

## SOLENOID OPERATORS ON DIRECTIONAL CONTROL VALVES

“Solenoid” valves use an electric signal to control the flow.

### BASIC TYPES

1. “On” – “Off” solenoid valves. When energized, they are either “fully on (or fully off)” and when de-energized they are the opposite state.
2. Proportional solenoid valves. The movement of the valve actuator is proportional to an electric signal. They have degrees of being either on or off.
3. Proportional – pressure compensated. The output of the valve is proportional to an electric signal, regardless of the output pressure.
4. Pilot operated or Direct acting. In a direct acting directional control valve, the solenoid’s armature directly acts on the spool (the coil rod pushes on the spool). In a pilot operated directional control valve, the solenoid moves a small spool in a cartridge and this cartridge spool movement allows pilot pressure to act on either on the spool or a piston connected to the spool. The pilot pressure provides the force that moves the spool. With traditionally sized solenoids, direct acting valves are generally limited to a flow capacity of a few gpm.

### PRINCIPLES OF OPERATION

1. All of our solenoid operated directional control valves are pilot operated.
2. The pilot pressure can come from an external pilot source, but our valves are normally internally piloted.
3. Currently all of our valves are “on” – “off” valves – also known as bang bang valves. When a solenoid is energized, the spool shift is very rapid. With the rapid shift, there is no metering or feathering. The systems can jump with the sudden start of flow.
4. Solenoid operators require spring center operation. We cannot have any detented operation or 4 position spools. We can have 3 way spools. We can have 2-position spring centered valves (by using one solenoid cartridge instead of two).
5. Generally, a manual handle cannot be used to move a spool, that has been shifted with pilot pressure, back to neutral. The force due to the pilot pressure is too great.
6. **The internal pilot pressure is the pressure between the power core and the tank core and is generated either by a pressure build up cartridge in the SV**

and RD5000 or by the Utility section in the Series 20 valves.

7. **The internal pilot pressure is used to initiate the spool shift when a solenoid is energized. Load induced pressure is required to complete the spool shift and hold the spool in a shifted position. Without load induced pressure the spool will only partially shift and then stop.**

Ninety percent of solenoid valve problems are associated with items 6 & 7. When trouble shooting solenoid valve problems always explore these items. Does the valve have a pressure build up cartridge or utility section? Is there load induced pressure (for instance, when trying to lower a weight, there would be no load induced pressure).

### SV SOLENOID SECTIONS

1. The SV solenoid sections require a pressure build up cartridge to provide the internal pilot pressure needed to initiate the spool shift.
2. The pressure build up cartridge goes in the power beyond cavity in the outlet. Outlet sections that have been defined with the pressure build up cartridge are:
  - A. SVEx6 – open center outlet with pressure build up.
  - B. SVEx7 – power beyond outlet with pressure build up.
  - C. SVEx3 – standard closed center outlet can be used for solenoid assemblies.
  - D. SVEx8 – open center outlet with low flow pressure build up (+50 psi pilot)
  - E. SVEx9 – power beyond outlet with low flow pressure build up (+50 psi pilot)
3. There is no pressure-reducing cartridge on the SV assemblies so when the spools are fully shifted, the pilot pressure is equal to the system pressure (i.e. up to 3000 psi.)

### SV “S” STYLE SOLENOID CARTRIDGES

1. “S” style solenoid sections have both solenoids on the “B” work port end and the standard handle options on the “A” work port end.
2. The pilot pressure acts on a double acting piston attached to the rear of the spool.
3. The “S” style solenoid sections can only use shim style work port relief cartridges in the “B” work port. They can use both adjustable and shim style work port relief cartridges in the “A” port.
4. When the solenoid closest to the handle is energized, flow comes out of the handle end port (except for series sections).

## SV T STYLE SOLENOID SECTIONS

1. The “T” style has a solenoid operator on each end. There is no handle.
2. The “T” style solenoid cartridges have an override pin at the center of the stem that goes through the coil. Pressing the pin “activates” the cartridge. The “T” style solenoid cartridge is the only one that has a manual override pin.
3. The “T” style solenoid sections can use both adjustable and shim style work port relief cartridges.
4. When the solenoid on the A port end is energized, flow comes out of the A port (except for series sections).

## SERIES 20 SOLENOID OPERATED SECTIONS

1. For the Series 20 sections, handle options 5 & 6 indicate solenoid operated sections.
2. Prince does not recommend converting handle option 5 (solenoid operation only) to handle option 6 (solenoid operators with manual handle) in the field. To do so would require that the actuator bodies be removed, the spool be removed, cleaned and the new shoulder bolt be “re-Loctited”.
3. The Series 20 solenoid sections required a utility section next to the outlet section.
  - A. The utility section counts as a section in regard to tie rods.
  - B. The utility sections provide pressure build up to initiate the spool shift.
  - C. The 20U1 uses a solenoid cartridge to generate the build-up pressure. Both the build-up solenoid and a work section solenoid have to be energized for a spool to shift. The wiring is somewhat more complex with double pole, double throw switches often being used.
  - D. The 20U2 uses a “mechanical” pressure build up cartridge (as long as oil is flowing through the open center core, the cartridge generates pilot pressure).
  - E. The 20U3 is used in closed center systems (typically pressure compensated piston pumps).
  - F. The 20U4 is used in power beyond systems. The power beyond line comes out of the utility section, a tank line must come out of the outlet (or inlet tank port). Note: the down stream pressure must provide pressure build up. There must be 300 psi or so in pressure required or pressure drop in the down stream “valve”.
  - G. The 20U5 has provision for an external pilot. There is a #4 ORB port on the

utility section to connect to the external pilot pressure source. The source must provide approximately 300 psi or more.

4. A utility section concept is used in the Series 20 assembly (instead of a pressure build up cartridge used in the outlet as in the SV) due to heat considerations. The added flow capacity of the Series 20 valve can make the heat generated in the pressure build up function a problem. The 20U1 can limit the heat build up to only when the solenoid is energized instead of all the time, as is the case in the mechanical pressure build up.
5. The pressure reducing cartridge on the utility section reduces the pressure applied to the ends of the spools to a maximum of ~300 psi.
6. When the solenoid on the A port end is energized, flow comes out of the A port.
7. Series 20 solenoid sections cannot have any standard sections between them and the utility section. (However, a special 20P section as been defined with the pilot pressure pass through holes.) SV solenoid sections can be anywhere in the assembly.
8. Only shim adjustable work port relief cartridges can be used in the Series 20 solenoid sections.

#### RD5000 SOLENOID OPERATORS

1. The RD5000 solenoid operators are relative expensive so we don't sell many.
2. There is external pilot plumbing either into a tee at the inlet/outlet fitting or into a pilot port machined into the top inlet/top outlet. Pilot lines can be steel tubing or ¼" hydraulic hose.
3. A pressure-reducing cartridge is used to limit the pilot pressure to 300 psi.
4. Any combination of spools can be solenoid operated. For instance on an RD5300, spools 1 or 2 or 3 or 1 & 2 or 2 & 3 or 1 & 3 or 1, 2 and 3 can be solenoid operated.
5. Solenoid operators can be added in the field.
6. Pilot pressure is provided by either an open center or power beyond pressure build up cartridge that goes in the power beyond cavity. Again, the pressure build up cartridge provides pilot pressure to initiate the spool shift.
7. The solenoids are both at the rear so standard handle options can be used.

#### COILS

1. Coil information is found on page V29 in the catalog. All coils are 20 watt. All coils are rated for continuous duty.
2. We have 12 VDC, 24 VDC & 120 VAC coils.
3. Standard coil connections are:
  - A. 12" long lead wires
  - B. Dual male spade connectors
  - C. Din 43650 type A (The Din connectors were at one time somewhat of a premium hydraulic connector. They aren't used as much now).
  - D. Conduit (female pipe thread with lead wires coming out of it)
  - E. Weather Pack – available in 12VDC (premium automotive type connector)
4. The same coils are used on the SV, the RD5000 and the Series 20 work sections & utility sections. The cartridges are different, but the coils are the same.

## SUMMARY

1. The most common solenoid section is the SV "S" style.
2. The least expensive solenoid section/family is the SV "T" style.
3. Some typical applications are:
  - Winches – tethered or wireless remote operation
  - Motor operation – ref. live bottom aggregate trailers – Trail King/Red River
  - Wrecker applications
  - Cotton modules

Used anywhere for remote operation or computer/electronic control.

SV sections can be used with flow control inlet (within a range of ~3 gpm to 15 gpm). The flow control inlet is pressure compensated (constant flow regardless of pressure). It's an entry level proportional system.