to avoid possible personal injury.

Figure 5 shows the Internal Assembly. To disassemble or reassemble this unit it is necessary to compress the Closing Spring (11). Figure 6 shows one way of safely doing this using a standard gear puller as the Spring Compression Tool. Note that the upper outer edge of the Stem Guide (15) is a seal surface and should be protected from the claws of the gear puller. The following procedure assumes the use of a gear puller as shown.

1--Put a protective ring over the seal surface on the outer edge of Stem Guide (15).

2--Insert the assembly into the gear puller, being very careful not to touch the Bellows with the claws of the puller, or any hard object. Any Bellows with slightest damage must be replaced. A spanner must be placed on the Nosepiece to prevent rotation as shown. The spanners are available from HPS.*

3--Tighten gear puller screw slightly to remove the spring load from the bottom of the piston.

*See the accessory section of the HPS Series 150/160 catalog.

4--Unscrew Piston Nut (22) while holding the spanner on the Nosepiece. Remove Piston Nut (22), Warning Washer (21), Piston (20), and Piston Bushing (19). Inspect the Piston for wear. After long use the edges of the Piston may show some scuffing.

5--Relax the puller, allowing Closing Spring (11) to expand. Hold onto the assembly to prevent its falling from the puller when the spring is fully relaxed.

6--Remove the Bellows Assembly from puller. Withdraw Stem Guide (15), Closing Spring (11), and Spring Bushing (12). Clean off all grease using a suitable solvent.

7--Inspect Stem (9) for wear. Slight abrasion of the stem which will not cause failure of the U-cup Stem Seal (16) is acceptable.

8--The Bellows Assembly can be leak tested. Normally the travel of the stem must somehow be limited by fixturing to prevent the atmospheric load from overcompressing and damaging the Bellows. See section 6.2.4.1 for details.

9--Disassembly of Stem Guide Assembly.

A--Remove the two 6-32 x 0.25 Pan Head Screws (18).

B--Remove the Seal Retainer (17).

C--Remove the Stem Seal (16). Inspect for wear.

D--Clean off the old grease using a suitable solvent such as trichloroethylene.

10--Reassembly of Stem Guide Assembly

A--Fill the relief inside the bore with a molybdenum disulphide grease, and place a small quantity in the counterbore which contains the Stem Seal (16).

B--Place the Stem Seal in the counterbore with the open side of the "U" cross section upward toward the Cylinder. Place the Seal Retainer (17) over the Seal, and hold firmly in position by tightening the two 6-32 x 0.25 Pan Head Screws.

6.3.4.2 Reassembly of Internal Assembly (4)

Lubricate the Stem including the lower portion where the Spring Bushing slides with a molybdenum disulphide grease. In compressing the Internal Assembly it is important that the Stem proceed straight through the Stem Guide, and that the shoulder not hang up on the relief inside the Stem Guide.

When the shoulder on the Stem below the thread is about .05 inch above

the upper surface of the Seal Retainer on the Stem Guide assembly, the Piston Bushing, Piston, and Warning Washer can be put in place. A bit of Loctite Cinch® put on clean threads will insure that the nut will stay in place. Tighten the Piston Nut (20) to a torque of 15 ft. - lbs. on valves up to 3.0 inch port and 20 ft. - lbs. on the 3.0 inch valve. The procedure for replacing the Nosepiece O-ring was given in section 6.2.2.

6.3.4.3 Limit Switch Assembly Service

1--If the Shield Can (42) was not removed as described previously, remove the two 6-32 Pan Head Screws (36) at the top of the Can and lift the Can off upward.

2--Individual Limit Switches can be removed at this time. Each is retained by a pair of 2-56 Pan Head Screws and Nuts with Star Washers (32,33,40). Connecting wires are soldered to the switch terminals.

3--The Limit Switch Mount (34) is held to the Actuator Cylinder by two 8-32 Socket Head Cap Screws (35). CAUTION: The length of these screws is important. Never replace them with longer ones.

4--A temporary air connection must be available, so that the valve can be cycled back and forth between open and closed.

5--The hole in the Limit Switch Mount for the 2-56 screw at the lever end of each switch is larger than the other end, to permit adjusting the switches. Using an ohmeter to determine whether the switch is actuated, rotate it in until it trips, and then set the screws firmly, but not so tightly that there is a risk of breaking the plastic switch housing. The valve should be cycled a couple of times and then the adjustment checked. Repeat this process for each switch.

6--Reconnect the wiring to the switches, if it was removed. Note that stress relief clamps are provided.

7--Replace the Shield Can, and its two retaining screws.

6.3.4.4 Service of Solenoid Valve

It is suggested that the Solenoid Control Valve be considered a

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throw-away component. In normal use it will last millions of cycles, although this number is reduced by about a factor of ten when absolutely dry air is used. The Solenoid Valve is held to the Actuator Cylinder by a close nipple (44) and the threads are sealed with a jointing compound or Teflon® tape.

When using Teflon® tape, it must not be allowed to overlap the end of the threads, or the end portion will be cut off and clog the small channels in the Solenoid Valve.

6.4 Commonly Required Spare Parts

Table VI shows commonly required spare parts and their order numbers.

7. TROUBLE SHOOTING

This section is a guide for solving problems that may occur with HPS Series 150/160 valves. Listed below are symptoms with possible causes and suggestions for help.

7.1 Problems Common to Both Manual and Pneumatic Valves

7.1.1 Valve Cannot Be Pumped Down to High Vacuum

1--Valve is dirty and contaminated with a material that is outgassing./ Correct by thoroughly cleaning the valve.

2--Valve leaks either from external atmosphere into vacuum system or across Nosepiece seal./ Make a careful leak test with a quality leak detector to locate the leak. Note: with careless leak dectection, a leak a large distance away can be picked up and the leaking component not found. Some possible sources of leaks are:

A--Non-sealing flanges between valve and system may be due to damaged flanges, dirt, or incorrect assembly. Locate problem and assemble correctly.

B--Leak signal at the Nosepiece port indicates that the Nosepiece O-ring may be bad, the seat damaged and needs to be repaired, or there is dirt on the seat preventing sealing. See section 6.2.1 (manual valve) or 6.3.1 (pneumatic).

C--Leak signal from the bellows vents indicates either that the bellows is bad or the bellows flange O-ring is defective. See section 6.2.1 or 6.3.1.

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D--Leaks in the body proper could arise if the body has been modified or subjected to undue stress or otherwise damaged. Rewelding might fix it but may harm the body further. A new body is the best solution.

7.2 Problems with Manual Valves

1--Knob rotates without turning actuator screw./ Knob is loose on the actuator screw and set screw in knob needs to be tightened. Note there is a dimple in the end of the actuator screw for the set screw.

2--Actuator screw turns but valve cannot be opened, especially with vacuum on Nosepiece./ Retaining ring (15 in Fig. 4) has come out of its groove in the stem. Inspect the groove for damage. See section 6.2.4.2.

3--Valve is hard to actuate./ Dirt in threads of actuator screw or screw is in need of lubrication. Clean and lubricate threads.

4--Actuator screw has end play on stem./ Actuation mechanism incorrectly assembled or parts from different size valve used. Reassemble, noting order shown in Fig. 4, using the correct parts.

5--Valve can be opened too far./ No positive stop for valve opening because parts missing or installed incorrectly. Reassemble valve correctly, noting order shown in Fig. 4.

7.3 Possible Problems with Pneumatic or Electropneumatic Valves

7.3.1 Valve Doesn't Open Fully

1--Cylinder air pressure is too low./ Check the specifications section for proper value and check valve supply.

2--Defective pneumatic control system or solenoid./ Replace defective parts.

3--Air is not reaching cylinder./ Check lines leading to cylinder and small hole at air inlet to cylinder.

4--Coil and supply voltage not matched./ Check coil rating and supply voltage. They must be the same.

7.3.2 Limit Switches Do Not Work

1--Valve is not opening fully./ See section 7.3.1 above.

2--Switches incorrectly adjusted./ See section 6.3.4.3 for adjusting directions.

3--Switch is defective./ Replace switch.

4--Bad connection to switch or faulty switch wiring./ Check wiring and change as needed.

5--Wrong parts installed on valve./ The limit switch blocks look similar on different sized HPS valves but differ in size. Be sure correct parts were used on the valve.

7.3.3 Valve Makes Scraping or Squealing Noise When Operating

1--Stem dry and needs lubrication./ Tear down valve, lubricate and replace seals. See section 6.3.4.1.

2--Piston needs lubrication./ Remove cylinder and lubricate. See section 6.3.3.

3--Closing spring rubbing./ Wrong spring, or spring bushing left out. Reassemble valve correctly.

4--Stem scraping on limit switch cover./ Loosen screws on cover and adjust position.

7.3.4 Compressed Air Leaks

1--From bad pneumatic connection./ Check air supply plumbing and correct as needed.

2--From faulty solenoid valve./ Replace solenoid control valve.

3--From top of cylinder./ Badly worn piston, loose stem nut or no seal between piston and bushing on the stem.

4--From all around cylinder base./ Cylinder O-ring left out or damaged.

5--From bellows vent when valve is open./ Stem seal failed. Tear valve down and replace. See section 6.3.4.1.

7.3.5 Valve Doesn't Close

1--Solenoid defective and not venting./ See if solenoid exhaust is blocked and clean if needed. If not, replace solenoid valve.

2--Control circuit may be defective and not removing power from solenoid./ Check circuit.

3--Valve cylinder not venting./ Find cause of blockage and repair.

4--Spring left out of valve./ Reassemble correctly.

5--Excessive pressure in valve body holding bellows open./ Internal pressure must not exceed specified value. Check specified value and actual value.

7.3.6 Solenoid Gets Too Hot

Coil and operating voltage/frequency not matched./ They must be the same.

8. RETURN TO FACTORY FOR REPAIR OR SERVICE

Series 150 and 160 valves have been designed for user repair, but occasionally for some reason it is necessary to return a valve to the factory. Before shipping, observe the following steps:

1--It is necessary that HPS Corporation prepare a Returned Material Report (RMR) before shipping so that the item will be recognized upon arrival. Call the factory, and from the Sales department obtain an RMR number which must be used on the packing slip, or shipping label of the returned item.

They will ask:

A--What is the problem, why is the item being returned?

B--What are the symptoms, and how are they observed?

C--What is the application--is the product in a suitable application?

D--Was the valve used with any dangerous, toxic, or radioactive materials? We do not want to endanger anyone repairing the valve.

E--Is it an emergency repair?

F--Is it a warranty repair? When was the valve received?

G--Who is the user or who can answer technical questions about use of the valve?

2--Prepare the valve for shipment. Cap the ports to prevent entry of foreign material and to protect the seal surfaces. Place the valve in a sealed plastic bag, and pack securely in a sturdy shipping container. Poor packing can contaminate the valve and cause needless repair. Either insert a packing slip or letter citing the RMR report, or put the number on the address label.

3--Payment: If inspection shows the problem to be a warranty matter, the valve will be repaired and returned free of charge. If it is not a warranty repair, an estimate will be made, and permission obtained before proceeding.

APPENDIX 1

NOMENCLATURE, MANUAL VALVE

(1) Assy, Body

(2) Seat

(3) Flange, Body

(4) Assy, Bellows

(5) Bellows

(6) Flange, Bellows

(7) Nosepiece

(8) Stem

(9) O-ring, Nosepiece

(10) Spacer

(11) Assy, Thrust Bearing

(12) O-ring, Bellows Flange

(13) Screw, Actuator

(14) Guide, Stem

(15) Ring, Retaining

(16) Knob

(17) Screw, Knob Set

(18) Screw, 10-32 x 0.625" Socket Head Cap SST

(19) Washers, Flat, 5mm SST

APPENDIX 2

NOMENCLATURE, ELECTROPNEUMATIC VALVE

(1) Assy, Body

(2) Seat, Valve

(3) Flange, Body

(4) Assy, Internal

(5) Assy, Bellows

(6) Bellows

(7) Flange, Bellows

(8) Nosepiece

(9) Stem

(10) O-ring, Nosepiece

(11) Spring, Closing

(12) Bushing, Spring

(13) O-ring, Bellows Flange

(14) Assy, Cylinder End

(15) Guide, Valve Stem

(16) U-cup, Stem Seal

(17) Retainer, Stem Seal

(18) Screw, Pan Head with Lock Washer 6-32 x 25"

(19) Bushing, Piston

(20) Piston

(21) Washer, Warning

(22) Nut, Piston

(23) O-ring, Cylinder

(24) Cylinder, Actuator

(25) Screw, Socket Head 10-32 x 1.25"

(26) Washer, Flat 5mm SST

(27) Assy, Limit Switch

(28) Washer, Limit Switch Actuating

(29) Spacer

(30) Screw, Socket Head, 8-32 x 0.5"

(31) Switch, Limit (2pl)

(32) Screw, Pan Head 2-56 x .75" (4pl)

(33) Nut, Hex 2-56 (4pl)

(34) Mount, Limit Switch

(35) Screw, Socket Head 8-32 x Various (2pl)

(36) Screw, Pan Head 6-32 x .25" (2pl)

(37) Lug, Solder Ground

(38) Clamp, Cable 1/4"

(39) Clamp, Cable 1/8"

(40) Washer, Star 2-56 (4pl)

(41) Grommet, Rubber (2pl)

(42) Can, Shield

(43) Nipple, Hex, Close 1/8" NPT

(44) Solenoid, 3-way

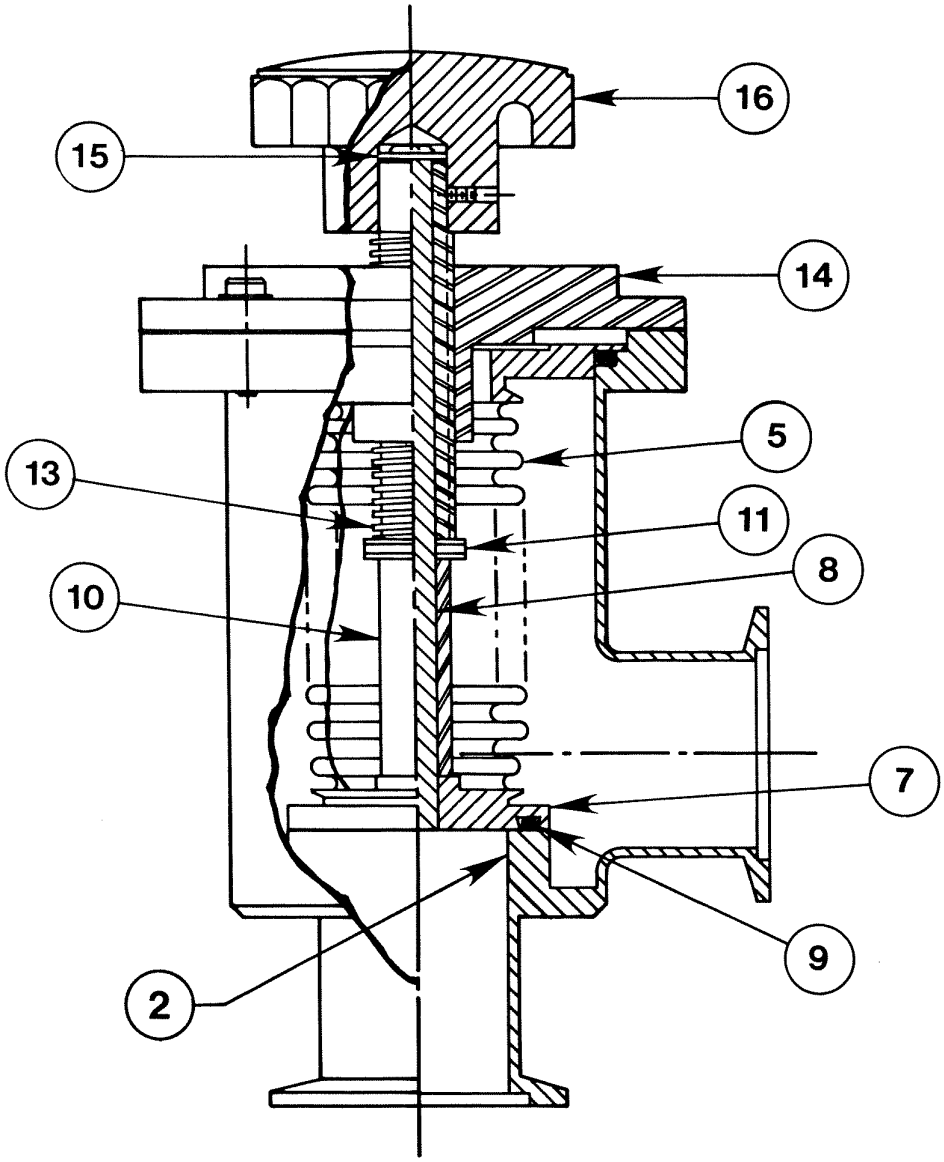

FIGURE 2

MANUAL ANGLE VALVE
PARTIAL SECTION VIEW

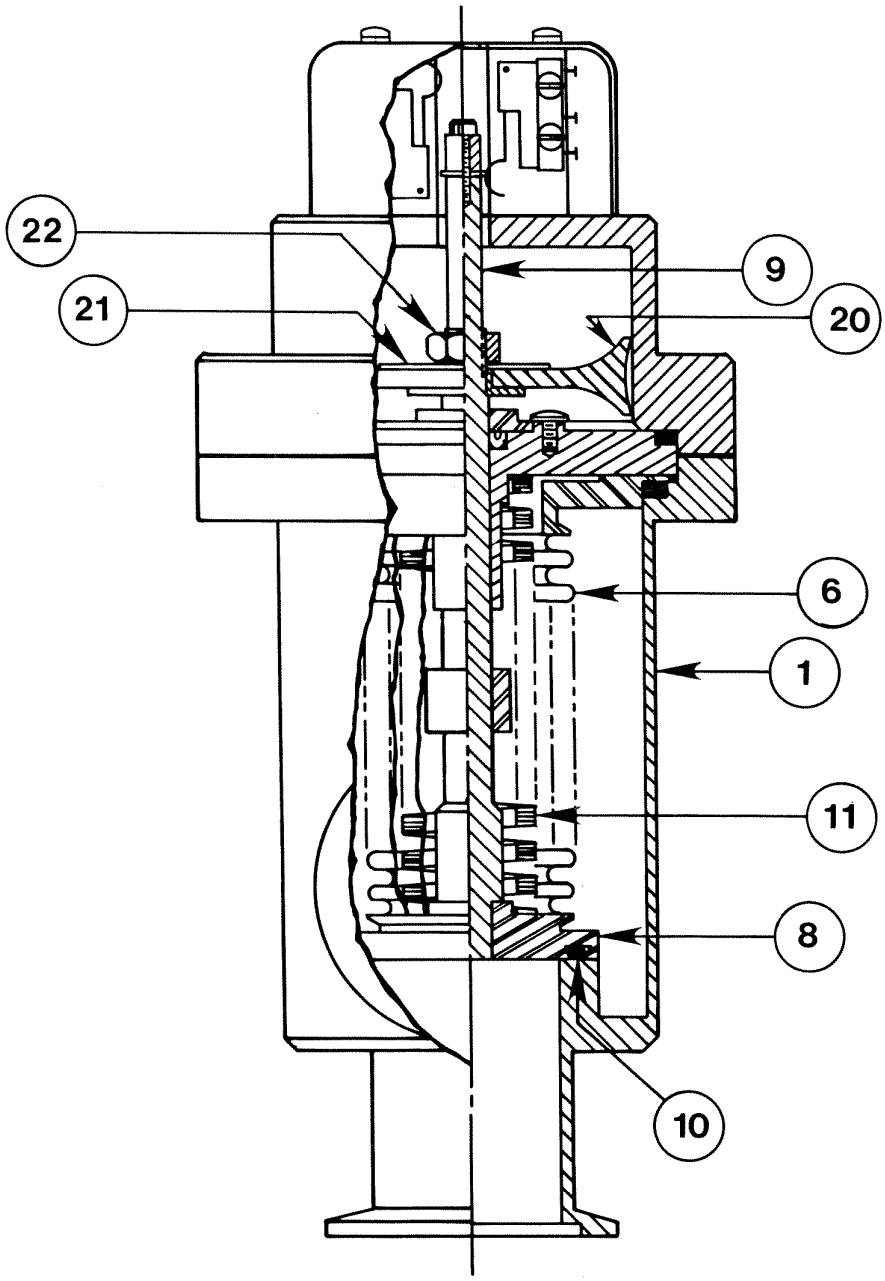

FIGURE 3

PNEUMATIC ANGLE VALVE
PARTIAL SECTION VIEW

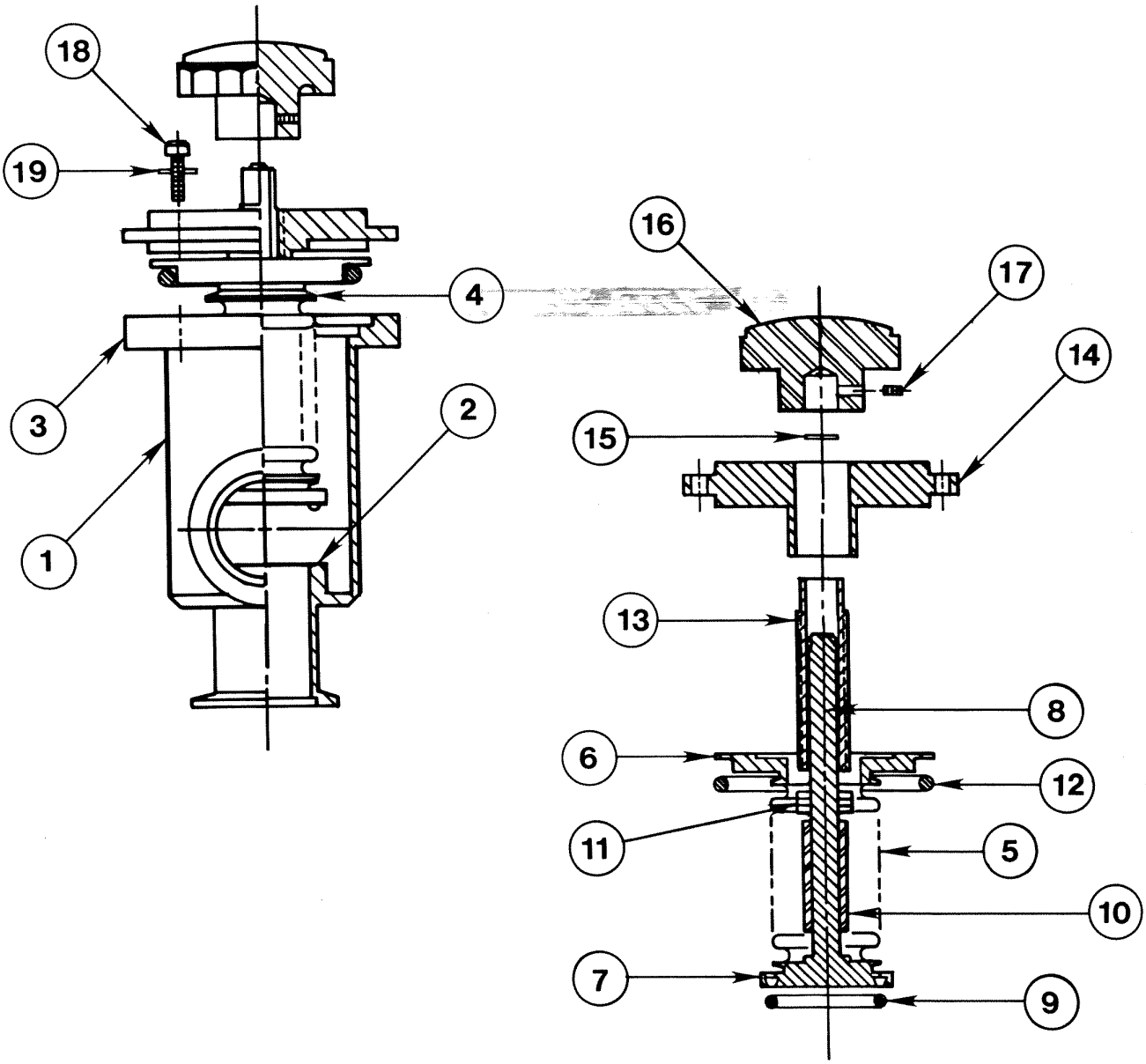

FIGURE 4
MANUAL ANGLE VALVE
EXPLODED VIEW

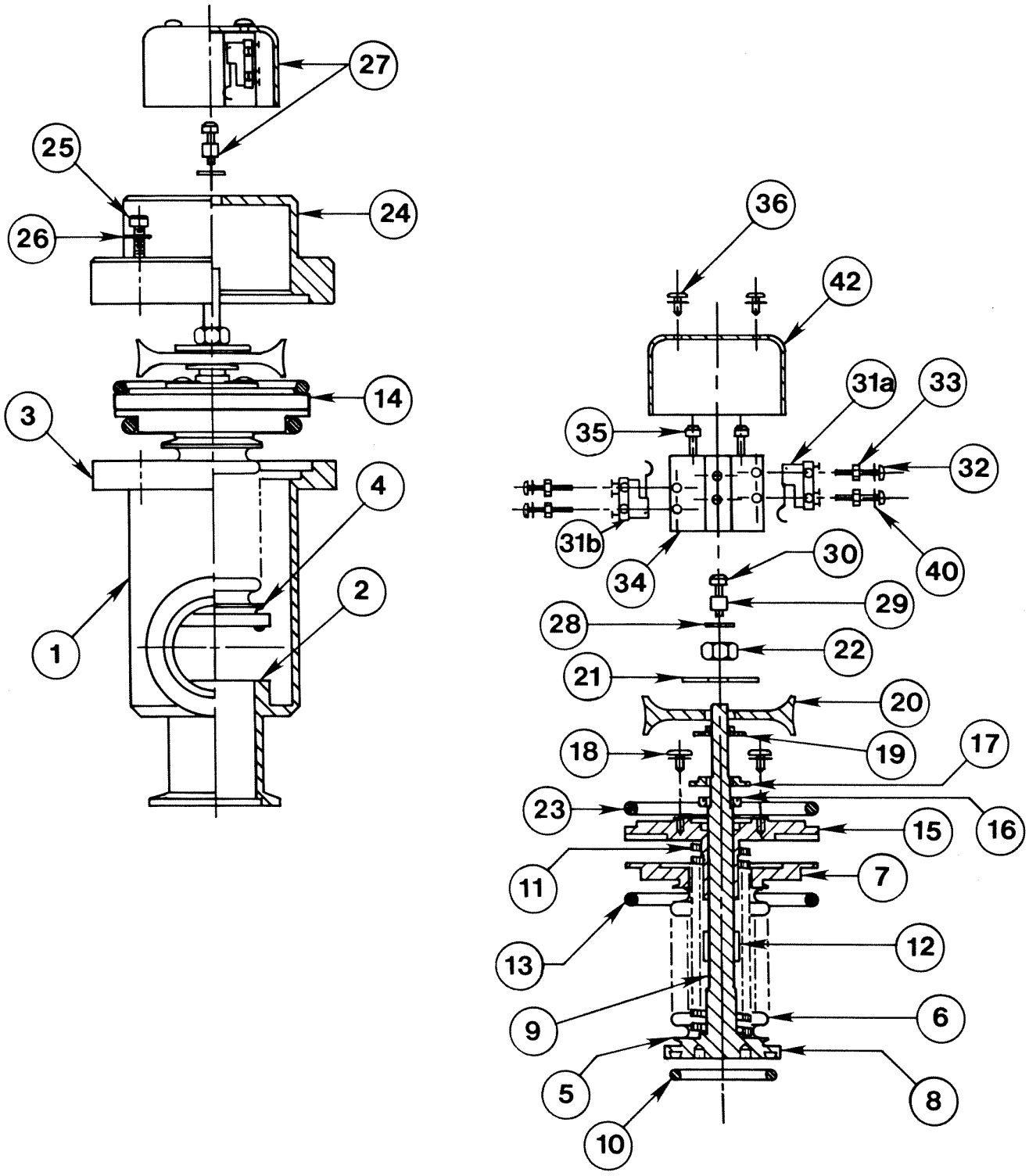

FIGURE 5

PNEUMATIC ANGLE VALVE
EXPLODED VIEW

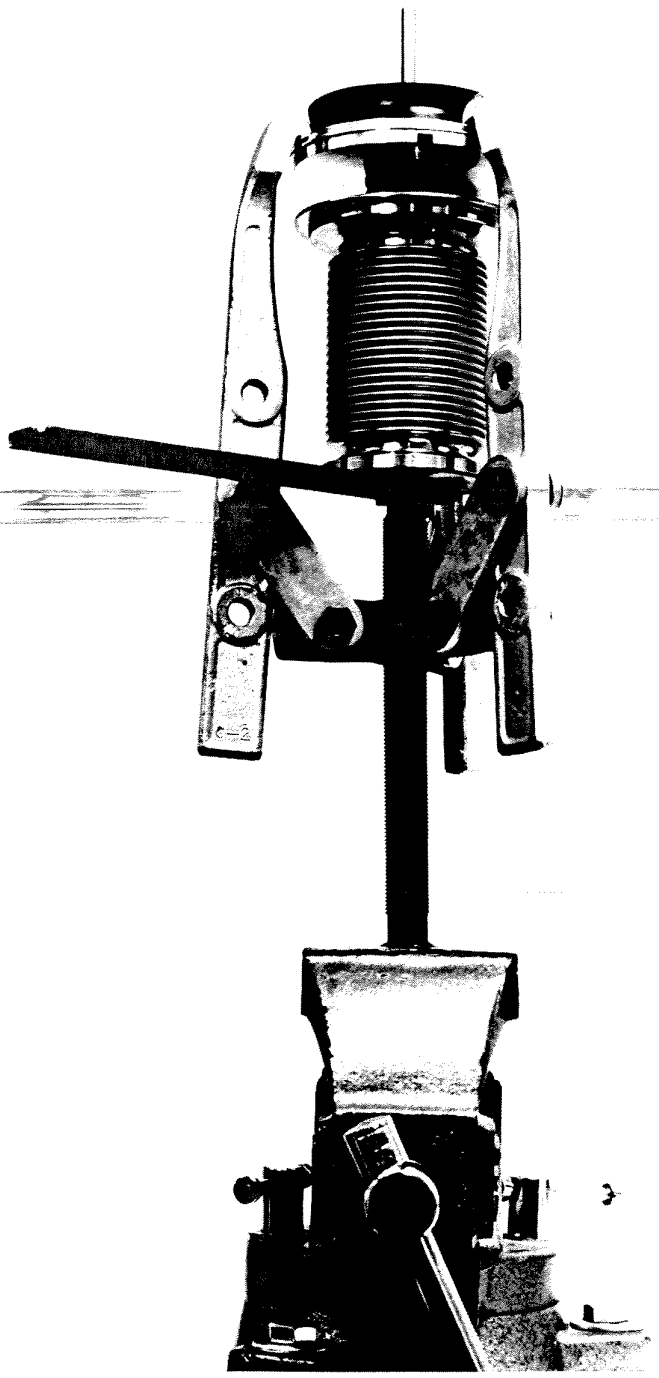

FIGURE 6

SPRING COMPRESSION METHOD

This simple method for valve disassembly uses a standard gear puller. Note the use of a ring below the claw to protect the seal surface of the stem guide and a spanner wrench on the nosepiece to prevent rotation while removing the piston nut.

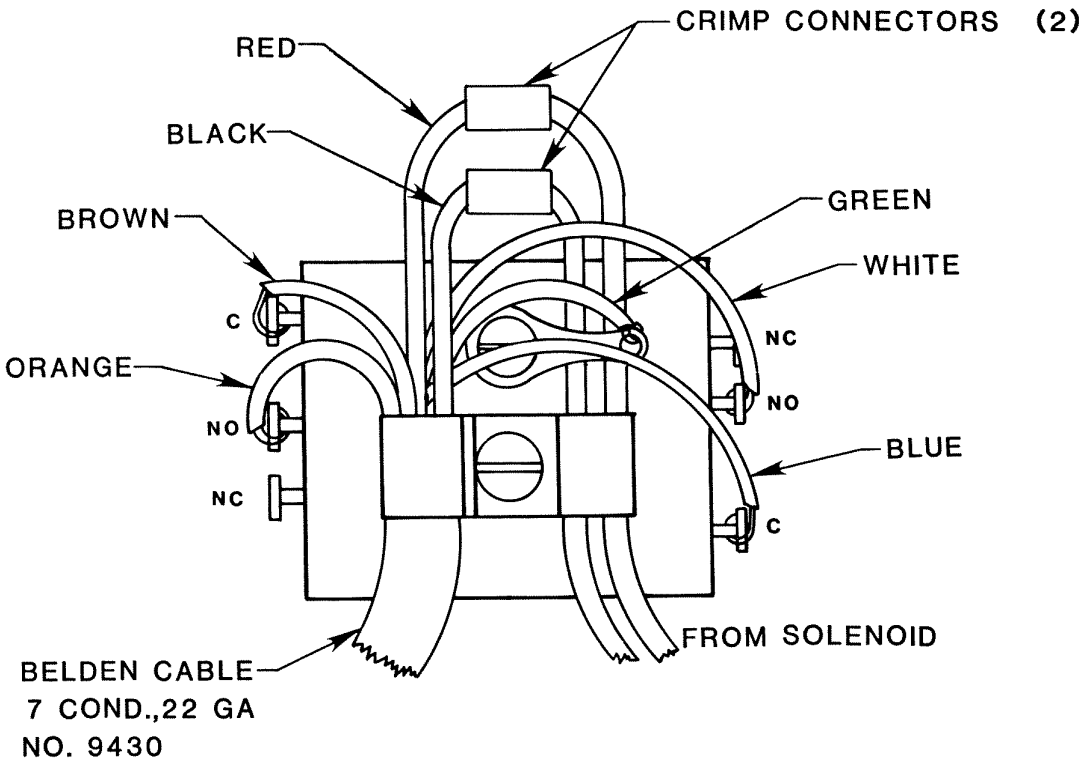

FIGURE 7
SUGGESTED LIMIT SWITCH WIRING

CONNECTOR PARTS:

MALE 9-PIN FOR END OF CABLE FROM VALVE - AMPHENOL CAT. NO. 17 DE 9P

FEMALE 9-PIN FOR CONNECTING CABLE - AMPHENOL CAT. NO. 17 DE 9S

SHELL WITH CABLE CLAMP FOR EITHER OF THE ABOVE, AMPHENOL CAT. NO. 17-1370

SPRING LATCH TO LOCK A PAIR OF CONNECTORS TOGETHER INCLUDES THE PAIR REQUIRED, AMPHENOL CAT. NO. 17-529

CONNECTIONS:

PIN	WIRE	USE
1	GREEN	GROUND
2 6	RED BLACK	SOLENOID CONTROL VALVE
4 8	ORANGE BROWN	CLOSED POSITION LIMIT SWITCH
5 9	WHITE BLUE	OPEN POSITION LIMIT SWITCH

FIGURE 8
SUGGESTED CABLE CONNECTOR WIRING ARRANGEMENT

LIMITED WARRANTY

1. **Scope of Coverage.**

HPS warrants Series 150 and 160 valves to be free from defects in materials and workmanship for a period of ONE YEAR from date of shipment by HPS or authorized representative to the original purchaser ("Purchaser"). Any product or parts of the product repaired or replaced by HPS under this warranty are warranted only for the remaining unexpired portion of the one year original warranty period applicable to the product which has been repaired or replaced. After expiration of the applicable warranty period, the Purchaser shall be charged HPS's current prices for parts and labor, plus any transportation for any repairs or replacement.

Repairs. The obligations of HPS under this warranty shall be at its option, (1) to repair, replace or adjust the product so that it meets applicable product specifications published by HPS; or (2) to refund the purchase price.

2. **Warranty Performance.**

To obtain warranty satisfaction contact the following:

HPS
Division of MKS INSTRUMENTS, INC.
5330 Sterling Drive
Boulder, Colorado 80301
(303) 449-9861

3. **What Is Not Covered.**

A. **Exclusions.** The above warranties do not apply:

1. To damages or malfunctions due to failure to provide reasonable, and necessary maintenance in accordance with HPS operating instructions.

2. To damages or malfunctions due to chemical or electrolytical influences, or use of the product in working environments outside the specification.

3. To seals, bellows, and all expendable items which by their nature or limited life-times may not function for a year. If such items fail to give reasonable service for a reasonable period of time within the warranty period of the product they will at the option of HPS be repaired or replaced.

4. To defects or damages caused by modifications and repairs effected by the original purchaser or third parties not authorized in the repair manual.

4. **Other Rights and Remedies.**

A. These Remedies are Exclusive. HPS SHALL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES, FOR ANTICIPATED OR LOST PROFITS, INCIDENTAL DAMAGES OR LOSS OF TIME OR OTHER LOSSES INCURRED BY THE PURCHASER OR BY ANY THIRD PARTY IN CONNECTION WITH THE PRODUCT COVERED BY THIS WARRANTY, OR OTHERWISE. SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU. ANY IMPLIED WARRANTY ON THESE PRODUCTS SHALL BE LIMITED TO ONE YEAR FROM DATE OF SHIPMENT TO PURCHASER. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS SO THE ABOVE LIMITATIONS MAY NOT APPLY TO PURCHASER.

B. No Other Express Warranties. Unless otherwise explicitly agreed in writing, it is understood that these are the only written warranties given by HPS. Any statements made by any persons including representatives of HPS which are inconsistent or in conflict with the terms of the warranty shall not be binding on HPS unless reduced to writing and approved by an authorized officer of HPS.

C. Specific Legal Rights. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

MKS INSTRUMENTS, INC.

For information or literature contact

HPS
Division of MKS INSTRUMENTS, INC.
5330 Sterling Drive
Boulder, CO 80301
Phone: (303) 449-9861