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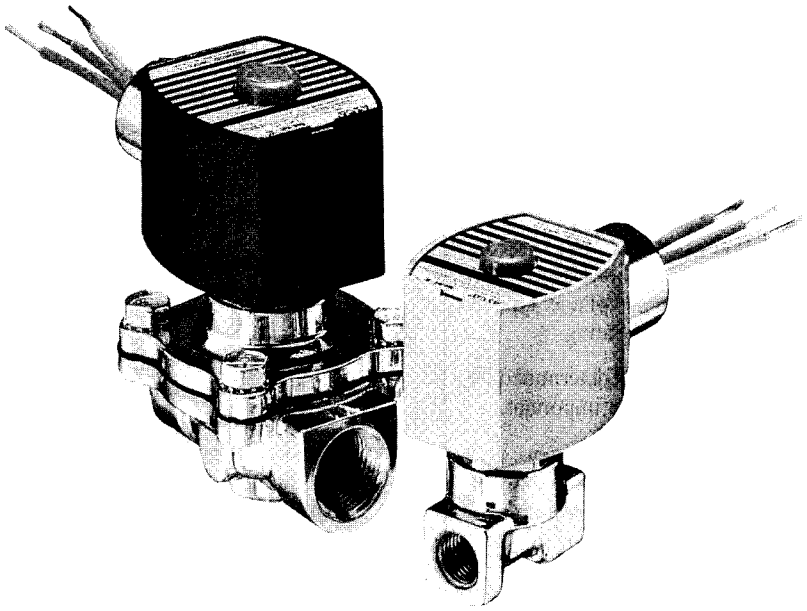
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ASCO® Red-Hat® and Red-Hat II®

Solenoid Valves

SELECTION
INSTALLATION/MAINTENANCE
TROUBLESHOOTING



ASCO®

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HOW TO SELECT
ASCO® Red-Hat and Red-Hat II Solenoid Valves

ASCO Red-Hat and Red Hat II① solenoid valves for the control of fluids are available in thousands of varieties, each designed to meet specific requirements. Many features are readily apparent and easily understandable; others are more complex and require special knowledge to select the best valve for your control application.

For example, selecting a valve too large for the application will usually involve needless initial cost; selecting a valve too small will usually lead to poor fluid control for the application.

Valves fall into four basic construction groups:

Two way Valves – have one inlet and one outlet pipe connection and are available for normally closed and normally open operations. Normally closed valves are closed when the valve is de-energized and open when the proper voltage is applied to the coil. Normally open valves are open when de- energized and close when the coil is energized.

Three way Valves – have three pipe connections and two orifices which are alternately open or closed. These valves are available normally closed, normally open, or with universal construction which can be used as normally closed or normally open. Three way valves are generally used as pilots for larger control valves, to actuate single-acting cylinders, or to divert the flow of fluids.

Four way Valves – usually have four pipe connections: one for pressure, one for exhaust, and two to operate double-acting cylinders. They are also used to pilot larger control valves.

Manual Reset Valves – must be opened or closed manually, then revert to their original position when, depending on the construction, they are energized or de-energized. They are used to prevent inadvertent startup of critical systems.

After determining the basic valve type, consideration must be given to pipe size; orifice size, flow rate, pressure rating, medium to be controlled, ambient and fluid temperatures, voltage, type of solenoid enclosure, cycling rate and required life rating.

Although the relative importance of each factor is determined by the application itself, valve size is usually the most important.

Valve Sizing

Valve configuration and orifice size, as well as the viscosity, specific gravity and temperature of the controlled medium have the greatest influence on determining proper valve size.

All variables affecting the selection have been reduced to a single parameter known as the flow coefficient (Cv.). ASCO provides graphs for determining Cv values, and displays those Cv values for each valve in its product catalogue. This makes it easier to select the proper valve to meet your particular flow requirements.

Pressure Ratings

Pressure rating is directly related to orifice size. For direct acting values which operate from zero to maximum pressure, the pressure rating decreases as orifice size increases.

Large valves, and those rated for high pressures, are offered in pilot-operated versions in which fluid line pressure operates the valve. These valves have a pilot and bleed orifice, and are usually of the diaphragm or piston type. For proper operation, a minimum pressure differential of 2 to 10 psi (depending on construction) is required between the inlet and exhaust ports.

The minimum and maximum pressure ratings for these valves are listed in the ASCO catalogue and are shown on the valve nameplate. Special care must be taken not to excessively oversize an internally piloted valve. Pressure drop or flow through the valve may be insufficient to lift the piston or diaphragm off the orifice, resulting in little or no flow.

In some designs, heavy-duty solenoid coils are used to increase the pressure rating for a given orifice size.

Pressure ratings should be as close as practicable to system pressure.

A valve will not open against pressure significantly higher than the valve's rating. The solenoid's magnetic circuit will not be completed, causing the coil to draw excessive current and burn out.

Conversely, if the system pressure is significantly lower than the valve's rating, the high impact of the solenoid core against the plug nut will cause excessive wear and reduced life.

For best results, select a valve with a pressure rating which is only slightly greater than system pressure.

Medium Compatibility

Valve materials and constructions are compatible with a wide variety of media: air, water, oil, steam, and corrosive and non-corrosive gases and liquids. It is essential that the valve you select be compatible with your controlled medium.

ASCO valve bodies and internal parts are stainless and carbon steel, aluminum, brass, and a wide variety of plastics and elastomers. The ASCO catalogue specifies media compatibility for each valve.

Solenoid Coil Insulation

A coil's worst enemy is heat. Prolonged periods at excessive temperatures lead to thermal degradation of coil insulation. This heat may come from high-temperature fluids passing through the valve, from the electrical energy spent in the coil, or simply from the air around it. The temperature which results from all these sources will determine the required coil insulation class.

Nominal maximum permissible ambient temperatures are based on test conditions used by Underwriter's Laboratories, Inc. to determine safe coil insulation temperatures. Tests are conducted with coils continuously energized and valves at maximum fluid temperatures.

The epoxy-molded coils and solenoids used in ASCO Red-Hat and Red-Hat II valves are resistant to thermal degradation; they dissipate heat more effectively than paper-section coils. They also resist moisture, chemical attack, fungi, and mechanical stress, significantly increasing their life.

① ASCO's new generation of solenoid valves, Red-Hat II, features one-piece epoxy encapsulated solenoids.

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Coil Operating Voltage

Standard voltage ratings are 6, 12, 24, 120, 240, and 480 volts AC, and 6, 12, 24, 120 and 240 volts DC.

Red-Hat and Red-Hat II valves operate satisfactorily on voltage reductions as much as 10 - 15% below nominal (depending on construction), and can withstand as much as 10% over voltage for brief periods.

Power Consumption

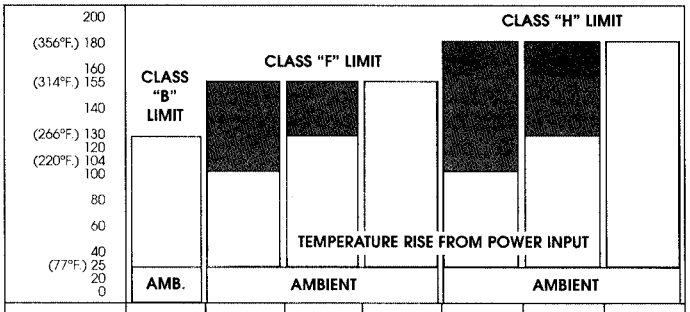
Power consumption can be determined from the ratings shown for each valve series shown in the ASCO catalogue. For AC valves, the watts, volt-ampere "inrush" (the high, momentary surge occurring at coil energization) and volt-ampere "holding" (the continuous draw following inrush) are given.

The current rating for inrush and holding may be determined by

ENCLOSURE TYPE DESIGNATIONS

Enclosure Type	Location	Application Criteria
1	Indoor	General purpose; normal atmospheric conditions
2	Indoor	Drip-proof.
3	Outdoor	Dust-tight, rainproof, and sleet (ice) resistant.
3S	Outdoor	Dust-tight, rainproof, and sleet (ice) proof.
4	Indoor	Watertight and dust-tight.
4X	Indoor	Watertight, dust-tight, and corrosion resistant.
6	Indoor/Outdoor	Submersible, watertight, dust-tight, and sleet (ice) resistant.
7	Indoor	Hazardous locations. Suffix to type (Class I and Group A, B, C or D) complete designation from definitions in National Electrical Code.
9	Indoor	Hazardous locations, combustible dust. Class I and Group E, F or G suffixes from National Electrical Code.

FINAL TEMP. (°C.)



COIL CLASS		B	FT	FB	FF	HT	HB	HP
TYPICAL AC WATT RATING	MXX	④	10.5	16.7	③	10.5	16.7	20.5
	M-12	④	15.4	20	③	15.4	20	28

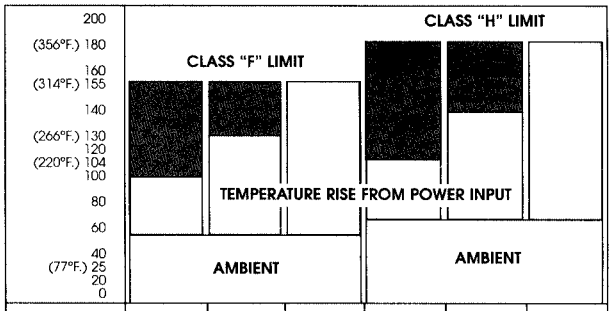
INDUSTRIAL TEMPERATURE LIMITATIONS① AND THERMAL CHARACTERISTICS OF ASCO RED-HAT SOLENOIDS AND COILS

The typical watt ratings given show the relationship between different classes of coil insulation and the watt ratings to achieve higher temperature capabilities.
The information contained in these tables applies only to non-explosionproof constructions.⑤

② **Excess margin for higher fluid or ambient temperature**

① As measured by the "Resistance Method"
② Ambient temperatures are directly additive to coil rise – fluid temperature is not.
③ Only available in limited watt ratings. Consult ASCO when required.
④ Only available in M-5 and MLXX solenoid sizes.
⑤ Because of explosionproof codes and surface temperature limitations, the maximum listed ambients for specific valves should not be exceeded. Consult factory concerning explosionproof applications where higher than listed ambients are encountered.

FINAL TEMP. (°C.)



COIL CLASS		FT	FB	FF	HT	HB	HP
TYPICAL AC WATT RATING	M6	6.1	9.1③	④	6.1③	9.1③	④
	MXX	10.1	17.1	④	10.1	17.1	④

INDUSTRIAL TEMPERATURE LIMITATIONS① AND THERMAL CHARACTERISTICS OF ASCO RED-HAT II SOLENOIDS AND COILS

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dividing the volt-ampere rating by the voltage:

$$\text{Inrush Amps} = \frac{\text{volt-amp inrush}}{\text{voltage}}$$

$$\text{Holding Amps} = \frac{\text{volt-amp holding}}{\text{voltage}}$$

DC valves have no inrush current. The amp rating can be determined by dividing the voltage into the DC watt rating:

$$\text{Amps} = \frac{\text{watts (DC)}}{\text{voltage}}$$

Solenoid Enclosures

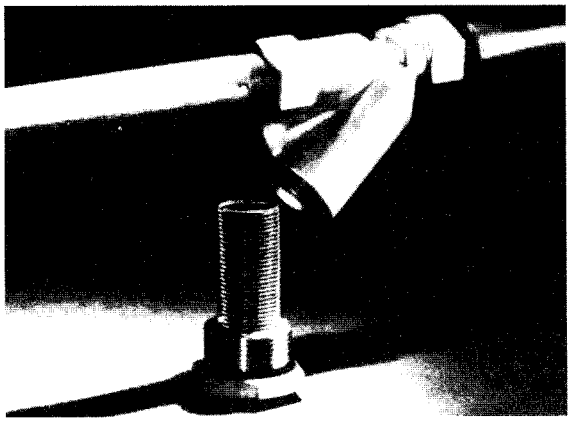
ASCO Red-Hat II solenoid enclosures have one-piece molded epoxy construction with an integral 1/2" N.P.T. conduit hub. The epoxy encapsulation serves as the enclosure. The magnetic frame is molded into the coil.

ASCO Red-Hat solenoid valves have an enclosure which is separate from the coil. The enclosure should be kept in place at all times because, with many types, it provides part of the magnetic circuit. Removal of the enclosure can reduce solenoid efficiency and expose the mechanism to damage.

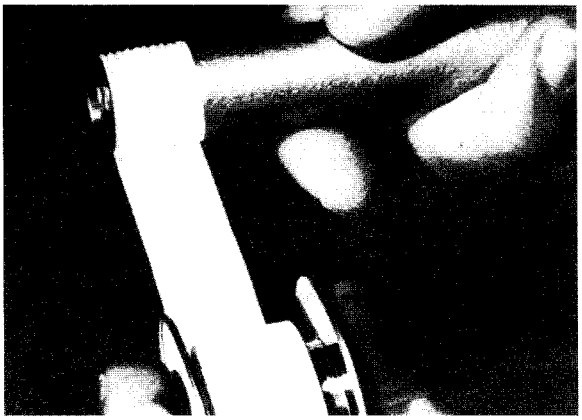
For optional electrical features such as junction boxes, spade and screw terminal coils, and DIN-type connections, consult ASCO catalogue.

Cycling Rate and Estimated Life

When controlling unlubricated air or dry, inert gas, special construction is usually required to provide long valve life. Selecting the solenoid valve to last as long as the rest of the system or equipment allows the valve to be serviced during normal maintenance downtime. Because foreign matter such as pipe scale can shorten the life of a solenoid valve, a suitable strainer should be installed as close as possible to the valve inlet.



A strainer or filter should always be installed as close as possible to the inlet of a solenoid valve.



Pipe joint compound or Teflon tape should be used on all male fittings, but should not be placed on the first two threads or on female fittings.

HOW TO INSTALL AND MAINTAIN

ASCO® Red-Hat and Red-Hat II Solenoid Valves

Proper installation and maintenance procedures go a long way toward prolonging valve life. Read and follow the instruction packed with each ASCO Red-Hat and Red-Hat II valve.

Nameplate data - voltage, pressure, etc. - should be checked to ensure compatibility with system conditions. Check, too, that the type of solenoid enclosure is compatible with your operating environment.

Some Red-Hat and Red-Hat II valves are designed to operate in any mounting position, while others must be oriented in a certain way to operate properly. Whenever possible, however, all valves should be mounted with the solenoid in a vertical and upright position to reduce the possibility of foreign matter accumulating in the core tube area. The first line of defense against this occurrence, however, is the installation of a filter or strainer as close as possible to the valve inlet.

Installation Practices

Teflon tape or pipe joint compound should be used, but only on male pipe threads. To prevent foreign matter from entering the valve, do not apply either sealant to the first two male threads or to any of the female treads.

Two wrenches should be used to attach the valve to its piping. Use a pipe wrench to turn the pipe into the valve, and a second wrench on the flat of the valve body. To prevent distortion of the valve body, apply the second wrench to the side of the valve into which the pipe is being inserted.

Because the Teflon tape or pipe joint compound reduces friction and makes turning easy, there is a tendency to over torque when installing valves. This poses potential damage to the valve body, especially aluminum or die-cast body valves.

Inlet and outlet piping must be properly supported to prevent strain on the valve body.

Wiring must comply with local codes and the Canadian Electrical Code. Be sure that the solenoid leads cannot be pulled from the coil. If you are not using flexible conduit for transition into the valve, the supply conduit must be properly supported to prevent stress on the solenoid assembly.

A considerable amount of foreign matter can collect in a system,

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especially during new construction. So, always flush the system thoroughly before releasing it for normal operation. Clean the strainers and filters after the line pressure and electric power have been shut off, but be sure to open the strainer service cap slowly to release trapped pressure. A second flush may be necessary.

Maintenance Procedures

Cleaning of filters and strainers should be part of your normal preventive maintenance program, along with cleaning and inspection of the valve. If the valve is not operating properly, and corrective steps are required, confirm that the problem is in the valve and not caused by other conditions in the system.

Foreign matter in the valve, such as pipe joint sealant, corrosion from pipes and process vessels, mineral deposits and other solids, is a major cause of solenoid valve failure. If valve disassembly is required, always follow the instructions supplied with the valve for disassembly, cleaning and reassembly.

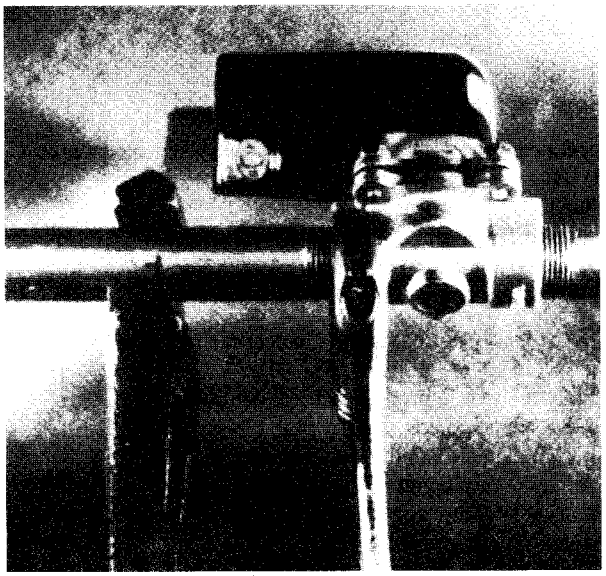
Before disassembling the valve, it's always best to have on hand those parts subject to wear which are most likely to require replacement. ASCO offers rebuild kits containing all the internal parts needed to restore the valve to its like- new condition.

Except on very old valves, you'll find the rebuild kit number listed on the valve nameplate. These kits include comprehensive instructions and an exploded view of the valve. On all valves, but especially Red-Hat II, always be sure to reinstall the nameplate. The nameplate serves as a retainer to hold the solenoid to the valve.

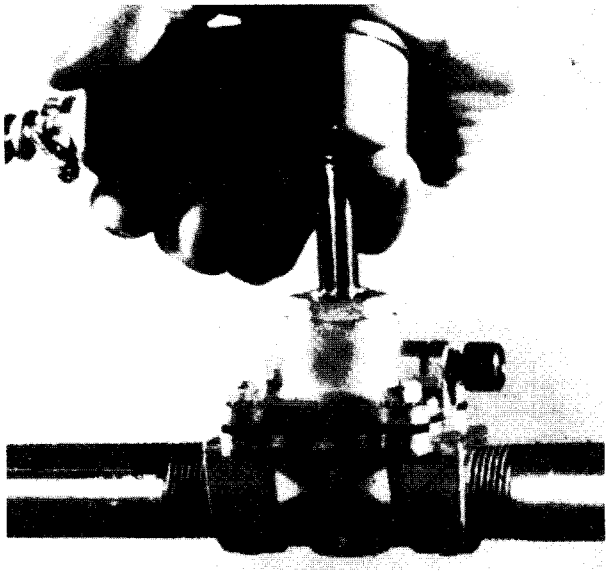
Maintenance Tips

Direct-Acting Valves

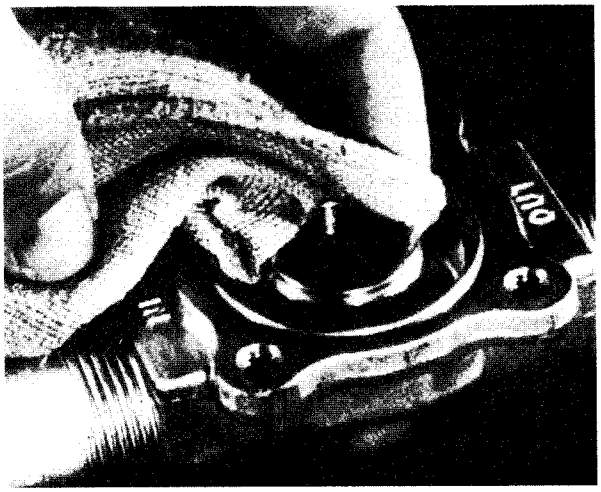
Always turn off electrical and fluid supplies before disassembling a valve, and loosen the solenoid base slowly to release any trapped pressure. Remove internal parts and wipe them clean with a lint-free cloth. Examine the valve body for foreign material and



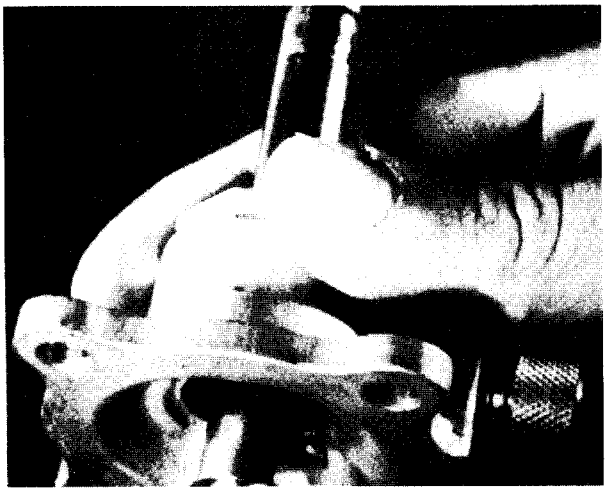
Two wrenches should be used when removing or installing a solenoid valve. Stress on the valve body can be prevented by placing the wrench on the same side of the valve as the pipe that is being screwed out of or into the valve.



After electric power and fluid line pressure have been shut off, the first step in valve disassembly is to remove the solenoid mechanism.



Dirt on the valve body and on internal parts should be wiped off with a lint-free cloth.



The solenoid core must move freely in the core tube and should be free from signs of binding and excessive wear.

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deposits. Be especially careful not to scratch the valve seat or disc during cleaning.

The movable core and core tube should be examined for signs of binding and wear. If present, all internal parts should be replaced. If there is excessive wear to the valve body (e.g. wire drawing of the seat), the valve should be replaced.

The disc at the end of the movable core or piston should be checked for signs of excessive impacting. If deep impressions are noted, and the system involves liquids, a water hammer condition may exist. To protect the pipes and equipment in the system, install a water hammer cushioner close to the valve inlet, or replace the valve with an ASCO Slow Closing valve.

After reassembly, check the valve operation by energizing the solenoid coil. A sharp metallic click should be heard if the valve is operating properly.

Pilot-Operated Valves

Cleaning and inspection procedures are essentially the same as for direct-acting valves. However, pilot operated valves also have a diaphragm or piston with bleed holes which must be cleaned. The piston should move freely in its cylinder and the piston rings should rotate freely in the groove.

HOW TO TROUBLESHOOT

ASCO® Red-Hat and Red-Hat II Solenoid Valves

Because there are so many potential reasons for solenoid valves to malfunction, they are often thought to be complex, trouble-prone devices. Actually, they are quite simple and very reliable. Many of the problems originate outside the valves themselves, while others are caused by misapplication or improper installation.

Troubleshooting should begin with a check of the voltage and pressure input. The problem may be caused by an inoperative control relay or a fluctuating pressure regulator. If voltage and pressure check out, look to the valve. The main reasons a direct-acting solenoid valve fails to operate include:

- Low or no voltage
- Burned-out solenoid
- Pressure higher than the valve's rating
- Foreign matter in the valve
- Binding core or damaged core tube

To operate properly, a solenoid valve core must move within the core tube and contact the plugnut when the coil is energized. You should hear a sharp metallic click at energization. Absence of the click usually indicates an electrical problem. For most valves, voltage applied to the coil must be at least 85% of the nameplate voltage rating.

If the valve coil is receiving the proper voltage, absence of a click may mean that the line pressure is higher than the valve's rating. Check that next.

If line pressure is OK, foreign matter may be preventing the core from moving in the core tube. Core movement can also be restricted if the top of the core has been peened over by millions of operations, if the disc is swollen or cut, or if the core itself has been damaged.

A pilot-operated valve might fail to operate when energized even though a click has been heard. A no-flow condition may be caused by:

- Insufficient pressure drop across the valve
- Ruptured diaphragm or damaged piston ring
- Plugged or restricted pilot orifice

Both pilot-operated and direct-acting valves can fail to operate when de-energized because of:

- Faulty control circuit
- Scale or other foreign matter in the valve
- Binding core or damaged core tube
- Broken spring

Pilot-operated valves may also malfunction when de-energized due to:

- Plugged bleed orifice
- Damaged pilot seat or disc
- Damaged diaphragm or piston
- Insufficient pressure drop across the valve

Excessive solenoid noise (hum or chatter) can be caused by:

- Low voltage
- Faulty relay or improper electrical control signal
- Loose solenoid parts
- Foreign matter on core or plugnut face
- Worn core or plugnut face
- Damaged spring
- Excessive system pressure

When troubleshooting 4 way valves controlling cylinders, it is important to follow the instructions provided with the valve. Some 4 way valves require an oil-mist lubricator for proper operation.

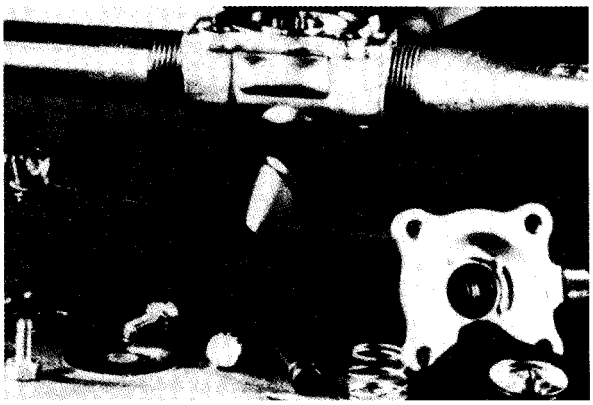
Pilot-activated 4 way valves normally require full-size piping for pressure inlet and exhaust. In some of these valves, restrictive speed control devices should be installed in the cylinder connections.

Because faulty cylinder operation is often caused by the cylinder itself, it should be checked for:

- Misalignment between the piston rod and connected load
- Lack of lubrication
- Worn and leaking piston cups which allow fluid to exhaust through the valve
- Foreign matter in the speed controls
- System overloading, low line pressure, or undersized hoses or fittings.

If the problem does not appear to be in the cylinder, the valve should be checked.

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ASCO offers rebuild kits which contain all components needed to make a valve like new again.

Pilot-activated 4 way valves normally require full-size piping for pressure inlet and exhaust. In some of these valves, restrictive speed control devices should be installed in the cylinder connections.

Because faulty cylinder operation is often caused by the cylinder itself, it should be checked for:

- Misalignment between the piston rod and connected load
- Lack of lubrication
- Worn and leaking piston cups which allow fluid to exhaust through the valve
- Foreign matter in the speed controls
- System overloading, low line pressure, or undersized hoses or fittings.

If the problem does not appear to be in the cylinder, the valve should be checked.

TROUBLESHOOTING GUIDE

Problem	Possible Cause	Probable Solution
Valve will not operate when valve circuit is energized (direct-acting valve)	Low voltage or no voltage to solenoid coil	Check voltage at coil; for most valves, voltage should be at least 85 percent on nameplate rating.
	Burned out coil	See "Coil Failure" below.
	Excessive foreign matter jamming core in core tube	Clean valve; install strainer close to valve inlet
	Binding core or damaged core tube	Replace parts.
	Excessive fluid pressure	Reduced pressure to valve nameplate pressure rating or install suitable valve.
Valve will not operate when valve circuit is energized (pilot-operated valve)	Same causes and solutions as for direct-acting valve, plus:	
	Low pressure drop across valve	Valve might be oversized; replace valve with one having a smaller orifice. Increase pressure, if possible.
	Ruptured diaphragm or piston ring	Replace damaged parts.
	Plugged or restricted pilot orifice	Clean valve and pilot orifice.
Valve will not close or shift when valve circuit is de-energized (direct-acting valve)	Coil not de-energized	Check electrical control circuit.
	Excessive foreign matter jamming core in core tube	Clean valve; install strainer close to valve inlet.
	Damaged disc or seat causing internal leakage	Replace with new parts.
	Binding core or damaged core tube	
	Damaged spring	Replace with new spring. Never elongate or shorten spring.
Valve will not close or shift when valve circuit is de-energized (pilot-operated valve)	Same causes and solutions as for direct-acting valve, plus:	
	Plugged bleed orifice	Clean orifice.
	Damaged pilot seat or pilot disc	Replace with new parts.
	Damaged diaphragm or piston	
	Damaged pilot spring	Replace with new spring. Never elongate or shorten spring.
	Insufficient pressure drop across the valve	Valve might be oversized; replace valve with one having a smaller orifice. Increase pressure, if possible.
Wire drawing	Dirt or foreign matter is lodged on seat	Replace valve body or install new valve; install suitable strainer close to inlet of valve.
Coil failure *	Overvoltage	Check voltage at coil; voltage must conform to nameplate rating.
	Damaged core or core tube causing inrush current to be drawn continuously	Check for damaged core and core tube, or damaged spring. Check for scale or foreign matter on the core or inside the core tube. Clean thoroughly and replace any damaged parts.
	Excessive foreign matter jamming core in core tube and causing inrush current to be drawn continuously	
	Excessive fluid pressure causing inrush current to be drawn continuously	Reduce pressure or install suitable valve.
	Excessive ambient or fluid temperature	Class A coils are limited to ambient temperatures of 77° F. For temperature up to 167° F, use Class F coils; for temperatures up to 212° F, use Class H.
	Missing solenoid parts	Install missing solenoid housing and other metal parts or properly install incorrectly assembled metal parts. The housing and other metal parts form part of the magnetic circuit and are required to provide the impedance needed to limit current draw.
	Moisture inside solenoid enclosure	Waterproof the entrance conduit to prevent entry of moisture. If valve is mounted outdoors, check to see that enclosure is weatherproof and that gaskets are in good condition; use appropriate sealant where required. If general-purpose enclosure is used in a damp or humid atmosphere, use watertight, molded coils

* In Red-Hat II Explosionproof solenoids, a binding core, high-input voltage, or excessive ambient or fluid temperature may cause the solenoid's non-resettable thermal fuse to open. If this occurs, the solenoid must be replaced.

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