HydraForce manufactures a comprehensive line of electro-proportional pressure, flow and directional valves. A proportional valve varies its output in response to a variable electric input.

Flow control valves (PV series) control the flow into or out of a hydraulic cylinder or motor, thereby regulating the speed of movement.

Pressure control valves (TS series) regulate the pressure applied to a hydraulic cylinder or motor. This regulates the torque of the motor, or the pressure or force that the cylinder applies to its load.

Directional control valves (SP series) determine whether the cylinder extends or retracts, or if the motor turns clockwise or counterclockwise.

- Cartridges are voltage interchangeable.
- Water/Weather resistant coils are available for most valves.
- Manual override available on most models.
- Industry common cavities—compact sizes.
- Cartridges are voltage interchangeable.
- Wide variety of voltage and connector options.
- Coils are rated for continuous duty operation.
- Excellent linearity and hysteresis characteristics.
## RECOMMENDED ELECTRONIC CONTROLLERS FOR HYDRAFORCE PROPORTIONAL VALVES

<table>
<thead>
<tr>
<th>Valve Model</th>
<th>Page No.</th>
<th>Controllers</th>
</tr>
</thead>
<tbody>
<tr>
<td>EHP08-33</td>
<td>2.970.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>EHR98-T33</td>
<td>2.971.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>PV08-30</td>
<td>2.370.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>PV08-31</td>
<td>2.380.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>PV42-M30</td>
<td>2.378.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>PV70-30</td>
<td>2.372.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>PV70-31</td>
<td>2.382.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>PV70-33</td>
<td>2.400.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>PV70-34</td>
<td>2.412.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>PV70-35</td>
<td>2.432.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>PV72-20</td>
<td>2.330.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>PV72-21</td>
<td>2.340.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>PV72-30</td>
<td>2.374.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>PV72-31</td>
<td>2.384.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>PV72-33</td>
<td>2.406.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>PV72-34</td>
<td>2.414.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>PV72-35</td>
<td>2.434.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>PV76-30A</td>
<td>2.376.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>PV76-31</td>
<td>2.386.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>TS08-20</td>
<td>2.812.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS08-27</td>
<td>2.860.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS10-26</td>
<td>2.852.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS10-27</td>
<td>2.862.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS10-36</td>
<td>2.890.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS12-26</td>
<td>2.854.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS12-27</td>
<td>2.864.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS12-36</td>
<td>2.891.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS12-37</td>
<td>2.892.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS12-38</td>
<td>2.893.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS38-20</td>
<td>2.813.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS38-21</td>
<td>2.823.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS80-30</td>
<td>2.872.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS80-31</td>
<td>2.882.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS89-31</td>
<td>2.890.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS98-30</td>
<td>2.882.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS98-31</td>
<td>2.890.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS98-T34</td>
<td>2.950.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS98-32</td>
<td>2.951.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS98-33</td>
<td>2.952.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS98-34</td>
<td>2.953.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS98-35</td>
<td>2.954.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>TS98-36</td>
<td>2.955.1</td>
<td>Table 2</td>
</tr>
<tr>
<td>ZL70-30</td>
<td>2.602.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>ZL70-31</td>
<td>2.603.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>ZL70-32</td>
<td>2.604.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>ZL70-33</td>
<td>2.632.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>ZL70-34</td>
<td>2.633.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>ZL70-35</td>
<td>2.634.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>ZL70-36</td>
<td>2.664.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>ZL72-30</td>
<td>2.604.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>ZL72-31</td>
<td>2.624.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>ZL72-32</td>
<td>2.644.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>ZL72-33</td>
<td>2.664.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>ZL72-34</td>
<td>2.664.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>ZL72-35</td>
<td>2.664.1</td>
<td>Table 1</td>
</tr>
<tr>
<td>ZL72-36</td>
<td>2.664.1</td>
<td>Table 1</td>
</tr>
</tbody>
</table>

### TABLE 1 — For all PV, ZL and SP Valves (except SPxx-47, SPxx-57 and SPxx-58)

<table>
<thead>
<tr>
<th>Valve Coil Voltage</th>
<th>Control Input Signal</th>
<th>DIN Coil Mount</th>
<th>PCB Board Only</th>
<th>Metal Box Style</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 or 24 VDC</td>
<td>0–5 VDC</td>
<td>7114950</td>
<td>4000046</td>
<td>4000049</td>
<td>4000136</td>
</tr>
<tr>
<td>12 or 24 VDC</td>
<td>0–10 VDC</td>
<td>4000070</td>
<td>4000141</td>
<td>4000124</td>
<td>4000137</td>
</tr>
<tr>
<td>12 or 24 VDC</td>
<td>0–20 mA</td>
<td>4000123</td>
<td>4000143</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>12 or 24 VDC</td>
<td>PWM</td>
<td>4000144</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
<tr>
<td>12 or 24 VDC</td>
<td>4–20 mA</td>
<td>4000161</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>12 or 24 VDC</td>
<td>0–10 VDC</td>
<td>4000165</td>
<td>4000141</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>12 or 24 VDC</td>
<td>4–20 mA</td>
<td>4000169</td>
<td>4000143</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>12 or 24 VDC</td>
<td>PWM</td>
<td>4000144</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

### TABLE 2 — For all EHPR and TS Series Valves

<table>
<thead>
<tr>
<th>Valve Coil Voltage</th>
<th>Control Input Signal</th>
<th>DIN Coil Mount</th>
<th>PCB Board Only</th>
<th>Metal Box Style</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 or 24 VDC</td>
<td>0–5 VDC</td>
<td>40000161</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>12 or 24 VDC</td>
<td>0–10 VDC</td>
<td>40000165</td>
<td>4000141</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>12 or 24 VDC</td>
<td>0–20 mA</td>
<td>40000169</td>
<td>4000143</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>12 or 24 VDC</td>
<td>PWM</td>
<td>4000144</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

### TABLE 3 — Driver/Controller for SPxx-47, SPxx-57, SPxx-58 Series Dual-Solenoid Valves

<table>
<thead>
<tr>
<th>Valve Coil Voltage</th>
<th>Driver Part No.</th>
<th>Cat. Pg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 or 24 VDC</td>
<td>4000149</td>
<td>3.438.1</td>
</tr>
</tbody>
</table>
## INTRODUCTION TO SP VALVES AND COIL OPERATION

For proportional valves, performance depends on the current in the coil. Coil current is a function of the applied voltage and the resistance in the coil. Increasing voltage will increase the current level while increasing resistance will decrease the current level. In most mobile equipment electrical systems the applied voltage is not controlled; instead it varies around the nominal battery voltage. In the case of battery-operated vehicles the voltage decreases continually until the battery is recharged. The internal resistance of the coil is a function of the material used in the coil winding, and the ambient temperature around the coil. As the temperature of the coil winding increases, the electrical resistance increases. This results in a decrease in the current in the coil, which can decrease the output of a proportional valve. To assure that constant current is delivered to the coil regardless of this change in resistance, a closed-loop current controller should be used.

In order to maintain maximum flow at high temperatures, it is important to know the actual applied voltage to the coil including any voltage drop across the controller. Generally, on engine-driven equipment where alternator voltage is several volts above battery voltage, a coil rated at nominal voltage may work well. On battery-operated equipment, a coil rated at several volts below nominal voltage works best.

In general, it is expected that in actual application, the current applied to the SP valve will vary. Sometimes the current applied may be close to maximum, while at other times it may be close to the threshold current. Therefore, the increase in coil resistance resulting from the power applied will typically stabilize around a nominal or average value. This stabilized, average current value is defined as:

\[
I_{\text{Average}} = (I_{\text{Threshold}} + I_{\text{Maximum}}) \div 2
\]

The graphs illustrate the operating range of HydraForce standard coils on the SP valves. The graphs show the voltage required to continuously maintain average current. The voltage supplies sufficient power to reach maximum current on an intermittent basis. Since it is recommended to use the SP valve with a closed-loop current controller, a voltage drop of 1.5V across the controller has been taken into consideration in these graphs.

For example, the graph for the 08 size 10 VDC coil shows that at an ambient temperature of 20°C, maximum current is available with only 83% of nominal system voltage. If ambient temperature rises to 80°C, maximum output is achieved only if 102% of nominal voltage is available to the coil. However, with the 12 VDC coil, 102% of nominal voltage is required at 20°C. Notice that the voltage required at 80°C is above the maximum 115% of nominal voltage line. This indicates that the 12 VDC coil is not suitable for this ambient condition regardless of the system voltage available.

### Coil Electrical Rating

<table>
<thead>
<tr>
<th>Valve Size</th>
<th>Coil Voltage</th>
<th>Maximum Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>08</td>
<td>10</td>
<td>1170 ±115 mA</td>
</tr>
<tr>
<td>08</td>
<td>12</td>
<td>1000 ±100 mA</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>1320 ±120 mA</td>
</tr>
<tr>
<td>10</td>
<td>12</td>
<td>1100 ±100 mA</td>
</tr>
</tbody>
</table>

Note: I-Threshold varies from product to product. Refer to the Flow vs. Current graph shown for each product. The tolerance is the same as that given for I-Max.
**DESCRIPTION**

A proportional solenoid-operated, 2-way, poppet-type, normally closed, screw-in hydraulic cartridge valve for low-leakage blocking and load-holding applications.

**OPERATION**

When de-energized, the SP08-20 acts as a check valve, allowing flow from ➀ to ➁, while blocking flow from ➁ to ➀. When energized, the poppet lifts to open the ➁ to ➀ flow path. Flow is proportional to current applied to the coil.

Note: If low voltage is expected on the machine, 12 or 24 volt systems will require the use of 10 volt or 20 volt coils respectively. See “SP Valves and Coil Operating Parameters,” page 2.002.1.

**FEATURES**

- Industry-common cavity.
- Efficient wet-armature construction.
- Continuous-duty rated coils.
- Manual override options.
- Optional waterproof E-Coils rated up to IP69K.

**RATINGS**

- **Operating Pressure:** 250 bar (3625 psi)
- **Flow:** 22 lpm (5.8 gpm) at 34.5 bar (500 psid)
- **Minimum Operating Dither/Pulse Frequency:** 70 Hz
- **Hysteresis:** Less than 5% up to 85% of I-max.; Less than 10% above 85% of I-max.
- **Max. Internal Leakage:** 5 drops per minute at 250 bar (3625 psi)
- **Temperature:** -40 to 120°C with standard Buna seals
- **Filtration:** See page 9.010.1
- **Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 sus)
- **Installation:** No Restrictions. See page 9.020.1
- **Cavity:** VC08-2; See page 9.108.1; **Cavity Tool:** CT08-2XX; See page 8.600.1
- **Seal Kit:** SK08-2X-T; See page 8.650.1
- **Coil Nut:** Part No. 7004400; For E-coils manuf. prior to 1-1-04, see page 3.400.1

**PERFORMANCE**

**FLOW vs. CURRENT at Various Differential Pressures**

- 32 cSt/150 sus oil at 40°C

**PRESSURE DROP ➁ to ➀ at 110% of I-max.**

<table>
<thead>
<tr>
<th>PRESSURE DROP (bar/psi)</th>
<th>FLOW (lpm/gpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>31.0/450</td>
<td>3.4/50</td>
</tr>
<tr>
<td>27.6/400</td>
<td>4.9/70</td>
</tr>
<tr>
<td>24.1/350</td>
<td>6.3/90</td>
</tr>
<tr>
<td>20.7/300</td>
<td>7.8/105</td>
</tr>
<tr>
<td>17.2/250</td>
<td>9.3/120</td>
</tr>
<tr>
<td>13.8/200</td>
<td>10.8/135</td>
</tr>
<tr>
<td>10.3/150</td>
<td>12.3/150</td>
</tr>
<tr>
<td>6.9/100</td>
<td>13.8/165</td>
</tr>
<tr>
<td>3.4/50</td>
<td>15.1/180</td>
</tr>
</tbody>
</table>

**PRESSURE DROP ➁ to ➀ at Various Current Levels**

<table>
<thead>
<tr>
<th>PRESSURE DROP (bar/psi)</th>
<th>FLOW (lpm/gpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>35/500</td>
<td>11.4</td>
</tr>
<tr>
<td>35/500</td>
<td>22.7</td>
</tr>
<tr>
<td>35/500</td>
<td>34.1</td>
</tr>
<tr>
<td>35/500</td>
<td>45.2</td>
</tr>
<tr>
<td>35/500</td>
<td>56.8</td>
</tr>
<tr>
<td>35/500</td>
<td>69/1000</td>
</tr>
<tr>
<td>35/500</td>
<td>103/1500</td>
</tr>
<tr>
<td>35/500</td>
<td>138/2000</td>
</tr>
<tr>
<td>35/500</td>
<td>172/2500</td>
</tr>
<tr>
<td>35/500</td>
<td>207/3000</td>
</tr>
</tbody>
</table>

**FLOW vs. CURRENT at Various Differential Pressures**

- 32 cSt/150 sus oil at 40°C

**PERCENT of MAX. CONTROL CURRENT**

- 0.12
- 0.23
- 0.35
- 0.47
- 0.59
- 0.70
- 0.82
- 0.94
- 1.05
- 1.17

**PERCENT of MAX. CONTROL CURRENT**

- 250 bar 3625 psi
- 104 bar 1500 psi
- 35 bar 500 psi
- 17 bar 250 psi

**Nominal Flow Rating**
**Performance (cont'd.)**

Frequency Response
Average Current ±20% Applied

<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>GAIN (dB)</th>
<th>PHASE (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>-7</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>-3</td>
<td>45</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>90</td>
</tr>
<tr>
<td>25</td>
<td>3</td>
<td>135</td>
</tr>
</tbody>
</table>

**Dimensions**

COIL MUST BE INSTALLED WITH LETTERING UP

- Manual Override J
- Manual Override M, T, or Y

**Torque**
4–5 ft-lbs (5.4–6.8 Nm) max.

19–21 ft-lbs (25.8–28.5 Nm) max.

**Standard Coils**
Standard: Weight: 0.11 kg. (0.25 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.
E-Coil: Weight: 0.14 kg. (0.3 lbs.); Perfect wound, fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors; Note: See page 3.400.1 for all E-Coil retrofit applications.

**MATERIALS**
Cartridge: Weight: 0.09 kg. (0.20 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces; Buna N O-rings and back-ups standard.

Standard Ported Body: Weight: 0.16 kg. (0.35 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.008.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

Standard Coil: Weight: 0.09 kg. (0.20 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces; Buna N O-rings and back-ups standard.

**TO ORDER**

**SP08-20**

Option
None (Blank)
Manual Override M
Manual Override T
Manual Override Y
Manual Override J

Voltage
0 Less Coil**
10 10 VDC
12 12 VDC
20 20 VDC
24 24 VDC

Porting
Cartridge Only 0
SAE 4 4T
SAE 6 6T
SAE 8 8T
1/4 in. BSP* 2B
3/8 in. BSP* 3B

**Terminals**

**Terminals (VDC)**
Std. Coil
DS Dual Spades
DG DIN 43650
DL Leadwires (2)
DL/W Leads w/Weatherpak® Connectors
DR Deutsch DT04-2P

**E-Coil**
ER Deutsch DT04-2P (IP69K Rated)
EY Metri-Pack® 150.2A (IP69K Rated)

Seals
N Buna N (Std.)
V Fluorocarbon

**Note:** See page 3.400.1 for all E-Coil retrofit applications.
**DESCRIPTION**

A proportional solenoid-operated, 2-way, poppet-type, normally closed, screw-in hydraulic cartridge valve for low-leakage blocking and load-holding applications.

**OPERATION**

When de-energized, the SP10-20 acts as a check valve, allowing flow from 1 to 2, while blocking flow from 2 to 1. When energized, the poppet lifts to open the 2 to 1 flow path. Flow is proportional to current applied to the coil.

**Note:** If low voltage is expected on the machine, 12 or 24 volt systems will require the use of 10 volt or 20 volt coils respectively. See “SP Valves and Coil Operating Parameters,” page 2.002.1.

**FEATURES**

- Industry-common cavity.
- Efficient wet-armature construction.
- Continuous-duty rated coils.
- Optional waterproof E-Coils rated up to IP69K.
- Manual override option.
- Metering Option.

**RATINGS**

**Operating Pressure:** 250 bar (3625 psi)

**Flow:** 68 lpm (18 gpm) at 34.5 bar (500 psid)

**Minimum Operating Dither/Pulse Frequency:** 70 Hz

**Hysteresis:** Less than 5% up to 75% of I-max; Less than 10% above 75% of I-max.

**Max. Internal Leakage:** 5 drops per minute at 250 bar (3625 psi)

**Temperature:** -40 to 120°C with standard Buna seals

**Filtration:** See page 9.010.1

**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 sus)

**Installation:** No Restrictions. See page 9.020.1

**Cavity:** VC10-2; See page 9.108.1; **Cavity Tool:** CT10-2XX; See page 8.600.1

**Seal Kit:** SK10-2X-T; See page 8.650.1

**Coil Nut:** Part No. 7004400; for E-coils manuf. prior to 1-1-04, see page 3.400.1.

---

**PERFORMANCE**

**PRESSURE DROP 2 to 1 at 125% of I-max.**

<table>
<thead>
<tr>
<th>PRESSURE DROP 2 to 1 at 125% of I-max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.4/180</td>
</tr>
<tr>
<td>11.0/160</td>
</tr>
<tr>
<td>9.7/140</td>
</tr>
<tr>
<td>8.3/120</td>
</tr>
<tr>
<td>6.9/100</td>
</tr>
<tr>
<td>5.5/80</td>
</tr>
<tr>
<td>4.1/60</td>
</tr>
<tr>
<td>2.8/40</td>
</tr>
<tr>
<td>1.4/20</td>
</tr>
</tbody>
</table>

**FLOW vs. CURRENT at Various Differential Pressures**

32 cSt/150 sus oil at 40°C

<table>
<thead>
<tr>
<th>FLOW lpm/gpm</th>
<th>PRESSURE DROP 2 to 1 at Various Current Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>113.6/30</td>
<td>250 bar</td>
</tr>
<tr>
<td>106.0/28</td>
<td>3625 psi</td>
</tr>
<tr>
<td>98.4/26</td>
<td>104 bar</td>
</tr>
<tr>
<td>90.8/24</td>
<td>1500 psi</td>
</tr>
<tr>
<td>83.2/22</td>
<td>35 bar</td>
</tr>
<tr>
<td>75.7/20</td>
<td>500 psi</td>
</tr>
<tr>
<td>68.1/18</td>
<td>17 bar</td>
</tr>
<tr>
<td>60.6/16</td>
<td>250 psi</td>
</tr>
<tr>
<td>53.0/14</td>
<td>207/3000</td>
</tr>
<tr>
<td>45.4/12</td>
<td>122/2500</td>
</tr>
<tr>
<td>37.9/10</td>
<td>103/1500</td>
</tr>
<tr>
<td>30.3/8</td>
<td>93/1000</td>
</tr>
<tr>
<td>22.7/6</td>
<td>69/1000</td>
</tr>
<tr>
<td>15.1/4</td>
<td>35/500</td>
</tr>
<tr>
<td>7.6/2</td>
<td>11.4/3</td>
</tr>
<tr>
<td>0</td>
<td>0.14</td>
</tr>
</tbody>
</table>

**FLOW lpm/gpm vs. PERCENT of MAX. CONTROL CURRENT**

AMP (10 Volt Coil) 100 Hz Dither
**PERFORMANCE (cont’d.)**

Frequency Response  
Average Current ±20% Applied  

**DIMENSIONS**

**COIL MUST BE INSTALLED WITH LETTERING UP**  

**Recommended Controllers** (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>7114960</td>
<td>4000468</td>
<td>4000494</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000070</td>
<td>4000141</td>
<td>4000124</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>400123</td>
<td>4000413</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

**Termination (VDC)**  

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Option</th>
<th>Screen</th>
<th>Metering</th>
<th>Manual Override</th>
<th>Manual Override</th>
<th>Cartridge Only</th>
<th>SAE 6</th>
<th>SAE 8</th>
<th>1/4 in. BSP</th>
<th>3/8 in. BSP</th>
<th>1/2 in. BSP</th>
<th>Seals</th>
<th>Termination (VDC) Std. Coil</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>None</td>
<td>—</td>
<td>A</td>
<td>J</td>
<td>Y</td>
<td>0</td>
<td>6T</td>
<td>8T</td>
<td>2B</td>
<td>3B</td>
<td>4B</td>
<td>N</td>
<td>DS Dual Spades</td>
</tr>
<tr>
<td>10</td>
<td>10 VDC</td>
<td>S</td>
<td>A</td>
<td>J</td>
<td>Y</td>
<td>SAE 6</td>
<td>6T</td>
<td>8T</td>
<td>2B</td>
<td>3B</td>
<td>4B</td>
<td>V</td>
<td>DG DIN 43650</td>
</tr>
<tr>
<td>12</td>
<td>12 VDC</td>
<td></td>
<td>A</td>
<td>J</td>
<td>Y</td>
<td>SAE 8</td>
<td></td>
<td></td>
<td>2B</td>
<td>3B</td>
<td>4B</td>
<td>P</td>
<td>DL Leadwires (2)</td>
</tr>
<tr>
<td>20</td>
<td>20 VDC</td>
<td></td>
<td>A</td>
<td>J</td>
<td>Y</td>
<td>1/4 in. BSP</td>
<td>2B</td>
<td>3B</td>
<td>4B</td>
<td>3B</td>
<td>4B</td>
<td></td>
<td>DL/W Leads w/Weatherpak® Connectors</td>
</tr>
<tr>
<td>24</td>
<td>24 VDC</td>
<td></td>
<td>A</td>
<td>J</td>
<td>Y</td>
<td>3/8 in. BSP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DR Deutsch DT04-2P</td>
</tr>
</tbody>
</table>

**Frequency Response**  

**Average Current ±20% Applied**  

**Recommended Controllers** (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>7114960</td>
<td>4000468</td>
<td>4000494</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000070</td>
<td>4000141</td>
<td>4000124</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>400123</td>
<td>4000413</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

**Materials**

**Cartridge:** Weight: 0.16 kg. (0.34 lbs.); Steel with hardened work surfaces; Zinc-plated exposed surfaces; Buna N O-rings and back-ups standard.

**Standard Ported Body:** Weight: 0.16 kg. (0.35 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.010.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

**Standard Coil:** Weight: 0.27 kg. (0.60 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

**E-Coil:** Weight: 0.41 kg. (0.9 lbs.); Perfect wound, fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors; **Note:** See page 3.400.1 for all E-Coil retrofit applications.

**TO ORDER**

**SP10-20**  

<table>
<thead>
<tr>
<th>Option</th>
<th>Voltage</th>
<th>Seals</th>
<th>Porting</th>
<th>Termination (VDC) Std. Coil</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0 Less Coil**</td>
<td>N Buna N (Std.)</td>
<td>0 Cartridge Only</td>
<td>DS Dual Spades</td>
</tr>
<tr>
<td>Screen</td>
<td>10 10 VDC</td>
<td>V Fluorocarbon</td>
<td>SAE 6</td>
<td>DG DIN 43650</td>
</tr>
<tr>
<td>Metering</td>
<td>12 12 VDC</td>
<td>P Polyurethane</td>
<td>SAE 8</td>
<td>DL Leadwires (2)</td>
</tr>
<tr>
<td>Manual Override</td>
<td>20 20 VDC</td>
<td></td>
<td>1/4 in. BSP</td>
<td>DL/W Leads w/Weatherpak® Connectors</td>
</tr>
<tr>
<td>Manual Override</td>
<td>24 24 VDC</td>
<td></td>
<td>3/8 in. BSP</td>
<td>DR Deutsch DT04-2P</td>
</tr>
<tr>
<td>Cartridge Only</td>
<td>2B</td>
<td></td>
<td>1/2 in. BSP</td>
<td>ER Deutsch DT04-2P (IP69K Rated)</td>
</tr>
<tr>
<td>SAE 6</td>
<td>3B</td>
<td></td>
<td></td>
<td>EY Metri-Pack® 150.2A (IP69K Rated)</td>
</tr>
<tr>
<td>SAE 8</td>
<td>4B</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Recommended Controllers** (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>7114960</td>
<td>4000468</td>
<td>4000494</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000070</td>
<td>4000141</td>
<td>4000124</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>400123</td>
<td>4000413</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

**Recommended Controllers** (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>7114960</td>
<td>4000468</td>
<td>4000494</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000070</td>
<td>4000141</td>
<td>4000124</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>400123</td>
<td>4000413</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

**Recommended Controllers** (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>7114960</td>
<td>4000468</td>
<td>4000494</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000070</td>
<td>4000141</td>
<td>4000124</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>400123</td>
<td>4000413</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>
DESCRIPTION
A proportional solenoid-operated, 2-way, poppet-type, normally closed, screw-in hydraulic cartridge valve for low-leakage blocking and load-holding applications.

OPERATION
When de-energized, the SP12-20 acts as a check valve, allowing flow from ➀ to ➁, while blocking flow from ➁ to ➀. When energized, the poppet lifts to open the ➁ to ➀ flow path. Flow is proportional to current applied to the coil.

Note: If low voltage is expected on the machine, 12 or 24 volt systems will require the use of 10 volt or 20 volt coils respectively. See “SP Valves and Coil Operating Parameters,” page 2.002.1.

FEATURES
• Industry-common cavity.
• Efficient wet-armature construction.
• Continuous-duty rated coils.
• Manual override option.
• Optional waterproof E-Coils rated up to IP69K.
• Metering Option.

RATINGS
Operating Pressure: 250 bar (3625 psi)
Flow: 100 lpm (27 gpm) at 34.5 bar (500 psi)
Minimum Operating Dither/Pulse Frequency: 70 Hz
Hysteresis: Less than 5% below 60% of I-max.; Less than 10% above 60% of I-max.
Max. Internal Leakage: 5 drops per minute at 250 bar (3625 psi)
Temperature: -40 to 120°C with standard Buna seals
Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 sus)
Installation: No Restrictions. See page 9.020.1
Cavity: VC12-2; See page 9.112.1; Cavity Tool: CT12-2XX; See page 8.600.1
Seal Kit: SK12-2X-T; See page 8.650.1
Coil Nut: Part No. 7004400; for E-coils manuf. prior to 1-1-04, see page 3.400.1.

PERFORMANCE

FLOW vs. CURRENT at Various Differential Pressures
32 cSt/150 sus oil at 40°C

Nominal Flow Rating

FLOW lpm/gpm

PERCENT of MAX. CONTROL CURRENT

AMP (10 Volt Coil) 100 Hz Dither
**PERFORMANCE (cont'd.)**

**Frequency Response**

<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>0</th>
<th>0.1</th>
<th>1</th>
<th>10</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GAIN (dB)</strong></td>
<td>-7</td>
<td>-6</td>
<td>-5</td>
<td>-4</td>
<td>-3</td>
</tr>
<tr>
<td><strong>PHASE (degrees)</strong></td>
<td>0</td>
<td>45</td>
<td>90</td>
<td>135</td>
<td>180</td>
</tr>
</tbody>
</table>

**Recommended Controllers** (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000070</td>
<td>4000046</td>
<td>4000049</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000123</td>
<td>4000143</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DIMENSIONS**

**COIL MUST BE INSTALLED WITH LETTERING UP**

- **Manual Override Y**
- **Manual Override J**
- **1.25 ** ACROSS FLATS TORQUE 33–37 ft-lbs (44.9–50.3 Nm) max.
- **0.75** 19.1 ACROSS FLATS TORQUE 4–5 ft-lb 5.4–6.8 Nm max.

**TERMINATION (VDC)**

- **DS** Dual Spades
- **DG** DIN 43650
- **DL** Leadwires (2)
- **DL/W** Leads w/Weatherpak® Connectors
- **DR** Deutsch DT04-2P

**TERMINATION (VDC) E-Coil**

- **ER** Deutsch DT04-2P (IP69K Rated)
- **EY** Metri-Pack® 150.2A (IP69K Rated)

Coils with internal diode are available. Consult factory.

**MATERIALS**

**Cartridge:** Weight: 0.25 kg. (0.55 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces; Buna N O-rings and back-ups standard.

**Standard Ported Body:** Weight: 0.57 kg. (1.25 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.012.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

**Standard Coil:** Weight: 0.27 kg. (0.60 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 8.012.1.

**E-Coil:** Weight: 0.41 kg. (0.9 lbs.); Perfect wound, fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors; Note: See page 3.400.1 for all E-Coil retrofit applications.

**TO ORDER**

**SP12-20**

**Option**

- None (Blank)
- Screen S
- Metering A
- Manual Override J
- Manual Override Y

**Porting**

- Cartridge Only 0
- SAE 10 10T
- SAE 12 12T
- SAE 16 16T
- 3/4 in. BSP* 6B
- 1 in. BSP* 8B

**Seals**

- N Buna N (Std.)
- V Fluorocarbon
- P Polyurethane

**Voltage**

- 0 Less Coil**
- 10 10 VDC†
- 12 12 VDC†
- 20 20 VDC†
- 24 24 VDC†

**Termination (VDC)**

- **Std. Coil**
- **DS** Dual Spades
- **DG** DIN 43650
- **DL** Leadwires (2)
- **DL/W** Leads w/Weatherpak® Connectors
- **DR** Deutsch DT04-2P
- **ER** Deutsch DT04-2P (IP69K Rated)
- **EY** Metri-Pack® 150.2A (IP69K Rated)

**Note:** See page 3.400.1 for all E-Coil retrofit applications.
A proportional solenoid-operated, 2-way, poppet-type, normally closed, screw-in hydraulic cartridge valve for low-leakage blocking and load-holding applications.

**OPERATION**

When de-energized, the SP16-20 acts as a check valve, allowing flow from ➀ to ➁, and blocking flow from ➁ to ➀. When energized, the ➁ to ➀ flow path opens. Flow is proportional to current applied to the coil.

**Note:** If low voltage is expected on the machine, 12 or 24 volt systems will require the use of 10 volt or 20 volt coils respectively. See “SP Valves and Coil Operating Parameters,” page 2.002.1.

**FEATURES**

- Industry-common cavity.
- Efficient wet-armature construction.
- Continuous-duty rated coils.
- Optional waterproof E-Coils rated up to IP69K.
- Manual override options.

**RATINGS**

- Operating Pressure: 250 bar (3625 psi)
- Flow: Up to 265 lpm (70 gpm); see performance curves.
- Dither/Pulse Frequency: 100 to 400 Hz
- Hysteresis: Less than 5% below 60% of I-max.; Less than 10% above 60% of I-max.
- Maximum Control Current: 1.2 amps
- Max. Internal Leakage: 5 drops per minute at rated pressure
- Temperature: -40 to 120°C with standard Buna seals
- Fluids: Mineral-based or synthetics with lubricating properties at viscosities
  of 7.4 to 420 cSt (50 to 2000 sus); See Temperature and Oil Viscosity, page 9.060.1
- Filtration: See page 9.010.1; **Installation:** No Restrictions. See page 9.020.1
- Cavity: VC16-2; See page 9.116.1; **Cavity Tool:** CT16-2XX; See page 8.600.1
- Seal Kit: SK16-2X-T; See page 8.650.1
- Coil Nut: Part No. 7004400; for E-coils manuf. prior to 1-1-04, see page 3.400.1.

**PERFORMANCE**

**FLOW vs. CURRENT at Various Differential Pressures**

- 32 cSt/150 sus oil at 40°C
- Curves shown are for standard 12V D-Coils, for E-Coils consult factory.

**PRESSURE DROP (average)**

Port 2 to 1; 1.5 Amp with 12 VC Coil

<table>
<thead>
<tr>
<th>PRESSURE DROP bar/psi</th>
<th>FLOW lpm/gpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>31.0/450</td>
<td>37.9</td>
</tr>
<tr>
<td>27.6/400</td>
<td>37.5</td>
</tr>
<tr>
<td>24.1/350</td>
<td>38.0</td>
</tr>
<tr>
<td>20.7/300</td>
<td>40.0</td>
</tr>
<tr>
<td>17.2/250</td>
<td>43.0</td>
</tr>
<tr>
<td>13.8/200</td>
<td>47.0</td>
</tr>
<tr>
<td>10.3/150</td>
<td>53.0</td>
</tr>
<tr>
<td>6.9/100</td>
<td>63.0</td>
</tr>
<tr>
<td>3.4/50</td>
<td>80.0</td>
</tr>
</tbody>
</table>

**FLOW lpm/gpm**

<table>
<thead>
<tr>
<th>FLOW lpm/gpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>50</td>
</tr>
</tbody>
</table>

Performance information continued on following page.
MATERIALS

Cartridge: Weight: 0.32 kg. (0.71 lbs.) Steel with hardened work surfaces. Zinc-plated exposed surfaces; Buna N O-rings and back-ups standard.

Standard Ported Body: Weight: 0.57 kg. (1.25 lbs.) Anodized high-strength 6061 T6 aluminum alloy, rated to 207 bar (3000 psi). Ductile iron bodies available; dimensions may differ. See page 8.016.1.

Standard Coil: Weight: 0.27 kg. (0.60 lbs.) Unitized thermoplastic encapsulated, Class H high temperature magnetwire. See page 3.200.1.

E-Coil: Weight: 0.41 kg. (0.9 lbs.) Perfect wound, fully encapsulated with rugged external metal shell. Rated up to IP69K with integral connectors. Note: See page 3.400.1 for all E-Coil retrofit applications.

TO ORDER

SP16-20

Option
None
Manual Override M
Manual Override Y
Manual Override J

Voltage
0 Less Coil**
10 10 VDC*
12 12 VDC
20 20 VDC*
24 24 VDC*

**Includes Std. Coil Nut
*10 VDC and 20 VDC coils should be used for most continuous-duty applications. Consult factory.

Porting
Cartridge Only 0
SAE 12 12T
SAE 16 16T
3/4 in. BSP* 6B
1 in. BSP* 8B

Seals
N Buna N (Std.)
V Fluorocarbon
P Polyurethane

Termination (VDC)
Std. Coil
DS Dual Spades
DG DIN 43650
DL Leadwires (2)
DL/W Leads w/Weatherpak® Connectors
DR Deutsch DT04-2P

Termination (VDC)
E-Coil
ER Deutsch DT04-2P (IP69K Rated)
EY Metri-Pack® 150.2A (IP69K Rated)

Coils with internal diode are available. Consult factory.
DESCRIPTION
A proportional solenoid-operated, 2-way, poppet-type, normally open, screw-in hydraulic cartridge valve for low-leakage load-holding applications and for starting or stopping a load or a pump system.

OPERATION
When de-energized, the SP08-21 allows flow from ② to ①. When the valve is partially energized, the valve begins to throttle the flow from ② to ①. When fully energized, the poppet closes on the seat, blocking flow from ② to ①. Flow from ① to ② will occur when hydraulic pressure exceeds the solenoid force.

Note: If low voltage is expected on the machine, 12 or 24 volt systems will require the use of 10 volt or 20 volt coils respectively. See “SP Valves and Coil Operating Parameters,” page 2.002.1.

FEATURES
• Industry-common cavity. • Efficient wet-armature construction.
• Continuous-duty rated coils. • Optional waterproof E-Coils rated up to IP69K.

RATINGS
Operating Pressure: 207 bar (3000 psi)
Flow: 0 to 22.7 lpm (0 to 6 gpm)
Max. Internal Leakage: 5 drops per minute at 207 bar (3000 psi)
Temperature: -40 to 120°C with standard Buna seals
Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 sus)
Installation: No Restrictions. See page 9.020.1
Cavity: VC08-2; See page 9.108.1; Cavity Tool: CT08-2XX; See page 8.600.1
Seal Kit: SK08-2X-T; See page 8.650.1
Coil Nut: Part No. 7004400;
For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut info.

PERFORMANCE

SYMBOLS
USASI/ISO:

PERFORMANCE

ELECTRO-PROPORTIONAL VALVES—DIRECTIONAL CONTROL

SP08-21 Poppet, 2-Way, Normally Open

TYPICAL PRESSURE RESPONSE
at 3000 psi with 12 VDC Coil

CURRENT RESPONSE
Note: Electronic Controller is required to ramp current.
DIMENSIONS

COIL MUST BE INSTALLED WITH LETTERING UP

TORQUE
4–5 ft-lbs
(5.4–6.8 Nm)
max.

* BSP BODY – 55.9 mm

MATERIALS

Cartridge: Weight: 0.11 kg. (0.25 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces; Buna N O-rings and back-ups standard.

Standard Ported Body: Weight: 0.16 kg. (0.35 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.008.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

Standard Coil: Weight: 0.11 kg. (0.25 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

E-Coil: Weight: 0.14 kg. (0.3 lbs.); Perfect wound, fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors.

TO ORDER

<table>
<thead>
<tr>
<th>Porting</th>
<th>Voltage</th>
<th>Seals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cartridge Only</td>
<td>0</td>
<td>Buna N (Std.)</td>
</tr>
<tr>
<td>SAE 4</td>
<td>10 VDC</td>
<td>N</td>
</tr>
<tr>
<td>SAE 6</td>
<td>12 VDC</td>
<td>V</td>
</tr>
<tr>
<td>SAE 8</td>
<td>20 VDC</td>
<td>P</td>
</tr>
<tr>
<td>1/4 in. BSP*</td>
<td>24 VDC</td>
<td>N</td>
</tr>
<tr>
<td>3/8 in. BSP*</td>
<td>**Includes Coil Nut</td>
<td></td>
</tr>
</tbody>
</table>

Termination (VDC) Std. Coil

DS Dual Spades
DG DIN 43650
DL Leadwires (2)
DL/W Leads w/Weatherpak® Connectors
DR Deutsch DT04-2P

Termination (VDC) E-Coil

ER Deutsch DT04-2P (IP69K Rated)
EY Metri-Pack® 150.2A (IP69K Rated)

Coils with internal diode are available. Consult factory.
**DESCRIPTION**
A proportional solenoid-operated, 2-way, poppet-type, normally open, screw-in hydraulic cartridge valve for low-leakage blocking and load-holding applications.

**OPERATION**
When de-energized, the SP16-21 allows flow from ② to ①. When the valve is partially energized, the valve begins to throttle the flow from ② to ①. When fully energized, the poppet closes on the seat, blocking flow from ② to ①. Flow from ① to ② will occur when hydraulic pressure exceeds the solenoid force.

**Note:** If low voltage is expected on the machine, 12 or 24 volt systems will require the use of 10 volt or 20 volt coils respectively. See “SP Valves and Coil Operating Parameters,” page 2.002.1.

**FEATURES**
- Industry-common cavity.
- Efficient wet-armature construction.
- Continuous-duty rated coils.
- Manual override option.
- Optional waterproof E-Coils rated up to IP69K.

**RATINGS**
- **Operating Pressure:** 250 bar (3625 psi)
- **Flow:** 265 lpm (70 gpm); see performance charts
- **Max. Internal Leakage:** 7 drops per minute at 207 bar (3000 psi)
- **Dither/Pulse Frequency:** 100 to 400 Hz
- **Hysteresis:** Less than 10% up to 70% of I-max.; Less than 5% above 70% of I-max.
- **Maximum Control Current:** 1.2 amp required to achieve rated flow
- **Threshold Current:** 0.3 A; see performance charts
- **Temperature:** -40 to 120°C with standard Buna seals
- **Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 sus); See Temperature and Oil Viscosity, page 9.060.1
- **Filtration:** See page 9.010.1; **Installation:** No Restrictions. See page 9.020.1
- **Cavity:** VC16-2; See page 9.116.1; **Cavity Tool:** CT16-2XX; See page 8.600.1
- **Seal Kit:** SK16-2X-T; See page 8.650.1
- **Coil Nut:** Part No. 7004400

**SYMBOLS**

**USASI/ISO:**

- **FLOW lpm/gpm**
  - 303/80
  - 265/70
  - 227/60
  - 189/50
  - 151/40
  - 114/40
  - 76/30
  - 38/10

**FLOW vs. CURRENT at Various Differential Pressures**

- **32 cSt/150 sus oil at 40°C**
  - Pressure Drop:
    - 100 mA: 1200 mA
    - D: 1000 psi - 3000 psi
    - C: 700 psi - 1530 psi
    - B: 450 psi - 1130 psi
    - A: 150 psi - 75.7 psi
  - Nominal Flow Rating

**PRESSURE RESPONSE with 12 VDC Coil**

- 241/3500
- 207/3000
- 172/2000
- 138/1500
- 103/1000
- 69/600
- 35/50

**RECOMMENDED ELECTRONIC CONTROLLERS:**
See page 2.001.1 or our Electronics catalog.

---

**PERFORMANCE**

- **PERCENT of MAX. CONTROL CURRENT**
  - 10 20 30 40 50 60 70 80 90 100

- **FLOW lpm/gpm**
  - 303/80
  - 265/70
  - 227/60
  - 189/50
  - 151/40
  - 114/40
  - 76/30
  - 38/10
**DIMENSIONS**

**MATERIALS**

**Cartridge:** Weight: 0.32 kg. (0.71 lbs.) Steel with hardened work surfaces. Zinc-plated exposed surfaces; Buna N O-rings and back-ups standard.

**Standard Ported Body:** Weight: 0.57 kg. (1.25 lbs.) Anodized high-strength 6061 T6 aluminum alloy, rated to 207 bar (3000 psi). Ductile iron bodies available; dimensions may differ. See page 8.016.1.

**Standard Coil:** Weight: 0.27 kg. (0.60 lbs.) Unitized thermoplastic encapsulated, Class H high temperature magnetwire. See page 3.200.1.

**E-Coil:** Weight: 0.41 kg. (0.9 lbs.) Perfect wound, fully encapsulated with rugged external metal shell. Rated up to IP69K with integral connectors. See page 3.400.1.

**TO ORDER**

**Option**

- None (Blank)
- Manual Override P

For Manual Override details see page 1.001.1

**Porting**

- Cartridge Only 0
- SAE 12 12T
- SAE 16 16T
- 3/4 in. BSP* 6B
- 1 in. BSP* 8B

*BSP Body; U.K. Mfr. Only

**Seals**

- Buna N (Std.) N
- Fluorocarbon V
- Polyurethane P

**Termination (VDC)**

- Std. Coil
  - DS Dual Spades
  - DG DIN 43650
  - DL Leadwires (2)
  - DL/W Leads w/Weatherpak® Connectors
  - DR Deutsch DT04-2P

**E-Coil**

- ER Deutsch DT04-2P (IP69K Rated)
- EY Metri-Pack® 150.2A (IP69K Rated)

Coils with internal diode are available. Consult factory.

---

For Manual Override details see page 1.001.1
A proportional solenoid-operated, 2-way, poppet-type, normally closed, screw-in hydraulic cartridge valve for low-leakage blocking and load-holding applications.

**OPERATION**

When de-energized, the SP08-22 acts as a check valve, allowing flow from \( \text{➀} \) to \( \text{➁} \), while blocking flow from \( \text{➁} \) to \( \text{➀} \). When energized, the poppet lifts to open the \( \text{➁} \) to \( \text{➀} \) flow path. There is a free-reverse-flow check to allow flow from \( \text{➀} \) to \( \text{➁} \) when energized. Flow is proportional to current applied to the coil.

Note: External circuitry is required to ramp current.

Note: If low voltage is expected on the machine, 12 or 24 volt systems will require the use of 10 volt or 20 volt coils respectively. See “SP Valves and Coil Operating Parameters,” page 2.002.1.

**FEATURES**

- Industry-common cavity.
- Hardened steel work surfaces.
- Continuous-duty rated coils.
- Optional waterproof E-Coils rated up to IP69K.

**RATINGS**

- **Operating Pressure:** 207 bar (3000 psi)
- **Flow:** 30.3 lpm (8 gpm) nominal
- **Max. Internal Leakage:** 328 ml/minute (20 cu. in./minute) at 207 bar (3000 psi)
- **Temperature:** -40 to 100°C with standard Buna seals
- **Filtration:** Recommend ISO 4406 16/13; See page 9.010.1
- **Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 sus)
- **Installation:** No Restrictions. See page 9.020.1
- **Cavity:** VC08-2; See page 9.108.1; **Cavity Tool:** CT08-2XX; See page 8.600.1
- **Seal Kit:** SK08-2X-M; See page 8.650.1
- **Coil Nut:** Part No. 7004400; For E-coils manuf. prior to 1-1-04, see page 3.400.1

**SYMBOLS**

**USASI/ISO:**

**PERFORMANCE**

**TYPICAL PRESSURE DROP** \( \text{➁} \) to \( \text{➀} \) with 12 VDC Coil

**TYPICAL PRESSURE RESPONSE** 12 VDC Coil

**FLOW vs. CURRENT at Various Differential Pressures** for Standard Coils (consult factory for E-Coils)

- 32 cSt/150 sus oil at 40°C
- 8 gpm Nominal Flow Rating
- 0.5 amp
- 0.65 amp
- 0.85 amp
- 1.0 amp
- 1.3 amp
- 207 bar 3000 psi
- 104 bar 1500 psi
- 35 bar 500 psi
- 10 bar 150 psi

**FLOW lpm/gpm**

**PRESSURE bar/psi**

**FLOW lpm/gpm**

**PERCENT of MAX. CONTROL CURRENT**

**AMP (10 Volt Coil) 100 Hz Dither**

0.12 0.23 0.35 0.46 0.58 0.69 0.81 0.92 1.04 1.15
PERFORMANCE (cont’d.)

PERCENT I-MAX. vs. TEMPERATURE for 10 or 20 VDC Coil (for 10 V Coil I-Max. = 1.15A)
Curves show percent of nominal system voltage minus 1.5V drop across controller

<table>
<thead>
<tr>
<th>TEMPERATURE (°F/°C)</th>
<th>4</th>
<th>32</th>
<th>68</th>
<th>104</th>
<th>140</th>
<th>176</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERCENT of I-MAX</td>
<td>78</td>
<td>80</td>
<td>82</td>
<td>84</td>
<td>86</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>92</td>
<td>94</td>
<td>96</td>
<td>98</td>
<td>100</td>
<td>102</td>
</tr>
</tbody>
</table>

Recommended Controllers (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig. w/12V Coil</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>7114950</td>
<td>4000046</td>
<td>4000049</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000070</td>
<td>4000141</td>
<td>4000124</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>400123</td>
<td>4000143</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input Sig. w/24V Coil</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>400161</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>400165</td>
<td>4000141</td>
<td>4000182</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>400169</td>
<td>4000143</td>
<td>4000186</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

DIMENSIONS

COIL MUST BE INSTALLED WITH LETTERING UP

| STANDARD DIMENSIONS |
|---------------------|----------------|
| FLATS AROUND         | 0.65 16.5 3.3 |
| FLATS ACROSS         | 0.88 5.5 |
| MOUNTING             | 1.91 48.5 |
| SCREEN STANDARD      | 0.88 22.4 |

PERFORMANCE (cont’d.)

Coils with internal diode are available. Consult factory.

MATERIALS

Cartridge: Weight: 1.10 kg. (0.23 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces; Buna N O-rings and back-ups standard.

Standard Ported Body: Weight: 0.16 kg. (0.35 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.008.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

Standard Coil: Weight: 0.11 kg. (0.25 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

E-Coil: Weight: 0.14 kg. (0.3 lbs.); Perfect wound, fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors; Note: See page 3.400.1 for all E-Coil retrofit applications.

TO ORDER

SP08-22

<table>
<thead>
<tr>
<th>Option</th>
<th>Voltage</th>
<th>Porting</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0</td>
<td>Cartridge Only</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>SAE 4</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>SAE 6</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>SAE 8</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>1/4 in. 2B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3/8 in. 3B</td>
</tr>
</tbody>
</table>

Termination (VDC)

<table>
<thead>
<tr>
<th>Standard Coil</th>
<th>Dual Spades</th>
<th>DIN 43650</th>
<th>Leadwires (2)</th>
<th>Deutsch DT04-2P</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS</td>
<td>DG</td>
<td>DL</td>
<td>DL/W</td>
<td>DR</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Deutsch DT04-2P</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(IP69K Rated)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>E-Coil</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Metri-Pack® 150.2A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(IP69K Rated)</td>
</tr>
</tbody>
</table>

Termination (VDC)

<table>
<thead>
<tr>
<th>Option</th>
<th>Termination (VDC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Std. Coil</td>
</tr>
<tr>
<td></td>
<td>DIN 43650</td>
</tr>
<tr>
<td></td>
<td>Leads w/Weatherpak® Connectors</td>
</tr>
<tr>
<td></td>
<td>Deutsch DT04-2P</td>
</tr>
<tr>
<td></td>
<td>(IP69K Rated)</td>
</tr>
</tbody>
</table>

Seals

| Seals | N Buna N (Std.) | V Fluorocarbon | P Polyurethane |

Coils with internal diode are available. Consult factory.
**SP08-24  Spool, 2-Way, Normally Closed**

**DESCRIPTION**
A proportional solenoid-operated, 2-way, spool-type, normally closed, screw-in hydraulic cartridge valve designed to operate as a bi-directional metering valve.

**OPERATION**
When de-energized, the SP08-24 blocks flow in both directions. When the coil is partially energized, the valve begins to throttle flow. When fully energized, the valve opens to allow full, bi-directional flow.

Note: If low voltage is expected on the machine, 12 or 24 volt systems will require the use of 10 volt or 20 volt coils respectively. See “SP Valves and Coil Operating Parameters,” page 2.002.1.

**FEATURES**
- Industry-common cavity.
- Efficient wet-armature construction.
- Continuous-duty rated coils.
- Optional waterproof E-Coils rated up to IP69K.

**RATINGS**
- **Operating Pressure:** 207 bar (3000 psi)
- **Operating Voltage:** See Performance Chart
- **Flow:** up to 11.4 lpm (3 gpm)
- **Max. Internal Leakage:** 164 cc (10 cu. in.) per minute at 207 bar (3000 psi)
- **Maximum Control Current:** 100 mA (12 VDC coil)
- **Minimum Control Current:** 400 mA (12 VDC coil)
- **Threshold Current:** 400 mA (12 VDC coil)
- **Hysteresis:** < 10% full flow
- **Dither/PWM Frequency Range:** 70 Hz min.
- **Operating Temperature:** -40 to 100°C (−40° to 212°F) with standard Buna N seals
  -26 to 204°C (−15° to 400°F) with Fluorocarbon seals
  -54 to 107°C (−65° to 225°F) with Polyurethane seals
- **Filtration:** See page 9.010.1
- **Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 sus); See Temperature and Oil Viscosity, page 9.060.1
- **Installation:** No Restrictions. See page 9.020.1
- **Cavity:** VC08-2; See page 9.108.1; **Cavity Tool:** CT08-2XX; See page 8.600.1
- **Seal Kit:** SK08-2X-M; See page 8.650.1
- **Coil Nut:** Part No. 7004400

**Recommended Electronic Controllers:**
See page 2.001.1 or our Electronics catalog.
**DIMENSIONS**

COIL MUST BE INSTALLED WITH LETTERING UP

TORQUE
4–5 ft-lbs (5.4–6.8 Nm) max.

TORQUE
19–21 ft-lbs (25.8–28.5 Nm) max.

* BSP BODY = 55.9 mm

**MATERIALS**

**Cartridge:** Weight: 0.11 kg. (0.25 lbs.) Steel with hardened work surfaces. Zinc-plated exposed surfaces Buna N O-rings and back-ups standard.

**Standard Ported Body:** Weight: 0.16 kg. (0.35 lbs.) Anodized high-strength 6061 T6 aluminum alloy, rated to 207 bar (3000 psi). Ductile iron bodies available; dimensions may differ. See page 8.008.1.

**Standard Coil:** Weight: 0.11 kg. (0.25 lbs.) Unitized thermoplastic encapsulated, Class H high temperature magnetwire. See page 3.200.1.

**E-Coil:** Weight: 0.14 kg. (0.3 lbs.) Perfect wound, fully encapsulated with rugged external metal shell. Rated up to IP69K with integral connectors. See page 3.400.1

**TO ORDER**

**SP08-24**

Option
None (Blank)
Screen S
Manual Override P

Voltage
**Less Coil 0**
**10 VDC 10**
**12 VDC 12**
**20 VDC 20**
**24 VDC 24**

**Porting**
Cartridge Only 0
SAE 4 4T
SAE 6 6T
1/4 in. BSP* 2B
3/8 in. BSP* 3B

**Seals**
Buna N (Std.) N
Fluorocarbon V
Polyurethane P

**Coil Termination**
Deutsch DT04-2P ER (IP69K)
Metri-Pack 150 EY (IP69K)
Dual Lead Wires EL (IP69K)
Amp Jr. Timer EJ (IP67)
DIN 43650 EG (IP65)
Dual Spades — DS (IP65)

For Coils with Zener Diode, add “Z” to option code. Not available on all models. See coil option info. on pages 3.200.1 & 3.400.1

**For Manual Override details see page 1.001.1**

**Includes Coil Nut**
**10 VDC and 20 VDC coils should be used for most continuous-duty applications. Consult factory.**
DESCRIPTION
A proportional solenoid-operated, 2-way, spool-type, normally-closed, direct-acting, screw-in hydraulic cartridge valve for bi-directional metering.

OPERATION
When energized, the SP10-24 acts as a bi-directional metering valve. When de-energized, the valve blocks flow in both directions.

Note: If low voltage is expected on the machine, 12 or 24 volt systems will require the use of 10 volt or 20 volt coils respectively. See “SP Valves and Coil Operating Parameters,” page 2.002.1.

FEATURES
• Industry-common cavity.
• Efficient wet-armature construction.
• Continuous-duty rated coils.
• Manual Override option.
• Optional waterproof E-Coils rated up to IP69K.

RATINGS
Operating Pressure: 207 bar (3000 psi)
Minimum Operating Dither/Pulse Frequency: 70 Hz
Flow: 0 to 26.5 lpm (0 to 7 gpm)
Max. Internal Leakage: 328 cc/minute (20 cu. in./minute) at 207 bar (3000 psi)
Operating Temperature:
-40 to 100°C (-40° to 212°F) with standard Buna N seals
-26 to 204°C (-15°F to 400°F) with Fluorocarbon seals
-54 to 107°C (-65°F to 225°F) with Polyurethane seals

Filtration: See page 9.010.1

Fluids: Mineral-based or synthetics with lubricating properties at viscosities of
7.4 to 420 cSt (50 to 2000 sus); See Temperature and Oil Viscosity, page 9.060.1

Installation: No Restrictions. See page 9.020.1

Cavity: VC10-2; See page 9.110.1

Cavity Tool: CT10-2XX; See page 8.600.1

Seal Kit: SK10-2X-M; See page 8.650.1

Coil Nut: Part No. 7004420
**MATERIALS**

**Cartridge**: Weight: 0.17 kg. (0.37 lbs.) Steel with hardened work surfaces. Zinc-plated exposed surfaces Buna N O-rings and back-ups standard.

**Standard Ported Body**: Weight: 0.16 kg. (0.35 lbs.) Anodized high-strength 6061 T6 aluminum alloy, rated to 207 bar (3000 psi). Ductile iron bodies available; dimensions may differ. See page 8.010.1.

**Standard D-Coil**: Weight: 0.27 kg. (0.60 lbs.) Utilized thermoplastic encapsulated, Class H high temperature magnetwire. See page 3.200.1.

**E-Coil**: Weight: 0.41 kg. (0.9 lbs.) Perfect wound, fully encapsulated with rugged external metal shell. Rated up to IP69K with integral connectors. See page 3.400.1.

**Seals**: Buna N (Std.) N Fluorocarbon V Polyurethane P

**Recommended Electronic Controllers**: See page 2.001.1 or our Electronics catalog.

**PERFORMANCE (cont’d.)**

**FLOW lpm/gpm**

<table>
<thead>
<tr>
<th>PRESSURE bar/psi</th>
<th>35</th>
<th>69</th>
<th>103</th>
<th>138</th>
<th>172</th>
<th>207</th>
<th>3500</th>
</tr>
</thead>
<tbody>
<tr>
<td>30/3.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26.6/2.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22.8/2.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.9/1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.1/1.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.4/0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.6/0.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.8/0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DIMENSIONS**

<table>
<thead>
<tr>
<th>DIA</th>
<th>1.84</th>
<th>1.62</th>
</tr>
</thead>
<tbody>
<tr>
<td>46.7</td>
<td>47.1</td>
<td></td>
</tr>
<tr>
<td>1.25</td>
<td>1.25</td>
<td></td>
</tr>
<tr>
<td>31.8</td>
<td>31.8</td>
<td></td>
</tr>
<tr>
<td>0.87</td>
<td>0.75</td>
<td></td>
</tr>
<tr>
<td>22.1</td>
<td>19.1</td>
<td></td>
</tr>
<tr>
<td>1.48</td>
<td>2.00</td>
<td></td>
</tr>
<tr>
<td>37.6</td>
<td>50.8</td>
<td></td>
</tr>
<tr>
<td>0.73</td>
<td>3.98</td>
<td></td>
</tr>
<tr>
<td>18.5</td>
<td>101.0</td>
<td></td>
</tr>
</tbody>
</table>

**Standard Porting**

- **SAE 6** 6T
- **SAE 8** 8T
- 1/4 in. BSP* 2B
- 3/8 in. BSP* 3B
- 1/2 in. BSP* 4B

*BSP Body; U.K. Mfr. Only

**Manual Override Option**

- **P**
- **K**

**Voltage**

- **0**
- **10 VDC** 10
- **12 VDC** 12
- **20 VDC** 20
- **24 VDC** 24

**Coil Termination**

- **Deutsch DT04-2P** ER (IP69K) DR (IP65)
- **Metri-Pak 150** EY (IP69K) DY (IP65)
- **Dual Lead Wires** EL (IP69K) DL (IP65)
- **Amp Jr. Timer** EJ (IP67) —
- **DIN 43650** EG (IP65) DG (IP65)
- **Dual Spades** — DS (IP65)

For Coils with Zener Diode, add “/Z” to option code. Not available on all models. See coil option info. on pages 3.200.1 & 3.400.1

**E-Coil**

- **Manual Override Option**
- **P**

**D-Coil**

- **Manual Override**
- **K**

**Seals**

- Buna N (Std.) N
- Fluorocarbon V
- Polyurethane P

**For Manual Override details see page 1.001.1**

**TO ORDER**

**SP10-24**

| Option | None (Blank) | Manual Override P | Manual Override K |

**Porting**

- **Cartridge Only** 0
- **SAE 6** 6T
- **SAE 8** 8T
- 1/4 in. BSP* 2B
- 3/8 in. BSP* 3B
- 1/2 in. BSP* 4B

**Coil Must Be Installed with Lettering Up**

**INCH MILLIMETRE**

- D-Coil View
- E-Coil View

**TORQUE**

- 4–5 ft-lbs (5.4–6.8 Nm)
- 33–37 ft-lbs (44.8–50.2 Nm)

**PRESSURE bar/psi**

- 3500
- 2070
- 1380
- 1030
- 690
- 35

**FLOW lpm/gpm**

- 30.3/8
- 26.6/7
- 22.8/6
- 18.9/5
- 15.1/4
- 11.4/3
- 7.6/2
- 3.8/1
DESCRIPTION
A proportional solenoid-operated, 2-way, spool-type, normally open, bi-directional, screw-in hydraulic cartridge valve.

OPERATION
When de-energized, the SP08-25 allows flow from ➀ to ➁ or from ➁ to ➀. When partially energized, the valve begins to throttle the flow in either direction. When fully energized, flow is blocked in either direction.

External circuitry is required to ramp current.

Note: If low voltage is expected on the machine, 12 or 24 volt systems will require the use of 10 volt or 20 volt coils respectively. See “SP Valves and Coil Operating Parameters,” page 2.002.1.

FEATURES
• Industry-common cavity.
• Continuous-duty rated coils.
• Hardened precision spool and cage for long life.
• Optional waterproof E-Coils rated up to IP69K.

RATINGS
Operating Pressure: 207 bar (3000 psi)
Operating Voltage: See performance chart
Flow: 0 to 15.4 lpm (0 to 4 gpm)
Internal Leakage: 5 drops per minute at 207 bar (3000 psi)
Temperature: -40 to 120°C with standard Buna seals
Filtration: Recommend ISO 4406 16/13; See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 sus)
Installation: No Restrictions. See page 9.020.1
Cavity: VC08-2; See page 9.108.1
Cavity Tool: CT08-2XX; See page 8.600.1
Seal Kit: SK08-2X-T; See page 8.650.1

PERFORMANCE
**ELECTRONIC CONTROLLERS**

Recommended Controllers (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig. w/12V Coil</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>7114950</td>
<td>4000046</td>
<td>4000049</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000070</td>
<td>4000141</td>
<td>4000124</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>400123</td>
<td>4000143</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input Sig. w/24V Coil</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000161</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000165</td>
<td>4000141</td>
<td>4000182</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000169</td>
<td>4000143</td>
<td>4000186</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

**DIMENSIONS**

COIL MUST BE INSTALLED WITH LETTERING UP

TORQUE 4–5 ft-lbs (5.4–6.8 Nm) max.

TORQUE 19–21 ft-lbs (25.8–28.5 Nm) max.

**MATERIALS**

Cartridge: Weight: 0.11 kg. (0.25 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces; Buna N O-rings and back-ups standard.

Standard Ported Body: Weight: 0.16 kg. (0.35 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.008.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

Standard Coil: Weight: 0.11 kg. (0.25 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

E-Coil: Weight: 0.14 kg. (0.3 lbs.); Perfect wound, fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors.

**TO ORDER**

<table>
<thead>
<tr>
<th>Porting</th>
<th>0 Cartridge Only</th>
<th>4 Cartridge Only</th>
<th>6 Cartridge Only</th>
<th>8 Cartridge Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage 0</td>
<td>Less Coil**</td>
<td>10 10 VDC’</td>
<td>12 12 VDC’</td>
<td>20 20 VDC’</td>
</tr>
<tr>
<td>Voltage 24</td>
<td>24 VDC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage 10</td>
<td>10 VDC’</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage 20</td>
<td>20 VDC’</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage 24</td>
<td>24 VDC</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Seals**

Buna N (Std.) N
Fluorocarbon V
Polyurethane P

**Termination (VDC) Std. Coil**

DS Dual Spades
DG DIN 43650
DL Leadwires (2)
DL/W Leads w/Weatherpack® Connectors
DR Deutsch DT04-2P

**Termination (VDC) E-Coil**

ER Deutsch DT04-2P (IP69K Rated)
EY Metri-Pack® 150.2A (IP69K Rated)

Coils with internal diode are available. Consult factory.
**DESCRIPTION**
A proportional, solenoid-operated, 4-way, 2-position, screw-in hydraulic cartridge valve.

**OPERATION**
When de-energized, the SP08-41 blocks flow to all ports. When energized, metered flow is allowed from ③ to ④, as well as metered return flow from ② to ①. Please note that this valve will allow flow from ④ to ③ and from ① to ② but these flows will not be metered.

**FEATURES**
- Continuous-duty rated solenoid.
- Hardened parts for long life.
- Optional coil voltages and terminations.
- Efficient wet-armature construction.
- Cartridges are voltage interchangeable.
- Optional waterproof E-Coils rated up to IP69K.
- Good linearity and hysteresis.
- Industry common cavity.

**RATINGS**
- Operating Pressure: 247 bar (3625 psi) with standard Buna N seals
- Flow: 11.4 lpm (3 gpm) maximum; see performance chart
- Internal Leakage: 328 ml/minute (20 cu. in./minute) max. at 207 bar (3000 psi)
- Temperature: -40 to 120°C with standard Buna seals
- Coil Duty Rating: Standard Coils and E-Coils: Continuous from 85% to 115% of nominal voltage
- Filtration: See page 9.010.1
- Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
- Installation: No restrictions; See page 9.020.1
- Cavity: VC08-4; See page 9.108.1
- Cavity Tool: CT08-4XX; See page 8.600.1
- Seal Kit: SK08-4X-MMM; See page 8.650.1
- Coil Nut: Part No. 7004400;
  - For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut info.

**FLOW vs. CURRENT**
Flow vs. Current
100 Hz PWM; 12 VDC
32 cSt/150 sus oil at 40°C

**PRESSURE DROP**
Pressure Compensation, Inlet to Work Port
Typical Differential Pressure
32 cSt/150 sus oil at 40°C

**Recommended Controllers**
(See Section 3)

---

2.078.1
MATERIALS

**Cartridge:** Weight: 0.13 kg. (0.28 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and single-turn polyester elastomer back-up standard.

**Standard Ported Body:** Weight: 0.27 kg. (0.60 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.008.1. Steel and Ductile Iron bodies available, dimensions may differ, consult factory.

**Standard Coil:** Weight: 0.11 kg. (0.25 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

**E-Coil:** Weight: 0.14 kg. (0.3 lbs.); Perfect wound, fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors; **Note:** See page 3.400.1 for all E-Coil retrofit applications.

TO ORDER

**Option**
- None (Blank)

**Porting**
- Cartridge Only
- SAE 6T
- SAE 8T
- 1/4 in. BSP*
- 3/8 in. BSP*
- *BSP Body; U.K. Mfr. Only

**Voltage**
- 0 Less Coil**
- 12 12 VDC
- 24 24 VDC
- **Includes Coil Nut

**Seals**
- Buna N (Std.) N
- Fluorocarbon V

**Termination (VDC)**
- Std. Coil
- DS Dual Spades
- DG DIN 43650
- DL Leadwires (2)
- DL/W Leads w/Weatherpak® Connectors
- DR Deutsch DT04-2P

**Termination (VDC)**
- E-Coil
- EY Metri-Pack® 150 (IP69K Rated)
- ER Deutsch DT04-2P (IP69K Rated)

Coils with internal diode are available. Consult factory.
**SP10-41 Spool, 4-Way, 2-Position, Normally Closed**

**DESCRIPTION**
A proportional, solenoid-operated, 4-way, 2-position, normally closed, spool-type, screw-in hydraulic cartridge valve.

**OPERATION**
When de-energized, the SP10-41 blocks flow to all ports. When the coil is energized, metered flow is allowed from ③ and ④, as well as metered return flow from ② to ①. While port ① may be fully pressurized, it is not intended for use as the valve’s inlet. In circuits where work port flows are unequal due to cylinder ratios, the higher return flow should be directed to port ②.

**Note:** Valve will allow flow from ① to ② and from ④ to ③ but flow will not be metered.

**FEATURES**
- Continuous-duty rated solenoid.
- Hardened precision spool and cage for long life.
- Optional coil voltages and terminations.
- Efficient wet-armature construction.
- Cartridges are voltage interchangeable.
- Optional waterproof E-Coils rated up to IP69K.
- Good linearity and hysteresis.
- Industry common cavity.

**RATINGS**
- **Operating Pressure:** 207 bar (3000 psi)
- **Flow:** 20.8 lpm (5.5 gpm) maximum; see performance chart
- **Internal Leakage:** 164 ml/minute (10 cu. in./minute) max. at 207 bar (3000 psi)
- **Temperature:** -40 to 120°C with standard Buna seals
- **Coil Duty Rating:** Standard Coils and E-Coils: Continuous from 85% to 115% of nominal voltage
- **Filtration:** See page 9.010.1
- **Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
- **Installation:** No restrictions; See page 9.020.1
- **Cavity:** VC10-4; See page 9.110.1
- **Cavity Tool:** CT10-4XX; See page 8.600.1
- **Seal Kit:** SK10-4X-MMM; See page 8.650.1
- **Coil Nut:** Part No. 7004400;
  - For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut info.

**PERFORMANCE** (Cartridge Only)

![Flow vs. Current Graph](image)

**SYMBOLS**

**USASI/ISO:**

![Symbol Diagram](image)

**Recommended Controllers** (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>w/12V Coil</td>
<td>w/24V Coil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-5 VDC</td>
<td>7114950</td>
<td>4000046</td>
<td>4000049</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000070</td>
<td>4000141</td>
<td>4000124</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000123</td>
<td>4000114</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
<tr>
<td>w/24V Coil</td>
<td>4000161</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>0-5 VDC</td>
<td>4000165</td>
<td>4000141</td>
<td>4000182</td>
<td>4000137</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000169</td>
<td>4000143</td>
<td>4000186</td>
<td>4000139</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

2.080.1
**DIMENSIONS**

<table>
<thead>
<tr>
<th>COIL MUST BE INSTALLED WITH LETTERING UP</th>
<th>TORQUE: 5–7 ft-lbs (6.8–9.5 Nm) max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Coil View</td>
<td>E-Coil View</td>
</tr>
</tbody>
</table>

**MATERIALS**

Cartridge: Weight: 0.20 kg. (0.45 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and single-turn polyester elastomer back-up standard.

Standard Ported Body: Weight: 0.36 kg. (0.80 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.010.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

Standard Coil: Weight: 0.27 kg. (0.60 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

E-Coil: Weight: 0.41 kg. (0.9 lbs.); Perfect wound, fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors; Note: See page 3.400.1 for all E-Coil retrofit applications.

**TO ORDER**

SP10-41

Option

None (Blank)

Voltage

0 Less Coil**

12 12 VDC

24 24 VDC

**Includes Coil Nut

Voltage

12 12 VDC

24 24 VDC

Termination (VDC)

Std. Coil

DS Dual Spades

DG DIN 43650

DL Leadwires (2)

DL/W Leads w/Weatherpak® Connectors

DR Deutsch DT04-2P

Termination (VDC)

E-Coil

EY Metri-Pack® 150 (IP69K Rated)

ER Deutsch DT04-2P (IP69K Rated)

EG DIN 43650 (IP65 Rated)

Seals

Buna N (Std.) N

Fluorocarbon V

Notes:

- Voltage options: 0, 12, 24 VDC
- Termination options: DS, DG, DL, DL/W, DR
- Option: None (Blank)
- Porting options: Cartridge Only 0, SAE 6 6T, SAE 8 8T, 1/4 in. BSP* 2B, 3/8 in. BSP* 3B
- *BSP Body; U.K. Mfr. Only

Coils with internal diode are available. Consult factory.
**SP08-46R  Spool, 4-Way, 2-Position**

**DESCRIPTION**
A proportional, solenoid-operated, 4-way, 2-position, screw-in hydraulic cartridge valve.

**OPERATION**
When de-energized, the SP08-46R allows flow from ⃷, ⃥ and ⃨, while blocking flow at ⃤. When energized, metered flow is allowed from ⃤ to ⃨, as well as metered return flow from ⃷ to ⃥. Please note that this valve will allow flow from ⃨ to ⃤ and from ⃥ to ⃷ but these flows will not be metered.

**FEATURES**
- Continuous-duty rated solenoid.
- Hardened parts for long life.
- Optional coil voltages and terminations.
- Efficient wet-armature construction.
- Cartridges are voltage interchangeable.
- Optional waterproof E-Coils rated up to IP69K.
- Good linearity and hysteresis.
- Industry common cavity.

**RATINGS**
- **Operating Pressure**: 247 bar (3625 psi) with standard Buna N seals
- **Flow**: 11.4 lpm (3 gpm) maximum; see performance chart
- **Internal Leakage**: 328 ml/minute (20 cu. in./minute) max. at 207 bar (3000 psi)
- **Temperature**: -40 to 120°C with standard Buna seals
- **Coil Duty Rating**: Standard Coils and E-Coils: Continuous from 85% to 115% of nominal voltage
- **Filtration**: See page 9.010.1
- **Fluids**: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
- **Installation**: No restrictions; See page 9.020.1
- **Cavity**: VC08-4; See page 9.108.1
- **Cavity Tool**: CT08-4XX; See page 8.600.1
- **Seal Kit**: SK08-4X-MMM; See page 8.650.1
- **Coil Nut**: Part No. 7004400;
  For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut info.

**PERFORMANCE** (Cartridge Only)

<table>
<thead>
<tr>
<th>Flow vs. Current</th>
<th>100 Hz PWM; 12 VDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 cSt/150 sus oil at 40°C</td>
<td></td>
</tr>
</tbody>
</table>

**FLOW lpm/gpm**

<table>
<thead>
<tr>
<th>CURRENT amps</th>
<th>1.9/0.5</th>
<th>3.8/1.0</th>
<th>5.7/1.5</th>
<th>7.5/2.0</th>
<th>9.5/2.5</th>
<th>11.4/3.0</th>
</tr>
</thead>
</table>

**Pressure Compensation, Inlet to Work Port**

**Typical Differential Pressure**

32 cSt/150 sus oil at 40°C

**FLOW lpm/gpm**

<table>
<thead>
<tr>
<th>PRESSURE bar/psi</th>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 amp Current</td>
<td>0</td>
<td>1.725</td>
<td>3.450</td>
<td>5.275</td>
<td>6.900</td>
<td>8.525</td>
<td>10.150</td>
<td>11.775</td>
<td>13.390</td>
</tr>
<tr>
<td>1.0 amp Current</td>
<td>0</td>
<td>3.810</td>
<td>7.620</td>
<td>11.430</td>
<td>15.140</td>
<td>18.950</td>
<td>22.760</td>
<td>26.570</td>
<td>30.380</td>
</tr>
<tr>
<td>0.7 amp Current</td>
<td>0</td>
<td>3.810</td>
<td>7.620</td>
<td>11.430</td>
<td>15.140</td>
<td>18.950</td>
<td>22.760</td>
<td>26.570</td>
<td>30.380</td>
</tr>
</tbody>
</table>

**Recommended Controllers** (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil Mount</th>
<th>DIN Rail Mount</th>
<th>DWC Board</th>
<th>Metal Box</th>
<th>DIN Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000169</td>
<td>4000170</td>
<td>4000168</td>
<td>4000166</td>
<td>4000164</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000169</td>
<td>4000170</td>
<td>4000168</td>
<td>4000166</td>
<td>4000164</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000169</td>
<td>4000170</td>
<td>4000168</td>
<td>4000166</td>
<td>4000164</td>
</tr>
<tr>
<td>PWM</td>
<td>4000169</td>
<td>4000170</td>
<td>4000168</td>
<td>4000166</td>
<td>4000164</td>
</tr>
<tr>
<td>0-5 VDC</td>
<td>4000169</td>
<td>4000170</td>
<td>4000168</td>
<td>4000166</td>
<td>4000164</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000169</td>
<td>4000170</td>
<td>4000168</td>
<td>4000166</td>
<td>4000164</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000169</td>
<td>4000170</td>
<td>4000168</td>
<td>4000166</td>
<td>4000164</td>
</tr>
<tr>
<td>PWM</td>
<td>4000169</td>
<td>4000170</td>
<td>4000168</td>
<td>4000166</td>
<td>4000164</td>
</tr>
</tbody>
</table>
**DIMENSIONS**

**COIL MUST BE INSTALLED WITH LETTERING UP**

**TORQUE**
- 4–5 ft-lbs (5.4–6.8 Nm)
- 19–21 ft-lbs (25.8–28.5 Nm)

**MATERIALS**

**Cartridge**: Weight: 0.13 kg. (0.28 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and single-turn polyester elastomer back-up standard.

**Standard Ported Body**: Weight: 0.27 kg. (0.60 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.008.1. Steel and Ductile Iron bodies available, dimensions may differ, consult factory.

**Standard Coil**: Weight: 0.11 kg. (0.25 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

**E-Coil**: Weight: 0.14 kg. (0.3 lbs.); Perfect wound, fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors; **Note**: See page 3.400.1 for all E-Coil retrofit applications.

**TO ORDER**

**SP08-46R**

**Option**
- None (Blank)

**Porting**
- Cartridge Only
- SAE 6 6T
- SAE 8 8T
- 1/4 in. BSP* 2B
- 3/8 in. BSP* 3B

**Seals**
- Buna N (Std.) N
- Fluorocarbon V

**Voltage**
- 0 Less Coil**
- 12 12 VDC
- 24 24 VDC

**Termination (VDC)**
- Std. Coil
- DS Dual Spades
- DG DIN 43650
- DL Leadwires (2)
- DL/W Leads w/Weatherpak® Connectors
- DR Deutsch DT04-2P

**Termination (VDC)**
- E-Coil
  - EY Metri-Pack® 150 (IP69K Rated)
  - ER Deutsch DT04-2P (IP69K Rated)

Coils with internal diode are available. Consult factory.
**DESCRIPTION**
A proportional, solenoid-operated, 4-way, 2-position, screw-in hydraulic cartridge valve.

**OPERATION**
When de-energized, the SP10-46R allows flow from ➄, ➅ and ➅, while blocking flow at ➃. When energized, metered flow is allowed from ➃ to ➄, as well as metered return flow from ➄ to ➅.

**FEATURES**
- Continuous-duty rated solenoid.
- Hardened precision spool and cage for long life.
- Optional coil voltages and terminations.
- Efficient wet-armature construction.
- Cartridges are voltage interchangeable.
- Optional waterproof E-Coils rated up to IP69K.
- Good linearity and hysteresis.
- Industry common cavity.

**RATINGS**
- **Operating Pressure:** 247 bar (3625 psi) with standard Buna N seals
- **Flow:** 22.7 lpm (6 gpm) maximum; see performance chart
- **Internal Leakage:** 328 ml/minute (20 cu. in./minute) max. at 207 bar (3000 psi)
- **Temperature:** -40 to 120°C with standard Buna seals
- **Coil Duty Rating:** Standard Coils and E-Coils: Continuous from 85% to 115% of nominal voltage
- **Filtration:** See page 9.010.1
- **Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
- **Installation:** No restrictions; See page 9.020.1
- **Cavity:** VC10-4; See page 9.110.1
- **Cavity Tool:** CT10-4XX; See page 8.600.1
- **Seal Kit:** SK10-4X-MMM; See page 8.650.1
- **Coil Nut:** Part No. 7004400:
  - For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut info.

---

**SYMBOLS**

**USASI/ISO:**

1. 4
2. 2
3. 1
4. 3

**PERFORMANCE (Cartridge Only)**

**Flow vs. Current**
- Flow: 22.7 lpm (6 gpm) maximum; see performance chart
- 100 Hz PWM; 12 VDC
- 32 cSt/150 ssu oil at 40°C

**Pressure Compensation, Inlet to Work Port**
- Typical Differential Pressure: 32 cSt/150 ssu oil at 40°C
- 0.5 amp Current
- 0.7 amp Current

---

**Recommended Controllers (See Section 3)**

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000046</td>
<td>4000049</td>
<td>0000136</td>
<td>0000133</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000141</td>
<td>4000124</td>
<td>0000137</td>
<td>0000138</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000143</td>
<td>4000130</td>
<td>0000139</td>
<td>0000140</td>
</tr>
<tr>
<td>PWM</td>
<td>4000144</td>
<td>4000133</td>
<td>0000141</td>
<td>0000142</td>
</tr>
</tbody>
</table>

---

**2.090.1**
DIMENSIONS

COIL MUST BE INSTALLED WITH LETTERING UP

TORQUE: 5-7 ft-lbs (6.8-9.5 Nm) max.

COIL VIEW

MATERIALS

Cartridge: Weight: 0.20 kg. (0.45 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and single-turn polyester elastomer back-up standard.

Standard Ported Body: Weight: 0.36 kg. (0.80 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.010.1. Steel and Ductile Iron bodies available, dimensions may differ, consult factory.

Standard Coil: Weight: 0.27 kg. (0.60 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

E-Coil: Weight: 0.41 kg. (0.9 lbs.); Perfect wound, fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors; Note: See page 3.400.1 for all E-Coil retrofit applications.

TO ORDER

SP10-46R

Option
None (Blank)

Porting
Cartridge Only
0
SAE 6
6T
SAE 8
8T
1/4 in. BSP*
2B
3/8 in. BSP*
3B
*BSP Body; U.K. Mfr. Only

Voltage
0
Less Coil**
12
12 VDC
24
24 VDC
**Includes Coil Nut

Termination (VDC)
Std. Coil
DS
Dual Spades
DG
DIN 43650
DL
Leadwires (2)
DL/W
Leads w/Weatherpak® Connectors
DR
Deutsch DT04-2P

Voltage
E-Coil
12
12 VDC
24
24 VDC

Termination (VDC)
E-Coil
EY
Metri-Pack® 150 (IP69K Rated)
ER
Deutsch DT04-2P (IP69K Rated)
EG
DIN 43650 (IP65 Rated)

Seals
Buna N (Std.)
N
Fluorocarbon
V

*Seals for all E-Coil retrofit applications.
**DESCRIPTION**

A proportional solenoid-operated, 4-way, 3-position, spool-type, closed center, screw-in hydraulic cartridge valve.

**OPERATION**

When de-energized, the SP08-47C blocks flow to all ports. When coil S1 is energized, flow is allowed from ③ to ④, and from ② to ①. When coil S2 is energized, flow is allowed from ④ to ②, and from ③ to ①.

Initial meter-in flow begins at a nominal 0.4 amp on a 12 VDC system. Full flow of 3 gpm occurs at 1.0 to 1.1 amp on a 12 VDC system. Each coil has its own metering characteristics, which are quite similar (see performance chart).

While port ① may be fully pressurized, it is not intended for use as the valve’s inlet. In circuits where work port flows are unequal due to cylinder ratios, the higher return flow should be directed to port ②.

**FEATURES**

- Continuous-duty rated solenoids.
- Optional manual override.
- Efficient wet-armature construction.
- Industry-common cavity.
- Optional coil voltages and terminations.
- Hardened precision spool and cage for long life.
- Optional waterproof E-Coils rated up to IP69K.
- Designed for good linearity and hysteresis.

**RATINGS**

**Operating Pressure:** 240 bar (3500 psi)
**Flow:** 11.4 lpm (3 gpm) max. (see performance chart); Flow rate is based on 50% duty cycle and coil temperature of 20°C (140°F). Consult factory if higher duty cycle and coil temperatures are anticipated.

**Internal Leakage:** 164 cc/minute (10 cu. in./minute) max. per side at 207 bar (3000 psi)

**Hysteresis:** Less than 7%

**Temperature:** -40 to 120°C with standard Buna seals

**Coil Duty Rating:** Standard Coils and E-Coils: Continuous up to 115% of nominal voltage

**Filtration:** See page 9.010.1

**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)

**Installation Recommendation:** When possible, the valve should be mounted below the reservoir oil level. This will maintain oil in the armature preventing trapped air instability. If this is not feasible, mount the valve horizontally for best results. See page 9.020.1

**Cavity:** VC08-4; See page 9.108.1; **Cavity Tool:** CT08-4XX; See page 8.600.1

**Seal Kit:** SK08-4X-MMM; See page 8.650.1

**Coil Nut:** Part No. 7004400; **Manual Override Coil Nut:** Part No. 4528180; **Coil Spacer:** Part No. 4534720

For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut & spacer info.

---

**PERFORMANCE** (Cartridge Only)

<table>
<thead>
<tr>
<th>PRESSURE DROP bar/psi</th>
<th>FLOW lpm/gpm</th>
<th>32 cSt/150 ssu oil at 40°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>0.5</td>
<td>3.8</td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td>11.4</td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>15.1</td>
<td></td>
</tr>
</tbody>
</table>

**Recommended Controller**

**Dual Solenoid Driver**
**Part No. 4000149**
(See page 3.550.1)
**MATERIALS**

**Cartridge:** Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and single-turn polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 0.18 kg (0.40 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.008.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

**Standard Coil:** (2 required) Weight each: 0.11 kg (0.25 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

**E-Coil:** (2 required) Weight each: 0.14 kg (0.3 lbs.); Fully encapsulated with external metal shell; Rated up to IP69K with integral connectors; See page 3.400.1.

---

**TO ORDER**

<table>
<thead>
<tr>
<th>Option</th>
<th>Voltage Standard Coil</th>
<th>Voltage E-Coil</th>
<th>Seals</th>
</tr>
</thead>
<tbody>
<tr>
<td>None (Blank)</td>
<td>0 12 VDC</td>
<td>12 12 VDC</td>
<td>Buna N (Std.)</td>
</tr>
<tr>
<td>Manual Override B</td>
<td><strong>Includes Std. Coil Nut</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manual Override M</td>
<td></td>
<td></td>
<td>Fluorocarbon</td>
</tr>
</tbody>
</table>

**Porting**

- **Cartridge Only**
- **SAE 6**
- **1/4 in. BSP**
- **3/8 in. BSP**
- **3B**
- **BSP Body; U.K. Mfr. Only**

**Termination (VDC)**

- **Std. Coil**
- **DS Dual Spades**
- **DG DIN 43650**
- **DL Leadwires (2)**
- **DL/W Leads w/Weatherpak® Connectors**
- **DR Deutsch DT04-2P**

**Termination (VDC) E-Coil**

- **EY Metri-Pack® 150 (IP69K Rated)**
- **ER Deutsch DT04-2P (IP69K Rated)**

Coils with internal diode are available. Consult factory.
DESCRIPTION
A proportional solenoid-operated, 4-way, 3-position, spool-type, closed center, screw-in hydraulic cartridge valve with lower maximum flow rate of 7.6 lpm (2 gpm).

OPERATION
When de-energized, the SP08-47CL blocks flow to all ports. When coil S1 is energized, flow is allowed from ③ to ④, and from ② to ①. When coil S2 is energized, flow is allowed from ③ to ②, and from ④ to ①.

Initial meter-in flow begins at a nominal 0.4 amp on a 12 VDC system. Full flow of 2 gpm occurs at 1.0 to 1.1 amp on a 12 VDC system. Each coil has its own metering characteristics, which are quite similar (see performance chart).

While port ① may be fully pressurized, it is not intended for use as the valve’s inlet. In circuits where work port flows are unequal due to cylinder ratios, the higher return flow should be directed to port ②.

FEATURES
• Continuous-duty rated solenoids.
• Optional manual override.
• Efficient wet-armature construction.
• Industry-common cavity.
• Optional coil voltages and terminations.
• Hardened precision spool and cage for long life.
• Cartridges are voltage interchangeable.
• Optional waterproof E-Coils rated up to IP69K.
• Designed for good linearity and hysteresis.

RATINGS
Operating Pressure: 240 bar (3500 psi)
Flow: 7.6 lpm (2 gpm) max. (see performance chart); Flow rate is based on 50% duty cycle and coil temperature of 20°C (140°F). Consult factory if higher duty cycle and coil temperatures are anticipated.
Internal Leakage: 164 cc/minute (10 cu. in./minute) max. per side at 207 bar (3000 psi)
Hysteresis: Less than 7%
Temperature: -40 to 120°C with standard Buna seals
Coil Duty Rating: Standard Coils and E-Coils: Continuous up to 115% of nominal voltage
Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
Installation Recommendation: When possible, the valve should be mounted below the reservoir oil level. This will maintain oil in the armature preventing trapped air instability. If this is not feasible, mount the valve horizontally for best results. See page 9.020.1
Cavity: VC08-4; See page 9.108.1; Cavity Tool: CT08-4XX; See page 8.600.1
Seal Kit: SK08-4X-MMM; See page 8.650.1
Coil Nut: Part No. 7004400; Manual Override Coil Nut: Part No. 4528180; Coil Spacer: Part No. 4534720
For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut & spacer info.

Recommended Controller
Dual Solenoid Driver
Part No. 4000149
(See page 3.550.1)
### MATERIALS

**Cartridge:** Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and single-turn polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 0.18 kg (0.40 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.008.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

**Standard Coil:** (2 required)

- Weight each: 0.11 kg (0.25 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.
- E-Coil: (2 required) Weight each: 0.14 kg (0.3 lbs.); Fully encapsulated with external metal shell; Rated up to IP69K with integral connectors; See page 3.400.1.

### TO ORDER

**SP08-47CL**

- **Option**
  - None (Blank)
  - Manual Override B
  - Manual Override M

- **Porting**
  - Cartridge Only 0
  - SAE 6 6T
  - 1/4 in. BSP* 2B
  - 3/8 in. BSP* 3B
  - *BSP Body; U.K. Mfr. Only

- **Seals**
  - Buna N (Std.) N
  - Fluorocarbon V

- **Voltage**
  - **Standard Coil**
    - 0 Less Coil**
    - 12 12 VDC
    - 24 24 VDC
  - **E-Coil**
    - 12 12 VDC
    - 24 24 VDC

**Termination (VDC)**

- Std. Coil
  - DS Dual Spades
  - DG DIN 43650
  - DL Leadwires (2)
  - DL/W Leads w/Weatherpak® Connectors
  - DR Deutsch DT04-2P

**Termination (VDC)**

- E-Coil
  - EY Metri-Pack® 150 (IP69K Rated)
  - ER Deutsch DT04-2P (IP69K Rated)

Coils with internal diode are available. Consult factory.
**DESCRIPTION**
A proportional solenoid-operated, 4-way, 3-position, spool-type, closed center, screw-in hydraulic cartridge valve.

**OPERATION**
When de-energized, the SP10-47C blocks flow to all ports. When coil S1 is energized, flow is allowed from ➂ to ➃, and from ➁ to ➀. When coil S2 is energized, flow is allowed from ➀ to ➂, and from ➃ to ➁.

Initial meter-in flow begins at a nominal 0.4 amp on a 12 VDC system. Full flow of 6 gpm occurs at 1.1 to 1.2 amp on a 12 VDC system. Each coil has its own metering characteristics, which are quite similar (see performance chart).

While port ➀ may be fully pressurized, it is not intended for use as the valve’s inlet.

In circuits where work port flows are unequal due to cylinder ratios, the higher return flow should be directed to port ➂.

**FEATURES**
- Continuous-duty rated solenoids.
- Hardened precision spool and cage for long life.
- Optional coil voltages and terminations.
- Efficient wet-armature construction.
- Cartridges are voltage interchangeable.
- Optional waterproof E-Coils rated up to IP69K.
- Optional manual override.
- Industry-common cavity.
- Designed for good linearity and hysteresis.

**RATINGS**
- **Operating Pressure:** 248 bar (3600 psi)
- **Flow:** 22.7 lpm (6 gpm) max. (see performance chart)
- **Internal Leakage:** 164 cc/minute (10 cu. in./minute) max. per side at 248 bar (3600 psi)
- **Hysteresis:** Less than 7%
- **Temperature:** -40 to 120°C with standard Buna seals
- **Coil Duty Rating:** Standard Coils and E-Coils: Continuous up to 115% of nominal voltage
- **Filtration:** See page 9.010.1
- **Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
- **Installation Recommendation:** When possible, the valve should be mounted below the reservoir oil level. This will maintain oil in the armature preventing trapped air instability. If this is not feasible, mount the valve horizontally for best results. See page 9.020.1
- **Cavity:** VC10-4; See page 9.110.1; **Cavity Tool:** CT10-4XX; See page 8.600.1
- **Seal Kit:** SK10-4X-MMM; See page 8.650.1
- **Coil Nut:** Part No. 7004400; **Manual Override Coil Nut:** Part No. 4528180
- **Coil Spacer:** Part No. 4539700
- **Coil Nut:** For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut & spacer info.

**PERFORMANCE**
*(Cartridge Only)*

***Recommended Controller***

**Dual Solenoid Driver**
**Part No. 4000149**
*(See page 3.550.1)*
**MATERIALS**

Cartridge: Weight: 0.30 kg, (0.65 lbs.) Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and single-turn polyester elastomer back-ups standard.

Standard Ported Body: Weight: 0.34 kg, (0.75 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.010.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

Standard Coil: (2 required) Weight each: 0.27 kg, (0.60 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

E-Coil: (2 required) Weight each: 0.41 kg, (0.9 lbs.); Fully encapsulated with external metal shell; See page 3.400.1.

**TO ORDER**

**SP10-47C**

Option
- None (Blank)
- Manual Override B
- Manual Override M

Porting
- Cartridge Only 0
- SAE 6 6T
- SAE 8 8T
- 1/4 in. BSP* 2B
- 3/8 in. BSP* 3B

*BSB Body: U.K. Mfr. Only

Seals
- Buna N (Std.) N
- Fluorocarbon V

Voltage Standard Coil
- 0 Less Coil**
- 12 12 VDC
- 24 24 VDC

**Includes Std. Coil Nut

Voltage E-Coil
- 12 12 VDC
- 24 24 VDC

Termination (VDC)
- Std. Coil
  - DS Dual Spades
  - DG DIN 43650
  - DL Leadwires (2)

- Leadwires w/Weatherpak® Connectors
- DR Deutsch DT04-2P

- E-Coil
  - EY Metri-Pack® 150 (IP69K Rated)
  - ER Deutsch DT04-2P (IP69K Rated)

Coils with internal diode are available. Consult factory.
**DESCRIPTION**
A proportional solenoid-operated, 4-way, 3-position, spool-type, motor spool, screw-in hydraulic cartridge valve.

**OPERATION**
When de-energized, the **SP08-47D** blocks flow to ③ while allowing flow from ① to ②, and from ④ to ①. When coil S1 is energized flow is allowed from ③ to ④ and from ② to ①. When coil S2 is energized flow is allowed from ③ to ② and from ④ to ①.

Initial meter-in flow begins at a nominal 0.4 amp on a 12 VDC system. Full flow of 3 gpm occurs at 1.0 to 1.1 amp on a 12 VDC system. Each coil has its own metering characteristics, which are quite similar (see performance chart).

While port ① may be fully pressurized, it is not intended for use as the valve’s inlet.

In circuits where work port flows are unequal due to cylinder ratios, the higher return flow should be directed to port ②.

**FEATURES**
- Continuous-duty rated solenoids.
- Optional coil voltages and terminations.
- Efficient wet-armature construction.
- Hardened precision spool and cage for long life.
- Cartridges are voltage interchangeable.
- Optional waterproof E-Coils rated up to IP69K.
- Designed for good linearity and hysteresis.

**RATINGS**
**Operating Pressure:** 240 bar (3500 psi)
**Flow:** 11.4 lpm (3 gpm) max. (see performance chart); Flow rate is based on 50% duty cycle and coil temperature of 20°C (140°F). Consult factory if higher duty cycle and coil temperatures are anticipated.

**Internal Leakage:** 328 cc/minute (20 cu. in./minute) max. per side at 207 bar (3000 psi)
**Hysteresis:** Less than 7%
**Temperature:** -40 to 120°C with standard Buna seals
**Coil Duty Rating:** Standard Coils and E-Coils: Continuous up to 115% of nominal voltage
**Filtration:** See page 9.010.1
**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)

**Installation Recommendation:** When possible, the valve should be mounted below the reservoir oil level. This will maintain oil in the armature preventing trapped air instability. If this is not feasible, mount the valve horizontally for best results. See page 9.020.1

**Cavity:** VC08-4; See page 9.108.1; **Cavity Tool:** CT08-4XX; See page 8.600.1
**Seal Kit:** SK08-4X-MMM; See page 8.650.1
**Coil Nut:** Part No. 7004400; **Manual Override Coil Nut:** Part No. 4528180; **Coil Spacer:** Part No. 4534720
For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut & spacer info.

**Recommended Controller**
**Dual Solenoid Driver**
Part No. 4000149
(See page 3.550.1)
MATERIALS


Standard Ported Body: Weight: 0.18 kg (0.40 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.008.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

Standard Coil: (2 required) Weight each: 0.11 kg (0.25 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

E-Coil: (2 required) Weight each: 0.14 kg (0.3 lbs.); Fully encapsulated with external metal shell; Rated up to IP69K with integral connectors; See page 3.400.1.

TO ORDER

SP08-47D

<table>
<thead>
<tr>
<th>Option</th>
<th>Voltage Standard Coil</th>
<th>Porting</th>
<th>Seals</th>
</tr>
</thead>
<tbody>
<tr>
<td>None (Blank)</td>
<td>0 Less Coil**</td>
<td>Cartridge Only</td>
<td>Buna N (Std.)</td>
</tr>
<tr>
<td>Manual Override B</td>
<td>12 VDC</td>
<td>1/4 in. BSP*</td>
<td>Fluorocarbon</td>
</tr>
<tr>
<td>Manual Override M</td>
<td>24 VDC</td>
<td>3/8 in. BSP*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>**Includes Std. Coil Nut</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Termination (VDC)

DS Dual Spades
DG DIN 43650
DL Leadwires (2)
DL/W Leads w/Weatherpak® Connectors
DR Deutsch DT04-2P

Termination (VDC) E-Coil

EY Metri-Pack® 150 (IP69K Rated)
ER Deutsch DT04-2P (IP69K Rated)

Coils with internal diode are available. Consult factory.
**DESCRIPTION**

A proportional solenoid-operated, 4-way, 3-position, spool-type, motor spool, screw-in hydraulic cartridge valve with lower maximum flow rate of 7.6 lpm (2 gpm).

**OPERATION**

When de-energized, the SP08-47DL blocks flow to ③ while allowing flow from ② to ①, and from ④ to ①. When coil S1 is energized flow is allowed from ③ to ④ and from ② to ①. When coil S2 is energized flow is allowed from ③ to ② and from ④ to ①.

Initial meter-in flow begins at a nominal 0.4 amp on a 12 VDC system. Full flow of 2 gpm occurs at 1.0 to 1.1 amp on a 12 VDC system. Each coil has its own metering characteristics, which are quite similar (see performance chart).

While port ① may be fully pressurized, it is not intended for use as the valve’s inlet. In circuits where work port flows are unequal due to cylinder ratios, the higher return flow should be directed to port ②.

**FEATURES**

- Continuous-duty rated solenoids.
- Optional coil voltages and terminations.
- Efficient wet-armature construction.
- Hardened precision spool and cage for long life.
- Cartridges are voltage interchangeable.
- Optional waterproof E-Coils rated up to IP69K.
- Designed for good linearity and hysteresis.

**RATINGS**

**Operating Pressure:** 240 bar (3500 psi)

**Flow:** 7.6 lpm (2 gpm) max. (see performance chart); Flow rate is based on 50% duty cycle and coil temperature of 20°C (140°F). Consult factory if higher duty cycle and coil temperatures are anticipated.

**Internal Leakage:** 328 cc/minute (20 cu. in./minute) max. per side at 207 bar (3000 psi)

**Hysteresis:** Less than 7%

**Temperature:** -40 to 120°C with standard Buna seals

**Coil Duty Rating:** Standard Coils and E-Coils: Continuous up to 115% of nominal voltage

**Filtration:** See page 9.010.1

**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)

**Installation Recommendation:** When possible, the valve should be mounted below the reservoir oil level. This will maintain oil in the armature preventing trapped air instability. If this is not feasible, mount the valve horizontally for best results. See page 9.020.1

**Cavity:** VC08-4; See page 9.108.1; **Cavity Tool:** CT08-4XX; See page 8.600.1

**Seal Kit:** SK08-4X-MMM; See page 8.650.1

**Coil Nut:** Part No. 7004400; **Manual Override Coil Nut:** Part No. 4528180; **Coil Spacer:** Part No. 4534720

For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut & spacer info.

**Recommended Controller**

**Dual Solenoid Driver**

Part No. 4000149

(See page 3.550.1)
Low Flow Version

SP08-47DL

**MATERIALS**

**Cartridge:** Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and single-turn polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 0.18 kg (0.40 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.008.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

**Standard Coil:** (2 required) Weight each: 0.11 kg (0.25 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

**E-Coil:** (2 required) Weight each: 0.14 kg (0.3 lbs.); Fully encapsulated with external metal shell; Rated up to IP69K with integral connectors; See page 3.400.1.

**Seals**

- Buna N (Std.) N
- Fluorocarbon V

**TO ORDER**

**Option**
- None (Blank)
- Manual Override B
- Manual Override M

**Porting**
- Cartridge Only 0
- SAE 6T 6T
- 1/4 in. BSP* 2B
- 3/8 in. BSP* 3B
- *BSP Body; U.K. Mfr. Only

**Voltage**
- Standard Coil
  - 0 Less Coil**
  - 12 12 VDC
  - 24 24 VDC
- *Includes Std. Coil Nut

**Voltage**
- E-Coil
  - 12 12 VDC
  - 24 24 VDC

**Termination (VDC)**
- Std. Coil
  - DS Dual Spades
  - DG DIN 43650
  - DL Leadwires (2)
  - DL/W Leads w/Weatherpak® Connectors
  - DR Deutsch DT04-2P

**Termination (VDC)**
- E-Coil
  - EY Metri-Pack® 150 (IP69K Rated)
  - ER Deutsch DT04-2P (IP69K Rated)

Coils with internal diode are available. Consult factory.

**DIMENSIONS**

**PRESSURE COMPENSATION**

<table>
<thead>
<tr>
<th>DIFFERENTIAL PRESSURE bar/psi</th>
<th>69</th>
<th>100</th>
<th>138</th>
<th>207</th>
<th>300</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLOW lpm/gpm</td>
<td>9.5/2.5</td>
<td>7.6/2.0</td>
<td>5.7/1.5</td>
<td>3.8/1.0</td>
<td>1.9/0.5</td>
</tr>
<tr>
<td>Inlet to Work Port</td>
<td>4.0 Amp</td>
<td>0.75 Amp</td>
<td>0.50 Amp</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PERFORMANCE**

Pressure Compensation

- Inlet to Work Port

**DIA.**

| E-Coil Dia. | 1.41 | 35.8 |

**TORQUE:**

- Across Flats
  - 4–5 ft-lbs (5.5–6.8 Nm) Max.

**SHOWN ABOVE WITH E-COILS AND EY CONNECTORS OPTION**

- Manual Override Option "B" Dia.
  - 1.50 (38.1)

**INCH**

- 0.75
  - T0.1

**MILLIMETRE**

- 0.75
  - 19.1

**NOTE:**

- COILS MUST BE INSTALLED WITH LETTERING UP

---

**NOTES:**

- SP08-47DL - __ __ __ - __ - __ __ __ __ __

- Voltage
  - Standard Coil
    - 0 Less Coil**
    - 12 12 VDC
    - 24 24 VDC
  - *Includes Std. Coil Nut

- Voltage
  - E-Coil
    - 12 12 VDC
    - 24 24 VDC

- Termination (VDC)
  - Std. Coil
    - DS Dual Spades
    - DG DIN 43650
    - DL Leadwires (2)
    - DL/W Leads w/Weatherpak® Connectors
    - DR Deutsch DT04-2P

- Termination (VDC)
  - E-Coil
    - EY Metri-Pack® 150 (IP69K Rated)
    - ER Deutsch DT04-2P (IP69K Rated)

Coils with internal diode are available. Consult factory.
DESCRIPTION
A proportional solenoid-operated, 4-way, 3-position, spool-type, motor spool, screw-in hydraulic cartridge valve.

OPERATION
When de-energized, the SP10-47D blocks flow to ➁ while allowing flow from ➂ to ➀, and from ➃ to ➀. When coil S1 is energized flow is allowed from ➂ to ➃ and from ➁ to ➀. When coil S2 is energized flow is allowed from ➃ to ➁ and from ➀ to port ➀.

Initial meter-in flow begins at a nominal 0.4 amp on a 12 VDC system. Full flow of 6 gpm occurs at 1.1 to 1.2 amp on a 12 VDC system. Each coil has its own metering characteristics, which are quite similar (see performance chart).

While port ➀ may be fully pressurized, it is not intended for use as the valve’s inlet.

In circuits where work port flows are unequal due to cylinder ratios, the higher return flow should be directed to port ➂.

FEATURES
• Continuous-duty rated solenoids.
• Hardened precision spool and cage for long life.
• Optional coil voltages and terminations.
• Efficient wet-armature construction.
• Cartridges are voltage interchangeable.
• Optional waterproof E-Coils rated up to IP69K.
• Optional manual override.
• Industry-common cavity.
• Designed for good linearity and hysteresis.

RATINGS
Operating Pressure: 207 bar (3000 psi)
Flow: 22.7 lpm (6 gpm) max. (see performance chart)
Internal Leakage: 246 cc/minute (15 cu. in./minute) max. per side at 207 bar (3000 psi)
Hysteresis: Less than 7%
Temperature: -40 to 120°C with standard Buna seals
Coil Duty Rating: Standard Coils and E-Coils: Continuous up to 115% of nominal voltage
Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
Installation Recommendation: When possible, the valve should be mounted below the reservoir oil level. This will maintain oil in the armature preventing trapped air instability. If this is not feasible, mount the valve horizontally for best results. See page 9.020.1
Cavity: VC10-4; See page 9.110.1; Cavity Tool: CT10-4XX; See page 8.600.1
Seal Kit: SK10-4X-MMM; See page 8.650.1
Coil Nut: Part No. 7004400; Manual Override Coil Nut: Part No. 4528180
Coil Spacer: Part No. 4539700
For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut & spacer info.

Recommended Controller
Dual Solenoid Driver
Part No. 4000149
(See page 3.550.1)
MATERIALS

Cartridge: Weight: 0.30 kg. (0.65 lbs.) Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and single-turn polyester elastomer back-ups standard.

Standard Ported Body: Weight: 0.34 kg. (0.75 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.010.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

Standard Coil: (2 required) Weight each: 0.27 kg. (0.60 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

E-Coil: (2 required) Weight each: 0.41 kg (0.9 lbs.); Fully encapsulated with external metal shell; See page 3.400.1.

TO ORDER

SP10-47D

Option
None (Blank)
Manual Override B
Manual Override M

Porting
Cartridge Only 0
SAE 6 6T
SAE 8 8T
1/4 in. BSP* 2B
3/8 in. BSP* 3B
*BSP Body; U.K. Mfr. Only

Voltage

Standard Coil

0 Less Coil**
12 12 VDC
24 24 VDC

Includes Std. Coil Nut

E-Coil

12 12 VDC
24 24 VDC

Termination (VDC)

DS Dual Spades
DG DIN 43650
DL Leadwires (2)
DL/W Leads w/Weatherpack® Connectors
DR Deutsch DT04-2P

Termination (VDC)

E-Coil

EY Metri-Pack® 150 (IP69K Rated)
ER Deutsch DT04-2P (IP69K Rated)

Seals
Buna N (Std.) N
Fluorocarbon V

Coils with internal diode are available. Consult factory.
**DESCRIPTION**
A solenoid-operated, 5-way, 3-position, proportional, screw-in hydraulic cartridge valve with integral load-sense port.

**OPERATION**
When de-energized, the SP10-57C blocks flow to all ports. When coil #1 is energized, flow is allowed from ⑥ to ②, and from ③ to ⑤. When coil #2 is energized, flow is allowed from ⑤ to ④, and from ② to ③. Load sense is connected to port ⑤ when the spool is in shifted positions.

**Note:** If low voltage is expected on the machine, 12 or 24 volt systems will require the use of 10 volt or 20 volt coils respectively. See “SP Valves and Coil Operating Parameters,” page 2.002.1.

**FEATURES**
- Continuous-duty rated solenoid.
- Hardened precision spool and cage for long life.
- Optional coil voltages and terminations
- Cartridges are voltage interchangeable.
- Optional manual override.
- Optional waterproof E-Coils rated up to IP69K.

**RATINGS**
- **Operating Pressure:** 250 bar (3625 psi) with standard Buna N seals
- **Flow:** 22.7 lpm (6 gpm) max. See performance chart
- **Internal Leakage:** 246 cc/minute (15 cu. in./minute) max. at 207 bar (3000 psi)
- **Temperature:** -40 to 120°C with standard Buna seals
- **Coil Duty Rating:** Continuous from 85% to 115% of nominal voltage
- **Filtration:** See page 9.010.1
- **Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 sus); See Temperature and Oil Viscosity, page 9.060.1
- **Installation:** No restrictions; See page 9.020.1
- **Cavity:** VC10-5; See page 9.110.1; **Cavity Tool:** CT10-5XX; See page 8.600.1
- **Seal Kit:** SK10-5X-MMMM; See page 8.650.1
- **Coil Nut:** Part No. 7004400; **Coil Spacer** for E-coils: Part No. 4539700

**Recommended Electronic Controllers:**
See page 2.001.1 or our Electronics catalog.

**PERFORMANCE** (Cartridge Only)

- ⑥ to ② or ③ to ⑤ at 100% current, S1 or S2 energized: - - - - - - - - - -
- ⑥ to ③ or ② to ⑤ at 100% current, S1 or S2 energized: - - - - - - - - - -

32 cSt/150 sus oil at 40°C

**Performance with 12 VDC Coils**
and 10.3 bar/150 psi inline compensator
(for other voltages consult factory)

**Top Coil**

**Bottom Coil**

Performance information continued on following page.
for Load Sense Applications

**SP10-57C**

**PERFORMANCE (Continued)**

<table>
<thead>
<tr>
<th>Pressure Compensation</th>
<th>Inlet to Work Port</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FLOW (l/min)</strong></td>
<td><strong>DIFFERENTIAL PRESSURE (bar/psi)</strong></td>
</tr>
<tr>
<td>22.76</td>
<td>189.5</td>
</tr>
<tr>
<td>15.14</td>
<td>145.5</td>
</tr>
<tr>
<td>11.43</td>
<td>89.4</td>
</tr>
<tr>
<td>7.62</td>
<td>67.7</td>
</tr>
<tr>
<td>3.81</td>
<td>24.7</td>
</tr>
</tbody>
</table>

**DIMENSIONS**

- **COILS MUST BE INSTALLED WITH LETTERING UP**
- **TORQUE:** 5–7 ft-lbs (6.8–9.5 Nm) max.
- **TORQUE:** 24–26 ft-lbs (32.5–35.3 Nm) max.

**MATERIALS**

**Cartridge:** Weight: 0.36 kg. (0.80 lbs.)
Steel with hardened work surfaces.
Zinc-plated exposed surfaces; Buna N O-rings and back-ups standard.

**Standard Ported Body:** Weight: 0.41 kg. (0.85 lbs.);
Anodized high-strength 6061 T6 aluminum alloy,
rated to 207 bar (3000 psi); Ductile iron bodies available; dimensions may differ. See page 8.010.1.

**Standard Coil:** Weight each: 0.27 kg. (0.60 lbs.);
Unitized thermoplastic encapsulated, Class H high temperature magnetwire.
See page 3.200.1

**E-Coil:** Weight each: 0.41 kg. (0.9 lbs.);
Perfect wound, fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors.
See page 3.400.1 for all E-Coil retrofit applications.

**TO ORDER**

**SP10-57C**

<table>
<thead>
<tr>
<th>Option</th>
<th>Voltage Std. Coil</th>
<th>Termination (VDC) Std. Coil</th>
</tr>
</thead>
<tbody>
<tr>
<td>None (Blank)</td>
<td>0 Less Coil**</td>
<td>DS Dual Spades</td>
</tr>
<tr>
<td>Manual Override B</td>
<td>10 10 VDC†</td>
<td>DG DIN 43650</td>
</tr>
<tr>
<td>Manual Override M</td>
<td>12 12 VDC</td>
<td>DL Leadwires (2)</td>
</tr>
<tr>
<td>For Manual Override options see page 1.001.1</td>
<td>20 20 VDC</td>
<td>DL/W Leads w/Weatherpak® Connectors</td>
</tr>
<tr>
<td></td>
<td>24 24 VDC</td>
<td>DR Deutsch DT04-2P</td>
</tr>
</tbody>
</table>

**Terminals (VDC)**

**E-Coil**

- **Voltage Std. Coil**
- **Termination (VDC) Std. Coil**
  - DS Dual Spades
  - DG DIN 43650
  - DL Leadwires (2)
  - DL/W Leads w/Weatherpak® Connectors
  - DR Deutsch DT04-2P

**Seals**

- Buna N (Std.) N
- Fluorocarbon V
- Polyurethane P

**Porting**

- Cartridge Only 0
- SAE 6 6T
- SAE 8 8T

**Terminations (VDC)**

- E-Coil 10 10 VDC
- 12 12 VDC
- 20 20 VDC
- 24 24 VDC

**Coils with internal diode are available. Consult factory.**
DESCRIPTION
A solenoid-operated, five-way, three-position, proportional, screw-in hydraulic cartridge valve with integral load-sense port.

OPERATION
When de-energized, the SP08-57D blocks flow at ➄ while allowing flow from both ➁ and ➄ to ➃. When coil #1 is energized, flow is allowed from ➄ to ➁, and from ➃ to ➂. When coil #2 is energized, flow is allowed from ➄ to ➃, and from ➁ to ➂. Load sense is connected to port ➅ when the spool is in shifted positions.

Note: If low voltage is expected on the machine, 12 or 24 volt systems will require the use of 10 volt or 20 volt coils respectively. See “SP Valves and Coil Operating Parameters,” page 2.002.1.

FEATURES
- Continuous-duty rated solenoid.
- Hardened precision spool and cage for long life.
- Optional coil voltages and terminations
- Cartridges are voltage interchangeable.
- Compact size; Manual override options.
- Optional waterproof E-Coils rated up to IP69K.

RATINGS
- Operating Pressure: 241 bar (3500 psi) with standard Buna N seals
- Flow: 9.5 lpm (2.5 gpm); see performance charts
- Internal Leakage: 164 cc/minute (10 cu. in./minute) max. at 207 bar (3000 psi)
- Temperature: -40 to 120°C with standard Buna seals
- Coil Duty Rating: Continuous from 85% to 115% of nominal voltage
- Initial Coil Current Draw at 20°C: Standard Coil: 1.2 amps at 12 VDC; 0.13 amps at 115 VAC (full wave rectified).
  E-Coil: 1.4 amps at 12 VDC; 0.7 amps at 24 VDC
- Minimum Pull-in Voltage: 85% of nominal at 207 bar (3000 psi)
- Filtration: See page 9.010.1
- Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 sus); See Temperature and Oil Viscosity, page 9.060.1
- Installation: No restrictions; See page 9.020.1
- Cavity: VC08-5; See page 9.108.1 Cavity Tool: CT08-5XX; See page 8.600.1
- Seal Kit: SK08-5X-MMM; See page 8.650.1
- Coil Nut: Part No. 7004400; Coil Spacer: Part No. 4534720

PERFORMANCE (Cartridge Only)

Flow vs. Current
Typical Performance
32 cSt/150 sus oil at 40°C

Differential Pressure vs. Flow
at I-Max. with No Load; Port ➄ to ➃
32 cSt/150 sus oil at 40°C
**Recommended Electronic Controllers:**
See page 2.001.1 or our Electronics catalog.

**MATERIALS**

**Cartridge:** Weight: 0.15 kg. (0.34 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces; Buna N O-rings and back-ups standard.

**Standard Ported Body:** Weight: 0.41 kg. (0.85 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 207 bar (3000 psi); Ductile iron bodies available; dimensions may differ. See [page 8.008.1](#).

**Standard Coil:** Weight each: 0.11 kg. (0.25 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire. See [page 3.200.1](#).

**E-Coil:** Weight: 0.14 kg. (0.3 lbs.); Perfect wound, fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors. See [page 3.400.1](#) for all E-Coil retrofit applications.

**PRESSURE  bar/psi**

### Pressure Response; Coil S1
- No Load; Port ➄ to ➂

### Pressure Response; Coil S2
- No Load; Port ➄ to ➂

**FLOW  lpm/gpm**

**DIMENSIONS**

COILS MUST BE INSTALLED WITH TERMINATING UP

**Pressure Response; Coil S1**

**Pressure Response; Coil S2**

**FLOW  lpm/gpm**

**PRESSURE  bar/psi**

**Recommended Electronic Controllers:**
See page 2.001.1 or our Electronics catalog.

**MATERIALS**

**Cartridge:** Weight: 0.15 kg. (0.34 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces; Buna N O-rings and back-ups standard.

**Standard Ported Body:** Weight: 0.41 kg. (0.85 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 207 bar (3000 psi); Ductile iron bodies available; dimensions may differ. See [page 8.008.1](#).

**Standard Coil:** Weight each: 0.11 kg. (0.25 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire. See [page 3.200.1](#).

**E-Coil:** Weight: 0.14 kg. (0.3 lbs.); Perfect wound, fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors. See [page 3.400.1](#) for all E-Coil retrofit applications.

**PRESSURE  bar/psi**

### Pressure Response; Coil S1
- No Load; Port ➄ to ➂

### Pressure Response; Coil S2
- No Load; Port ➄ to ➂

**FLOW  lpm/gpm**

**DIMENSIONS**

COILS MUST BE INSTALLED WITH TERMINATING UP

**Pressure Response; Coil S1**

**Pressure Response; Coil S2**

**FLOW  lpm/gpm**

**PRESSURE  bar/psi**

**Recommended Electronic Controllers:**
See page 2.001.1 or our Electronics catalog.

**MATERIALS**

**Cartridge:** Weight: 0.15 kg. (0.34 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces; Buna N O-rings and back-ups standard.

**Standard Ported Body:** Weight: 0.41 kg. (0.85 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 207 bar (3000 psi); Ductile iron bodies available; dimensions may differ. See [page 8.008.1](#).

**Standard Coil:** Weight each: 0.11 kg. (0.25 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire. See [page 3.200.1](#).

**E-Coil:** Weight: 0.14 kg. (0.3 lbs.); Perfect wound, fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors. See [page 3.400.1](#) for all E-Coil retrofit applications.

**PRESSURE  bar/psi**

### Pressure Response; Coil S1
- No Load; Port ➄ to ➂

### Pressure Response; Coil S2
- No Load; Port ➄ to ➂

**FLOW  lpm/gpm**

**DIMENSIONS**

COILS MUST BE INSTALLED WITH TERMINATING UP

**Pressure Response; Coil S1**

**Pressure Response; Coil S2**

**FLOW  lpm/gpm**

**PRESSURE  bar/psi**

**Recommended Electronic Controllers:**
See page 2.001.1 or our Electronics catalog.

**MATERIALS**

**Cartridge:** Weight: 0.15 kg. (0.34 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces; Buna N O-rings and back-ups standard.

**Standard Ported Body:** Weight: 0.41 kg. (0.85 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 207 bar (3000 psi); Ductile iron bodies available; dimensions may differ. See [page 8.008.1](#).

**Standard Coil:** Weight each: 0.11 kg. (0.25 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire. See [page 3.200.1](#).

**E-Coil:** Weight: 0.14 kg. (0.3 lbs.); Perfect wound, fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors. See [page 3.400.1](#) for all E-Coil retrofit applications.

**PRESSURE  bar/psi**

### Pressure Response; Coil S1
- No Load; Port ➄ to ➂

### Pressure Response; Coil S2
- No Load; Port ➄ to ➂

**FLOW  lpm/gpm**

**DIMENSIONS**

COILS MUST BE INSTALLED WITH TERMINATING UP

**Pressure Response; Coil S1**

**Pressure Response; Coil S2**

**FLOW  lpm/gpm**

**PRESSURE  bar/psi**
**SP10-57D  Spool, 5-Way, 3-Position . . .**

**DESCRIPTION**
A solenoid-operated, 5-way, 3-position, proportional, screw-in hydraulic cartridge valve with integral load-sense port.

**OPERATION**
When de-energized, the SP10-57D blocks flow at ➄ while allowing flow from both ➁ and ➃ to ➂. When coil #1 is energized, flow is allowed from ➄ to ➁, and from ➃ to ➂. When coil #2 is energized, flow is allowed from ➄ to ➃, and from ➁ to ➂. Load sense is connected to port ➆ when the spool is in shifted positions.

Note: If low voltage is expected on the machine, 12 or 24 volt systems will require the use of 10 volt or 20 volt coils respectively. See “SP Valves and Coil Operating Parameters,” page 2.002.1.

**FEATURES**
- Continuous-duty rated solenoid.
- Hardened precision spool and cage for long life.
- Optional coil voltages and terminations.
- Optional manual override.
- Optional waterproof E-Coils rated up to IP69K.
- Cartridges are voltage interchangeable.

**RATINGS**
- **Operating Pressure:** 250 bar (3625 psi) with standard Buna N seals
- **Flow:** 22.8 lpm (6 gpm) max. See performance chart
- **Internal Leakage:** 246 cc/minute (15 cu. in./minute) max. at 207 bar (3000 psi)
- **Temperature:** -40 to 120°C with standard Buna seals
- **Coil Duty Rating:** Continuous from 85% to 115% of nominal voltage
- **Filtration:** See page 9.010.1
- **Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 sus)
- **Installation:** No restrictions; See page 9.020.1
- **Cavity:** VC10-5; See page 9.110.1; **Cavity Tool:** CT10-5XX; See page 8.600.1
- **Seal Kit:** SK10-5X-MMMM; See page 8.650.1
- **Coil Nut:** Part No. 7004400; **Coil Spacer** for E-Coils: Part No. 4539700

**PERFORMANCE (Cartridge Only)**

- ➄ to ➁ or ➃ to ➂ at 100% current, S1 or S2 energized: ————
- ➄ to ➁ or ➃ to ➂ at 100% current, S1 or S2 energized: - - - - - - -

**Recommended Controller**
- **Dual Solenoid Driver**
- **Part No. 4000149**

(See page 3.550.1)

Performance with 12 VDC Coils and 10.3 bar/150 psi inline compensator (for other voltages consult factory)

Performance information continued on following page.
**PERFORMANCE** (Continued)

**DIMENSIONS**

**Pressure Compensation Inlet to Work Port**

**FLOW lpm/gpm**

<table>
<thead>
<tr>
<th>DIFFERENTIAL PRESSURE bar/psi</th>
<th>69</th>
<th>138</th>
<th>207</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.85 AMP</td>
<td>7.62</td>
<td>11.43</td>
<td>15.14</td>
</tr>
<tr>
<td>0.60 AMP</td>
<td>5.14</td>
<td>7.62</td>
<td>10.11</td>
</tr>
<tr>
<td>0.45 AMP</td>
<td>3.62</td>
<td>5.14</td>
<td>6.62</td>
</tr>
<tr>
<td>0.25 AMP</td>
<td>2.13</td>
<td>3.62</td>
<td>4.62</td>
</tr>
<tr>
<td>0.14 AMP</td>
<td>1.62</td>
<td>2.13</td>
<td>2.62</td>
</tr>
</tbody>
</table>

**COILS MUST BE INSTALLED WITH LETTERING UP**

**TORQUE:**
- 5–7 ft-lbs (6.8–9.5 Nm) max.
- 24–26 ft-lbs (32.5–35.3 Nm) max.

**MATERIALS**

**Cartridge:** Weight: 0.36 kg. (0.80 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-up standard.

**Standard Ported Body:** Weight: 0.41 kg. (0.85 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.010.1. Steel and Ductile Iron bodies available, dimensions may differ, consult factory.

**Standard Coils:** Weight each: 0.27 kg. (0.60 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

**E-Coils:** Weight each: 0.41 kg. (0.9 lbs.); Fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors.

**TO ORDER**

**Option**
- None (Blank)
- Manual Override

**Porting**
- Cartridge Only
- SAE 6
- SAE 8

**Seals**
- Buna N (Std.)
- Fluorocarbon

**Voltage**
- Std. Coil
- Less Coil**
- 10 VDC†
- 12 VDC
- 20 VDC
- 24 VDC

**Termination (VDC)**
- Std. Coil
- DS Dual Spades
- DG DIN 43650
- DL Leadwires (2)
- DL/W Leads w/Weatherpack® Connectors
- DR Deutsch DT04-2P
- ER Deutsch DT04-2P (IP69K Rated)
- EY Metri-Pack® 150 (IP69K Rated)

Coils with internal diode are available. Consult factory.
### DESCRIPTION
A solenoid-operated, 5-way, 3-position, proportional, screw-in hydraulic cartridge valve with integral brake release port.

### OPERATION
When de-energized, the SP10-58D allows flow between ➃, ➂, ➁, and ➀. When coil #1 is energized, flow is allowed from ➄ to ➁, and from ➃ to ➂. When coil #2 is energized, flow is allowed from ➄ to ➃, and from ➁ to ➂. Load sense is connected to port ➅ when the spool is in shifted positions.

Note: If low voltage is expected on the machine, 12 or 24 volt systems will require the use of 10 volt or 20 volt coils respectively. See “SP Valves and Coil Operating Parameters,” page 2.002.1.

### FEATURES
- Continuous-duty rated solenoid.
- Hardened precision spool and cage for long life.
- Optional coil voltages and terminations.
- Optional manual override.
- Optional waterproof E-Coils rated up to IP69K.
- Cartridges are voltage interchangeable.

### RATINGS
**Operating Pressure:** 250 bar (3625 psi) with standard Buna N seals
**Flow:** 22.8 lpm (6 gpm) max. See performance chart
**Internal Leakage:** 246 cc/minute (15 cu. in./minute) max. at 207 bar (3000 psi)
**Temperature:** -40 to 120°C with standard Buna seals
**Coil Duty Rating:** Continuous from 85% to 115% of nominal voltage
**Filtration:** See page 9.010.1
**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 sus)
**Installation:** No restrictions; See page 9.020.1
**Cavity:** VC10-5; See page 9.110.1; **Cavity Tool:** CT10-5XX; See page 8.600.1
**Seal Kit:** SK10-5X-MMMM; See page 8.650.1
**Coil Nut:** Part No. 7004400; **Coil Spacer** for E-coils: Part No. 4539700

### PERFORMANCE (Cartridge Only)
- ➊ to ➋ or ➋ to ➌ at 100% current, S1 or S2 energized: ————
- ➌ to ➍ or ➍ to ➋ at 100% current, S1 or S2 energized: ————

### PERFORMANCE (Cartridge Only) Graphs
- **PRESSURE bar/psi** vs. **FLOW lpm/gpm** for 32 cSt/150 sus oil at 40°C
- **FLOW lpm/gpm** vs. **AMPERAGE with 100 Hz Dither**

**Recommended Controller**
**Dual Solenoid Driver**
**Part No. 4000149**
(See page 3.550.1)

Performance information continued on following page.
for Brake Release Applications

### PERFORMANCE (Continued)

Pressure Compensation
Inlet to Work Port

<table>
<thead>
<tr>
<th>FLOW lpm/gpm</th>
<th>69</th>
<th>138</th>
<th>207</th>
<th>3000</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIFFERENTIAL PRESSURE bar/psi</td>
<td>26.5/7</td>
<td>22.7/6</td>
<td>18.9/5</td>
<td>15.1/4</td>
</tr>
<tr>
<td>11.4/3</td>
<td>7.6/2</td>
<td>3.8/1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### DIMENSIONS

COILS MUST BE INSTALLED WITH LETTERING UP

TORQUE:
5–7 ft-lbs (6.8–9.5 Nm) max.

1.36
34.5
2.62
66.5
5.00
127

### MATERIALS

**Cartridge:** Weight: 0.36 kg. (0.80 lbs.);
Steel with hardened work surfaces.
Zinc-plated exposed surfaces.
Buna N O-rings and polyester elastomer back-up standard.

**Standard Ported Body:** Weight:
0.41 kg. (0.85 lbs.); Anodized high-strength 6061 T6 aluminum alloy,
rated to 240 bar (3500 psi); See page 8.010.1. Steel and Ductile Iron bodies available, dimensions may differ, consult factory.

**Standard Coils:** Weight each: 0.27 kg.
(0.60 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

**E-Coils:** Weight each: 0.41 kg. (0.9 lbs.); Fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors.

### TO ORDER

**SP10-58D**

**Voltage Std. Coil**

<table>
<thead>
<tr>
<th>Option</th>
<th>None (Blank)</th>
<th>Manual Override</th>
<th>Manual Override</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>Std. Coil</td>
<td>10 VDC</td>
<td>12 VDC</td>
</tr>
</tbody>
</table>

**Termination (VDC)**

**Std. Coil**

<table>
<thead>
<tr>
<th>LS</th>
<th>DL</th>
<th>DL/W</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>T</td>
<td>2</td>
</tr>
</tbody>
</table>

**DS**
Dual Spades

**DG**
DIN 43650

**DL**
Leadwires (2)

**DR**
Deutsch DT04-2P

**Terminal (VDC)**

**E-Coil**

<table>
<thead>
<tr>
<th>E-Coil</th>
<th>10 VDC</th>
<th>12 VDC</th>
<th>20 VDC</th>
<th>24 VDC</th>
</tr>
</thead>
</table>

**Seals**

<table>
<thead>
<tr>
<th>Buna N (Std.)</th>
<th>Fluorocarbon</th>
</tr>
</thead>
</table>

**Termination (VDC)**

<table>
<thead>
<tr>
<th>E-Coil</th>
<th>10 VDC</th>
<th>12 VDC</th>
<th>20 VDC</th>
<th>24 VDC</th>
</tr>
</thead>
</table>

**Voltage Std. Coil**

<table>
<thead>
<tr>
<th>Option</th>
<th>None (Blank)</th>
<th>Manual Override</th>
<th>Manual Override</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>Std. Coil</td>
<td>10 VDC</td>
<td>12 VDC</td>
</tr>
</tbody>
</table>

**Termination (VDC)**

**Std. Coil**

<table>
<thead>
<tr>
<th>LS</th>
<th>DL</th>
<th>DL/W</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>T</td>
<td>2</td>
</tr>
</tbody>
</table>

**DS**
Dual Spades

**DG**
DIN 43650

**DL**
Leadwires (2)

**DR**
Deutsch DT04-2P

**Terminal (VDC)**

**E-Coil**

<table>
<thead>
<tr>
<th>E-Coil</th>
<th>10 VDC</th>
<th>12 VDC</th>
<th>20 VDC</th>
<th>24 VDC</th>
</tr>
</thead>
</table>

**Seals**

<table>
<thead>
<tr>
<th>Buna N (Std.)</th>
<th>Fluorocarbon</th>
</tr>
</thead>
</table>
SPCL10-30  Poppet, 3-Port, Normally Closed

DESCRIPTION
A solenoid-operated, normally-closed, proportional, poppet-type, screw-in hydraulic cartridge valve incorporating an integral load-sense pressure port with isolation check.

OPERATION
When de-energized, the SPCL10-30 blocks flow at all ports. When energized, proportionally-regulated flow is allowed from 3 to 1 with a check-isolated load-sense signal supplied at 2. Reverse flow is not allowed from 1 to 3.

Note: When using this valve in bridge circuits, seals should not be used on the pilot pistons of the pilot-operated check valves. This is to avoid trapping oil which would keep the pilot-operated check valve open.

Note: If low voltage is expected on the machine, 12 or 24 volt systems will require the use of 10 volt or 20 volt coils respectively. See “SP Valves and Coil Operating Parameters,” page 2.002.1.

FEATURES
- Industry-common cavity.
- Efficient wet-armature construction.
- Continuous-duty rated coils.
- Optional waterproof E-Coils rated up to IP69K.
- Reduce manifold space claim.

RATINGS
Operating Pressure: 250 bar (3625 psi); Holding Pressure at 1: 350 bar (5000 psi)
Internal Leakage: Ports 1 and 3: 5 drops/minute max. at 250 bar (3625 psi)
Port 2: 10 drops/minute max. at 250 bar (3625 psi)
Operating Temperature: -40° to 100°C (-40° to 212° F) with standard Buna N seals;
-26° to 204°C (-15° to 400°F) with Fluorocarbon seals;
-54°C to 107°C (-65°F to 225°F) with Polyurethane seals
Coil Duty Rating: Continuous from 85% to 115% of nominal voltage
Initial Coil Current Draw at 20°C: Standard D-Coil: 1.67 amps at 12 VDC;
E-Coil: 1.7 amps at 12 VDC; 0.85 amps at 24 VDC
Minimum Pull-in Voltage: 85% of nominal at 207 bar (3000 psi)
Installation: No restrictions; See page 9.020.1 Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 sus); See Temperature and Oil Viscosity, page 9.060.1
Cavity: VC10-3, Variation “B”; See page 9.110.1
Cavity Tool: CT10-3xx; See page 8.600.1
Seal Kit: SK10-3X-MM; See page 8.650.1
Coil Nut: Part No. 7004400

PERFORMANCE (Cartridge Only)
PERFORMANCE (Continued)

Recommended Electronic Controllers:
See page 2.001.1 or our Electronics catalog.

MATERIALS

Cartridge: Weight: 0.2 kg. (0.44 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-up standard.

Standard D-Coil: Weight: 0.27 kg. (0.60 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire. See page 3.200.1

E-Coil: Weight: 0.41 kg. (0.9 lbs.); Fully encapsulated with rugged external metal shell. Rated up to IP69K with integral connectors. Note: See page 3.400.1 for all E-Coil retrofit applications.

TO ORDER

Voltage
0 Less Coil**
12 12 VDC
20 20 VDC
24 24 VDC

Coil Termination
Deutsch DT04-2P
Metri-Pack® 150
Dual Lead Wires
Amp Jr. Timer
DIN 43650
Dual Spades

For Coils with Zener Diode, add "Z" to option code. For example: "ERIZ". Not available on all models.

Seals
Buna N (Std.) N
Fluorocarbon V
Polyurethane P

Note: Flow performance varies with manual override options. Consult factory for details.

SPCL10-30

Option
None (Blank)
Manual Override M
Manual Override Y
Manual Override J

For Manual Override details see page 1.001.1


PORTING
Cartridge Only 0

TORQUE
5 – 7 ft-lb. (6.8 Nm max.)

MANUFACTURED UNDER PATENT 7,921,880

OPTIONAL VOLTAGE
0 Less Coil**
12 12 VDC
20 20 VDC†
24 24 VDC

**Includes D-Coil Nut
†For Coils with Zener Diode, add "Z" to option code. For example: "ERIZ". Not available on all models.

See coil option info. on pages 3.200.1 & 3.400.1
**SPCL16-30  Poppet, 3-Port, Normally Closed**

**DESCRIPTION**
A solenoid-operated, 3-port, normally-closed, proportional, poppet-type, screw-in hydraulic cartridge valve for low-leakage blocking and load-holding applications.

**OPERATION**
When the SPCL16-30 is energized, the poppet lifts to allow flow from port 3 to ports 1 and 2. Flow at port 2 is typical for load sensing applications and includes a check valve for isolation.

**FEATURES**
- Industry-common cavity.
- Efficient wet-armature construction.
- Continuous-duty rated coils.
- Optional waterproof E-Coils rated up to IP69K.
- Reduce manifold space claim.

**RATINGS**
- **Operating Pressure**: Maximum: 250 bar (3625 psi); Minimum: 2.4 bar (35 psi)
- **Flow Rating**: up to 152 lpm (40 gpm); see performance charts
- **Internal Leakage**: Ports 1 and 3: 5 drops/minute max. at 250 bar (3625 psi)
  Port 2: 15 drops/minute max. at 250 bar (3625 psi)
- **Operating Temperature**: -40° to 100°C (-40° to 212° F) with standard Buna N seals;
  -26° to 204°C (-15° to 400°F) with Fluorocarbon seals;
  -54°C to 104°C (-65°F to 225°F) with Polyurethane seals
- **Valve Inductance**: 173.3 mH at 1.2A (Max. Control Current)
- **Threshold Current**: 0.40A to 0.60A
- **Hysteresis**: Less than 10% of maximum flow at 1.2A (Max. Control Current)
- **Dither Frequency**: 100 Hz recommended
- **Installation**: No restrictions; See page 9.020.1
- **Filtration**: See page 9.010.1
- **Fluids**: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 sus); See Temperature and Oil Viscosity, page 9.060.1
- **Cavity**: VC16-3SPCL; See page 9.116.1
- **Cavity Tool**: CT16-3SPCL; See page 8.600.1
- **Seal Kit**: SK16-3X-MM; See page 8.650.1
- **Coil Nut**: Part No. 7004400

**PERFORMANCE** (Cartridge Only)

**FLOW vs. CURRENT; Ports 3 to 1**
- Tested with EC16-32-160
- 34.5 bar/500 psi Inlet, Tested with EV20-S34

**FLOW vs. CURRENT; Ports 3 to 1**
- 103 bar/1500 psi Inlet
- 207 bar/3000 psi Inlet

Performance info. continued on next page.
**PERFORMANCE** (Continued)

- **Ports 3 to 1**
  - 0.6A - - - -
  - 0.75A - - - -
  - 1.0A - - - -
  - 1.2A - - - -
  - 32 cSt/150 sus oil at 40°C

- **Ports 3 to 2 at 1.2A**
  - 32 cSt/150 sus oil at 40°C

**DIMENSIONS**

U.S. Patent 7,921,880

- COIL MUST BE INSTALLED WITH LETTERING UP
- TORQUE 5–7 ft-lbs (6.8–9.5 Nm)
- ACROSS FLATS
- 0.75 (19.0)
- DIA.
- 1.84
- 46.7
- 1.62
- 41.1

**MATERIALS**

- **Cartridge**: Weight: 0.49 kg.
  - (1.09 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-up standard.

- **Standard D-Coil**: Weight: 0.27 kg.
  - (0.60 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire. See page 3.200.1.

- **E-Coil**: Weight: 0.41 kg.
  - (0.9 lbs.); Fully encapsulated with rugged external metal shell. Rated up to IP69K with integral connectors.
  - **Note**: See page 3.400.1 for all E-Coil retrofit applications.

**Recommended Electronic Controllers**: See page 2.001.1 or our Electronics catalog.

**TO ORDER**

- **SPCL16-30**
  - **Voltage**: 0 Less Coil**
  - **12**: 12 VDC
  - **20**: 20 VDC†
  - **24**: 24 VDC

- **Porting**: Cartridge Only
  - **0**

- **Seals**: Buna N (Std.)
  - **N**
  - Fluorocarbon
  - **V**
  - Polyurethane
  - **P**

- **Coil Termination**: Deutsch DT04-2P
  - **E-Coil**: ER (IP69K)
  - **D-Coil**: DR (IP65)
  - **EY (IP69K)**
  - **DY (IP65)**
  - **EL (IP69K)**
  - **DL (IP65)**
  - **Amp Jr. Timer**: EJ (IP67)
  - **DIN 43650**: EG (IP65)
  - **Metri-Pack® 150**: DY (IP65)
  - **Dual Lead Wires**: EL (IP69K)
  - **Dual Spades**: DS (IP65)

- **For Coils with Zener Diode, add “Z” to option code. For example: **ER/Z**. Not available on all models. See coil option info. on pages 3.200.1 & 3.400.1**
**SPCL10-32  Poppet, 3-Port, Normally Closed**

**DESCRIPTION**
A solenoid-operated, normally-closed, proportional, poppet-type screw-in hydraulic cartridge valve providing an integral, non-isolated load signal to pilot counterbalance or other control valves in bridge circuit applications.

**OPERATION**
When de-energized, the SPCL10-32 blocks flow at 1 and 3, while allowing the port 2 load signal to bleed to the low-pressure side of the circuit. When energized, proportionally-controlled flow is allowed from 3 to 1 with a load signal supplied at 2. Reverse flow is not allowed from 1 to 3.

Note: When using this valve in bridge circuits, seals should not be used on the pilot pistons of the pilot-operated check valves. This is to avoid trapping oil which would keep the pilot-operated check valve open.

Note: If low voltage is expected on the machine, 12 or 24 volt systems will require the use of 10 volt or 20 volt coils respectively. See “SP Valves and Coil Operating Parameters,” page 2.002.1.

**FEATURES**
- Industry-common cavity.
- Efficient wet-armature construction.
- Continuous-duty rated coils.
- Optional waterproof E-Coils rated up to IP69K.
- Reduce manifold space claim.

**RATINGS**
- **Operating Pressure:** 250 bar (3625 psi); Holding Pressure at 1: 350 bar (5000 psi)
- **Internal Leakage:** Ports 1 and 3: 5 drops/minute max. at 250 bar (3625 psi)
- **Operating Fluid Temperature:** -40 to 121°C with Buna N seals; -35 to 204°C with Fluorocarbon seals; -54 to 107°C with Polyurethane seals
- **Coil Duty Rating:** Continuous from 85% to 115% of nominal voltage
- **Initial Coil Current Draw at 20°C:** Standard D-Coil: 1.67 amps at 12 VDC; 0.18 amps at 115 VAC (full wave rectified).
  - E-Coil: 1.7 amps at 12 VDC; 0.85 amps at 24 VDC
- **Minimum Pull-in Voltage:** 85% of nominal at 207 bar (3000 psi)

**Ratings**
- **Installation:** No restrictions; See page 9.020.1
- **Filtration:** See page 9.010.1
- **Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 sus); See Temperature and Oil Viscosity, page 9.060.1
- **Cavity:** VC10-3, Variation “B”; See page 9.110.1
- **Cavity Tool:** CT10-3XX; See page 8.600.1
- **Seal Kit:** SK10-3X-MM; See page 8.650.1
- **Coil Nut:** Part No. 7004400

**PERFORMANCE (Cartridge Only)**

**FLOW vs. CURRENT**
- 16 bar/230 psi — — —; 35 bar/500 psi — —
- 75.7/20 to 7.6/2

**FLOW vs. CURRENT**
- 103 bar/1500 psi — — —; 206 bar/3000 psi — —
- 189.2/50 to 18.9/5
**PERFORMANCE (Continued)**

- **Coil Drop**:
  - 0.5A: 11.4 bar/350 lpm
  - 0.75A: 22.7 bar/69 lpm
  - 1.0A: 34.1 bar/172 lpm
  - 1.2A: 36.8 bar/138 lpm
  - 1.6A: 41.1 bar/207 lpm

- **Pressure Drop**:
  - 0.5A: 0.1 bar/0.5 lpm
  - 0.75A: 0.2 bar/1 lpm
  - 1.0A: 0.4 bar/2 lpm
  - 1.2A: 0.6 bar/3 lpm

- **Flow Rate**:
  - 0.5A: 350 lpm
  - 0.75A: 69 lpm
  - 1.0A: 172 lpm
  - 1.2A: 207 lpm

**MATERIALS**

- **Cartridge**: Weight: 0.18 kg. (0.40 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-up standard.
- **Standard D-Coil**: Weight: 0.27 kg. (0.60 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire. See page 3.200.1.
- **E-Coil**: Weight: 0.41 kg. (0.9 lbs.); Fully encapsulated with rugged external metal shell. Rated up to IP69K with integral connectors.
  - Note: See page 3.400.1 for all E-Coil retrofit applications.

**TO ORDER**

- **SPCL10-32**
- **Option**
  - None (Blank)
  - Manual Override M, Y, J
- **Voltage**
  - 0: Less Coil**
  - 12: 12 VDC
  - 20: 20 VDC†
  - 24: 24 VDC
- **Coil Termination**
  - Deutsch DT04-2P ER (IP69K)
  - Metri-Pack 150 ER (IP69K)
  - Dual Lead Wires EL (IP69K)
  - Amp Jr. Timer DJ (IP67)
  - DIN 43650 EG (IP65)
  - Dual Spades DS (IP65)
- **Voltage**
  - **Note**: Flow performance varies with manual override options. Consult factory for details.

**Recommended Electronic Controllers**:
See page 2.001.1 or our Electronics catalog.

**DIMENSIONS**

- **U.S. Patent 7,921,880**
- **Coil Must Be Installed With Lettering Up**
- **Torque**
  - 5 – 7 ft-lb. (6.8 Nm max.)

**Porting**

- **Cartridge Only**
- **Seals**
  - Buna N (Std.) N
  - Fluorocarbon V
  - Polyurethane P

**Note**: See coil option info. on pages 3.200.1 & 3.400.1.
**DESCRIPTION**

A solenoid-operated, 3-port, normally-closed, proportional, poppet-type, screw-in hydraulic cartridge valve for low-leakage blocking and load-holding applications.

**OPERATION**

When the SPCL16-32 is energized, the poppet lifts to allow flow from port 3 to ports 1 and 2. Flow at port 2 is typical for load sensing applications.

**FEATURES**

- Industry-common cavity.
- Efficient wet-armature construction.
- Continuous-duty rated coils.
- Optional waterproof E-Coils rated up to IP69K.
- Reduce manifold space claim.

**RATINGS**

- **Operating Pressure:** Maximum: 250 bar (3625 psi); Minimum: 2.4 bar (35 psi)
- **Flow Rating:** up to 152 lpm (40 gpm); see performance charts
- **Internal Leakage:** Ports 1 and 3: 5 drops/minute max. at 250 bar (3625 psi)
  - Port 2: 15 drops/minute max. at 250 bar (3625 psi)
- **Operating Temperature:** -40° to 100°C (-40° to 212° F) with standard Buna N seals;
  - -26° to 204°C (-15° to 400°F) with Fluorocarbon seals;
  - -54°C to 104°C (-65°F to 225°F) with Polyurethane seals
- **Valve Inductance:** 173.3 mH at 1.2A (Max. Control Current)
- **Threshold Current:** 0.40A to 0.60A
- **Hysteresis:** Less than 10% of maximum flow at 1.2A (Max. Control Current)
- **Dither Frequency:** 100 Hz recommended
- **Installation:** No restrictions; See page 9.020.1
- **Filtration:** See page 9.010.1
- **Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 sus); See Temperature and Oil Viscosity, page 9.060.1
- **Cavity:** VC16-3SPCL; See page 9.116.1
- **Cavity Tool:** CT16-3SPCL; See page 8.600.1
- **Seal Kit:** SK16-3X-MM; See page 8.650.1
- **Coil Nut:** Part No. 7004400

**FLOW vs. CURRENT; Ports 3 to 1**

Tested with EC16-32-160 – – –
- 34.5 bar/500 psi Inlet, Tested with EV20-S34

Tested with EV20-S34
- 103 bar/1500 psi Inlet – – –; 207 bar/3000 psi Inlet

Performance info. continued on next page.
PERFORMANCE (Continued)

![Flow vs. Pressure Chart]

<table>
<thead>
<tr>
<th>Flow (lpm/gpm)</th>
<th>Pressure Drop (bar/psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>0.4</td>
<td>0.5</td>
</tr>
<tr>
<td>0.6</td>
<td>0.8</td>
</tr>
<tr>
<td>0.8</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Recommended Electronic Controllers:
See page 2.001.1 or our Electronics catalog.

MATERIALS

Cartridge: Weight: 0.49 kg. (1.09 lbs.); Steel with hardened work surfaces. Buna N O-rings and polyester elastomer back-up standard.

Standard D-Coil: Weight: 0.27 kg. (0.60 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire. See page 3.200.1.

E-Coil: Weight: 0.41 kg. (0.9 lbs.); Fully encapsulated with rugged external metal shell. Rated up to IP69K with integral connectors. Note: See page 3.400.1 for all E-Coil retrofit applications.

TO ORDER

SPCL16-32 - - - - - - - -

- Porting: Cartridge Only - 0
- Voltage: 0 Less Coil**
12 12 VDC
20 20 VDC
24 24 VDC

- Coils: Deutsch DT04-2P
Metri-Pack® 150
Dual Lead Wires
Amp Jr. Timer
DIN 43650

- Seals:
Buna N (Std.) - N
Fluorocarbon - V
Polyurethane - P

For Coils with Zener Diode, add "Z" to option code. For example: "ERZ". Not available on all models. See coil option info. on pages 3.200.1 & 3.400.1
**SPCL16-40 Poppet, 2-Way, Normally Closed**

**DESCRIPTION**
A solenoid-operated, 4-port, normally-closed, proportional, poppet-type, screw-in hydraulic cartridge valve for low-leakage blocking and load-holding applications.

**OPERATION**
When the **SPCL16-40** is energized, the poppet lifts to allow flow from port 4 to ports 1, 2, and 3. Flow at ports 2 and 3 is typical for load sensing applications and includes a check valve for isolation.

**FEATURES**
- Industry-common cavity.
- Efficient wet-armature construction.
- Continuous-duty rated coils.
- Optional waterproof E-COils rated up to IP69K.
- Reduce manifold space claim.

**RATINGS**
- **Operating Pressure:**
  - Maximum: 250 bar (3625 psi);
  - Minimum: 2.4 bar (35 psi)
- **Flow Rating:** up to 152 lpm (40 gpm); see performance charts
- **Internal Leakage:**
  - Ports 1 and 4: 5 drops/minute max. at 250 bar (3625 psi)
  - Ports 2 and 3: 15 drops/minute max. at 250 bar (3625 psi)
- **Operating Temperature:**
  - -40° to 100°C (-40° to 212° F) with standard Buna N seals;
  - -26° to 204°C (-15° to 400°F) with Fluorocarbon seals;
  - -54°C to 104°C (-65°F to 225°F) with Polyurethane seals
- **Valve Inductance:** 173.3 mH at 1.2A (Max. Control Current)
- **Threshold Current:**
  - 0.40A to 0.60A
- **Hysteresis:** Less than 10% of maximum flow at 1.2A (Max. Control Current)
- **Dither Frequency:** 100 Hz recommended
- **Installation:** No restrictions; See page 9.020.1
- **Filtration:** See page 9.010.1
- **Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of
  - 7.4 to 420 cSt (50 to 2000 sus); See Temperature and Oil Viscosity, page 9.060.1
- **Cavity:** VC16-4SPCL; See page 9.116.1
- **Cavity Tool:** CT16-4SPCL; See page 8.600.1
- **Seal Kit:** SK16-4X-MM; See page 8.650.1
- **Coil Nut:** Part No. 7004400

**Recommended Electronic Controllers:**
See page 2.001.1 or our Electronics catalog.

**PERFORMANCE** (Cartridge Only)

**FLOW vs. CURRENT; Ports 4 to 1**
- Tested with EC16-32-160 -- -- 34.5 bar/500 psi Inlet, Tested with EV20-S34
- 151/40 132/35 113/30 95/25 76/20 57/15 38/10 19/5
- Amps: 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2
- % of Max. Control Current: 30 40 50 60 70 80 90 100

**FLOW vs. CURRENT; Ports 4 to 1**
- 103 bar/1500 psi Inlet -- -- 207 bar/3000 psi Inlet -- --
- 341/90 302/80 265/70 227/60 190/50 151/40 113/30 76/20 38/10
- Amps: 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2
- % of Max. Control Current: 30 40 50 60 70 80 90 100

Performance info. continued on next page.
PERFORMANCE (Continued)

U.S. Patent 7,921,880

**DIMENSIONS**

**MATERIALS**

**TO ORDER**

**Cartridge:** Weight: 0.50 kg. (1.11 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-up standard.

**Standard D-Coil:** Weight: 0.27 kg. (0.60 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire. See page 3.200.1

**E-Coil:** Weight: 0.41 kg. (0.9 lbs.); Fully encapsulated with rugged external metal shell. Rated up to IP69K with integral connectors. Note: See page 3.400.1 for all E-Coil retrofit applications.

**Coil Termination**

Deutsch DT04-2P  
Metri-Pack® 150  
Dual Lead Wires  
Amp Jr. Timer  
DIN 43650  
Dual Spades

**Voltage**  
0 Less Coil**  
12 12 VDC  
20 20 VDC†  
24 24 VDC

**Seals**

Buna N (Std.) N  
Fluorocarbon V  
Polyurethane P

**For Coils with Zener Diode, add “Z” to option code.**

For example: “ER/Z” Not available on all models. See coil option info. on pages 3.200.1 & 3.400.1
ELECTRO-PROPORTIONAL VALVES—FLOW CONTROLS

PV72-20 Proportional Flow Control Cartridge,

DESCRIPTION
A solenoid-operated, electrically-variable, two-port, pressure-compensated, spool-type, normally closed when de-energized, proportional flow control valve.

OPERATION
The PV72-20 will regulate flow out of port ➁ regardless of system working pressure. With an increasing current applied to the solenoid, the PV72-20 will increase output flow.

Operation of Manual Override:
To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.
To Disengage: Turn counterclockwise approximately 6 turns until positive stop is found.

FEATURES
- Excellent linearity and hysteresis characteristics.
- Hardened spool and cage for long life.
- Efficient wet armature construction.
- Optional coil voltages and terminations.
- Cartridges voltage interchangeable.
- Unitized, molded coil design.
- Coil waterproofing standard.
- Manual override option.

RATINGS
Operating Pressure: Port ➀: 240 bar (3500 psi); Port ➁: 207 bar (3000 psi)
Regulated Flow Rate: 0 to 56 lpm (0 to 15 gpm)
Internal Leakage: .38 lpm (0.1 gpm) fully closed at 207 bar (3000 psi)
Electrical: 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current</th>
<th>Max. Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>250 ± 100 mA</td>
<td>1500 ± 100 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>125 ± 50 mA</td>
<td>750 ± 50 mA</td>
</tr>
</tbody>
</table>

Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
Installation: No restrictions; See page 9.020.1.
Cavity: VC12-2 Cavity Variation “B”; See page 9.112.1
Cavity Tool: CT12-2X-XX; See page 8.600.1
Seal Kit: SK12-2X-M; See page 8.650.1

PERFORMANCE
Flow vs. Current
Input Pressure: 240 bar/3500 psi
12V Coil; 110 Hz PWM
32 cSt/150 ssu oil at 40°C

Regulated Flow vs. Pressure Drop
Input Pressure: 240 bar/3500 psi
12V Coil; 110 Hz PWM
32 cSt/150 ssu oil at 40°C

Recommended Controllers (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000139</td>
<td>4000186</td>
<td>4000139</td>
<td>4000140</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000139</td>
<td>4000186</td>
<td>4000139</td>
<td>4000140</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000139</td>
<td>4000186</td>
<td>4000139</td>
<td>4000140</td>
</tr>
</tbody>
</table>

2.330.1
**MATERIALS**

**Cartridge:** Weight: 0.32 kg. (0.7 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: .59 kg. (1.3 lbs.); Anodized high-strength 6061 T6 aluminum alloy; rated to 240 bar (3500 psi); See page 8.012.1. Steel and Ductile Iron bodies available; dimensions may differ; consult factory.

**Coil:** Weight: 0.32 kg. (0.7 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.1.

**TO ORDER**

**PV72-20**

**Porting**
- 0 Cartridge Only
- 10T SAE 10
- 12T SAE 12
- 16T SAE 16

**Option(s)**
- None (Blank)
- M Manual Override
- M Manual Override with Guard

**Seals**
- G Buna N (Std.)
- N Fluorocarbon

**Terminations Std. Coil**
- DS Dual Spades
- DG DIN 43650
- DL Leadwires (2)
- DL/W Leads w/Weatherpak® Connectors

**Terminations E-Coil**
- ER Deutsch DT04-2P (IP69K Rated)

**Voltage**
- 0 Less Coil
- 12 12 VDC
- 24 24 VDC
**DESCRIPTION**
A solenoid operated, electrically-variable, two-port, pressure-compensated, spool-type, normally open when de-energized, proportional flow control valve.

**OPERATION**
The PV72-21 will regulate flow out of port ② regardless of system working pressure. With an increasing current applied to the solenoid, the PV72-21 will decrease output flow.

**Operation of Manual Override:**
To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.
To Disengage: Turn counterclockwise approximately 6 turns until positive stop is found.

**FEATURES**
- Excellent linearity and hysteresis characteristics.
- Hardened spool and cage for long life.
- Efficient wet armature construction.
- Optional coil voltages and terminations.
- Cartridges voltage interchangeable.
- Unitized, molded coil design.
- Coil waterproofing standard.
- Manual override option.

**RATINGS**
**Operating Pressure:** Port ➀: 240 bar (3500 psi); Port ②: 207 bar (3000 psi)
**Regulated Flow Rate:** 56 lpm (15 gpm)
**Internal Leakage:** .38 lpm (0.1 gpm) fully closed at 207 bar (3000 psi)
**Electrical:** 2 standard voltage ratings

### Coil Voltage

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current</th>
<th>Max. Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>150 ± 100 mA</td>
<td>1350 ± 150 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>75 ± 50 mA</td>
<td>675 ± 75 mA</td>
</tr>
</tbody>
</table>

**Filtration:** See page 9.010.1
**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
**Installation:** No restrictions; See page 9.020.1.
**Cavity:** VC12-2, Cavity Variation “B”; See page 9.112.1
**Cavity Tool:** CT12-2X-XX; See page 8.600.1
**Seal Kit:** SK12-2X-M; See page 8.650.1

**PERFORMANCE**

### Flow vs. Current
Input Pressure: 240 bar/3500 psi
12V Coil: 110 Hz PWM
32 cSt/150 ssu oil at 40°C

### Regulated Flow vs. Pressure Drop
Input Pressure: 240 bar/3500 psi
12V Coil: 110 Hz PWM
32 cSt/150 ssu oil at 40°C

### Recommended Controllers (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coll Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000174</td>
<td>4000174</td>
<td>4000174</td>
<td>4000174</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000178</td>
<td>4000174</td>
<td>4000174</td>
<td>4000174</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000174</td>
<td>4000174</td>
<td>4000174</td>
<td>4000174</td>
</tr>
<tr>
<td>PWM</td>
<td>4000174</td>
<td>4000174</td>
<td>4000174</td>
<td>4000174</td>
</tr>
</tbody>
</table>
**Materials**

**Cartridge:** Weight: 0.32 kg. (0.7 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: .59 kg. (1.3 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.012.1. Steel and Ductile Iron bodies available; dimensions may differ; consult factory.

**Coil:** Weight: 0.32 kg. (0.7 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.1.

**To Order**

**PV72-21**

<table>
<thead>
<tr>
<th>Porting</th>
<th>Option(s)</th>
<th>Seals</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>None</td>
<td>G</td>
<td>0</td>
</tr>
<tr>
<td>10T</td>
<td>Manual</td>
<td>N</td>
<td>12</td>
</tr>
<tr>
<td>12T</td>
<td>Override</td>
<td>V</td>
<td>24</td>
</tr>
<tr>
<td>16T</td>
<td>Manual</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Override</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>with Guard</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Terminations Std. Coil**

- DS: Dual Spades
- DG: DIN 43650
- DL: Leadwires (2)
- DL/W: Leads w/Weatherpak® Connectors

**Terminations E-Coil**

- ER: Deutsch DT04-2P (IP69K Rated)

Coils with internal diode are available. Consult factory.
PV08-30  Proportional Flow Control Cartridge,

**DESCRIPTION**
A solenoid-operated, electrically-variable, three-port, pressure-compensated, spool-type, normally closed when de-energized, proportional flow control valve. It can be used as a priority-type flow regulator with pressure-compensated, regulated and bypass flow. It can also be used as a restrictive-type 2-way, pressure-compensated flow regulator when the bypass line (port ②) is blocked.

**OPERATION**
The PV08-30 will regulate flow out of port ③ regardless of system working pressure. With an increasing current applied to the solenoid, the PV08-30 will increase output flow.

**Note:** When used as a bypass flow control in applications where the priority flow port will be blocked by external valving (dead-headed), a small bleed orifice is required at the priority port (port ③). Consult factory.

**FEATURES**
- Excellent linearity and hysteresis characteristics.
- Hardened spool and cage for long life.
- Optional coil voltages and terminations.
- Efficient wet armature construction.

**RATINGS**

**Operating Pressure:** Inlet: 240 bar (3500 psi); Ports ② and ③: 207 bar (3000 psi)
**Regulated Flow Rate:**
- Bypass Blocked, Range A: 11.4 lpm (3.0 gpm)
- Bypass Blocked, Range B: 5.7 lpm (1.5 gpm)
- Bypass Open, Range A: 11.4 lpm (3.0 gpm)
- Bypass Open, Range B: 5.7 lpm (1.5 gpm)

**Nominal Input Flow:**
- Bypass Open, Range A: 15.2 lpm (4.0 gpm)
- Bypass Open, Range B: 7.6 lpm (2.0 gpm)

**Maximum Input Flow:**
- Bypass Open, Range A: 22.8 lpm (6.0 gpm)
- Bypass Open, Range B: 22.8 lpm (6.0 gpm)

**Internal Leakage:** 100 cc/min. (6 cu. in./min.) fully closed at 207 bar (3000 psi)

**Electrical:** 2 standard voltage ratings (Uses EHPR Series Coil; See page 3.200.8)

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current</th>
<th>Max. Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>400 ± 100 mA</td>
<td>1400 ± 150 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>200 ± 50 mA</td>
<td>700 ± 75 mA</td>
</tr>
</tbody>
</table>

**Filtration:** See page 9.010.1
**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
**Installation:** No restrictions; See page 9.020.1.
**Cavity:** VC08-3; See page 9.108.1
**Cavity Tool:** CT08-3X-XX; See page 8.600.1
**Seal Kit:** SK08-3X-MM; See page 8.650.1

**PERFORMANCE**

**Nominal Flow vs. Current**
207 bar/3000 psi; 12 V Coil; 200 Hz PWM
32 cSt/150 ssu oil at 40°C

**Regulated Flow vs. Pressure Drop**
2-Ported; Flow Range A
240 bar/3500 psi inlet
12 V Coil; 200 Hz PWM
32 cSt/150 ssu oil at 40°C

2-Ported; Flow Range B
240 bar/3500 psi inlet
12 V Coil; 200 Hz PWM
32 cSt/150 ssu oil at 40°C
**Cartridge:** Weight: 0.13 kg (0.28 lbs); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 0.27 kg (0.60 lbs); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.008.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

**EHPR Series Coil:** Weight: 0.32 kg (0.7 lbs); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.8.

**Recommended Controllers (See Section 3)**

<table>
<thead>
<tr>
<th>Input Sig. w/12V Coil</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>7114950</td>
<td>4000046</td>
<td>4000049</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000070</td>
<td>4000141</td>
<td>4000124</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000123</td>
<td>4000143</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input Sig. w/24V Coil</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000161</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000165</td>
<td>4000141</td>
<td>4000182</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000169</td>
<td>4000143</td>
<td>4000186</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

**DIMENSIONS**

<table>
<thead>
<tr>
<th>ACROSS FLATS</th>
<th>ACROSS FLATS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-5 ft-lbs</td>
<td>(7–10 Nm)</td>
</tr>
</tbody>
</table>

**Flow Range**

(Required. Refer to Performance Curves)

| Option(s) | None (Blank) |

**Porting**

<table>
<thead>
<tr>
<th>0</th>
<th>Cartridge Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>6T</td>
<td>SAE 6</td>
</tr>
<tr>
<td>3B</td>
<td>3/8 in. BSP*</td>
</tr>
</tbody>
</table>

*BSP Body: U.K. Mfr. Only

**Seals**

<table>
<thead>
<tr>
<th>N</th>
<th>Buna N (Std.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Fluorocarbon</td>
</tr>
</tbody>
</table>

**Terminations**

<table>
<thead>
<tr>
<th>DS</th>
<th>Dual Spades</th>
</tr>
</thead>
<tbody>
<tr>
<td>DG</td>
<td>DIN 43650</td>
</tr>
<tr>
<td>DL</td>
<td>Leadwires (2)</td>
</tr>
<tr>
<td>DL/W</td>
<td>Leads w/Weatherpak® Connectors</td>
</tr>
</tbody>
</table>

Coils with internal diode are available. Consult factory.

**Voltage**

<table>
<thead>
<tr>
<th>0</th>
<th>Less Coil</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>12 VDC</td>
</tr>
<tr>
<td>24</td>
<td>24 VDC</td>
</tr>
</tbody>
</table>
**PV70-30 Proportional Flow Control Cartridge,**

**DESCRIPTION**

A solenoid-operated, electrically-variable, three-port, pressure-compensated, spool-type, normally closed when de-energized, proportional flow control valve. It can be used as a priority-type flow regulator with pressure-compensated, regulated and bypass flow. It can also be used as a restrictive-type 2-way, pressure-compensated flow regulator when the bypass line (port ②) is blocked.

**OPERATION**

The PV70-30 will regulate flow out of port ③ regardless of system working pressure. With an increasing current applied to the solenoid, the PV70-30 will increase output flow.

**Note:** When used as a bypass flow control in applications where the priority flow port will be blocked by external valving, bypass pressure drop will increase unless a small amount of leakage is provided for the priority port. Consult factory.

**Operation of Manual Override:**

- **To Engage:** Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.
- **To Disengage:** Turn counterclockwise approximately 6 turns to positive stop.

**FEATURES**

- Excellent linearity and hysteresis characteristics.
- Hardened spool and cage for long life.
- Optional coil voltages and terminations.
- Efficient wet armature construction.
- Cartridges voltage interchangeable.
- Unitized, molded coil design.
- Coil waterproofing standard.
- Manual override option.

**RATINGS**

**Operating Pressure:** Inlet: 240 bar (3500 psi); Ports ② and ③: 207 bar (3000 psi)

**Regulated Flow Rate:**
- Bypass Blocked, Range A: 26 lpm (7 gpm)
- Bypass Blocked, Range B: 17 lpm (4.5 gpm)
- Bypass Open, Range A: 30 lpm (8 gpm)
- Bypass Open, Range B: 26 lpm (7 gpm)

**Maximum Input Flow:**
- Bypass Open, Range A: 50 lpm (13 gpm)
- Bypass Open, Range B: 26 lpm (7 gpm)

**Internal Leakage:** 197 cc/min. (12 cu. in./min.) fully closed at 207 bar (3000 psi)

**Electrical:** 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current</th>
<th>Max. Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>350 ± 70 mA</td>
<td>1500 ± 200 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>175 ± 35 mA</td>
<td>750 ± 100 mA</td>
</tr>
</tbody>
</table>

**Filtration:** See page 9.010.1

**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)

**Installation:** No restrictions; See page 9.020.1.

**Cavity:** VC10-3; See page 9.110.1

**Cavity Tool:** CT10-3X-XX; See page 8.600.1

**Seal Kit:** SK10-3X-MM; See page 8.650.1

**Recommended Controllers** (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil Mount</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>w/12V Coil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-5 VDC</td>
<td>7114950</td>
<td>4000049</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000020</td>
<td>4000124</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000123</td>
<td>4000130</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000133</td>
</tr>
<tr>
<td>w/24V Coil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-5 VDC</td>
<td>4000161</td>
<td>4000194</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000165</td>
<td>4000182</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000169</td>
<td>4000133</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000133</td>
</tr>
</tbody>
</table>

Performance info. continued on following page.
**Normaly Closed**

**PV70-30**

**PERFORMANCE (Continued)**

Regulated Flow vs. Pressure Drop
2-Ported; Flow Range A
240 bar/3500 psi Inlet
12V Coil; 200 Hz PWM
32 cSt/150 ssu oil at 40°C

<table>
<thead>
<tr>
<th>PRESSURE DROP bar/psi</th>
<th>69</th>
<th>130</th>
<th>207</th>
<th>276</th>
<th>400</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLOW lpm/gpm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37.9/10</td>
<td>1.3 AMP</td>
<td>2.09</td>
<td>0.67</td>
<td>1.13</td>
<td></td>
</tr>
<tr>
<td>30.3/8</td>
<td>1.0 AMP</td>
<td>1.71</td>
<td>0.87</td>
<td>22.7</td>
<td></td>
</tr>
<tr>
<td>22.7/6</td>
<td>0.7 AMP</td>
<td>43.4</td>
<td>1.86</td>
<td>47.2</td>
<td></td>
</tr>
<tr>
<td>15.1/4</td>
<td>0.5 AMP</td>
<td>43.4</td>
<td>1.86</td>
<td>47.2</td>
<td></td>
</tr>
<tr>
<td>7.6/2</td>
<td>0.4 AMP</td>
<td>43.4</td>
<td>1.86</td>
<td>47.2</td>
<td></td>
</tr>
</tbody>
</table>

Regulated Flow vs. Pressure Drop
2-Ported; Flow Range B
240 bar/3500 psi Inlet
12V Coil; 200 Hz PWM
32 cSt/150 ssu oil at 40°C

<table>
<thead>
<tr>
<th>PRESSURE DROP bar/psi</th>
<th>69</th>
<th>130</th>
<th>207</th>
<th>276</th>
<th>400</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLOW lpm/gpm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.9/5</td>
<td>1.25 AMP</td>
<td>2.70</td>
<td>3.37</td>
<td>53.8</td>
<td></td>
</tr>
<tr>
<td>15.1/4</td>
<td>1.0 AMP</td>
<td>53.8</td>
<td>3.37</td>
<td>53.8</td>
<td></td>
</tr>
<tr>
<td>11.4/3</td>
<td>0.75 AMP</td>
<td>53.8</td>
<td>3.37</td>
<td>53.8</td>
<td></td>
</tr>
<tr>
<td>7.6/2</td>
<td>0.5 AMP</td>
<td>53.8</td>
<td>3.37</td>
<td>53.8</td>
<td></td>
</tr>
<tr>
<td>3.9/1</td>
<td>0.3 AMP</td>
<td>53.8</td>
<td>3.37</td>
<td>53.8</td>
<td></td>
</tr>
</tbody>
</table>

**DIMENSIONS**

MANUAL OVERRIDE
OPTION "M"

MANUAL OVERRIDE
OPTION "G"

**MATERIALS**

**Cartridge:** Weight: 0.19 kg. (0.42 lbs.);
Steel with hardened work surfaces.
Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 0.36 kg. (0.80 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.010.1. Steel and Ductile Iron bodies available; dimensions may differ; consult factory.

**PV70 Series Coil:** Weight: 0.32 kg. (0.7 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.7.

**TO ORDER**

**PV70-30**

**Flow Range**
(A Refer to Performance Curves.)

<table>
<thead>
<tr>
<th>Option(s)</th>
<th>Flow Range</th>
<th>Porting</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>A</td>
<td>0</td>
</tr>
<tr>
<td>Manual Override</td>
<td>B</td>
<td>Cartridge Only</td>
</tr>
<tr>
<td>Manual Override with Guard</td>
<td>M</td>
<td>6T SAE 6</td>
</tr>
<tr>
<td>G</td>
<td>8T SAE 8</td>
<td></td>
</tr>
<tr>
<td>2B</td>
<td>1/4 in. BSP*</td>
<td></td>
</tr>
<tr>
<td>3B</td>
<td>3/8 in. BSP*</td>
<td></td>
</tr>
</tbody>
</table>

**Seals**

<table>
<thead>
<tr>
<th>Seals</th>
<th>Buna N (Std.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Fluorocarbon</td>
</tr>
</tbody>
</table>

**Terminations Std. Coil**

<table>
<thead>
<tr>
<th>Terminations</th>
<th>Std. Coil</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS</td>
<td>Dual Spades</td>
</tr>
<tr>
<td>DG</td>
<td>DIN 43650</td>
</tr>
<tr>
<td>DL</td>
<td>Leadwires (2)</td>
</tr>
<tr>
<td>DL/W</td>
<td>Leads w/Weatherpak® Connectors</td>
</tr>
<tr>
<td>ER</td>
<td>Deutsch DT04-2P (IP69K Rated)</td>
</tr>
</tbody>
</table>

**Terminations E-Coil**

<table>
<thead>
<tr>
<th>Terminations</th>
<th>E-Coil</th>
</tr>
</thead>
<tbody>
<tr>
<td>ER</td>
<td>Deutsch DT04-2P (IP69K Rated)</td>
</tr>
</tbody>
</table>

**Voltage**

<table>
<thead>
<tr>
<th>Voltage</th>
<th>0 Less Coil</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>12 VDC</td>
</tr>
<tr>
<td>24</td>
<td>24 VDC</td>
</tr>
</tbody>
</table>
**PV72-30  Proportional Flow Control Cartridge,**

**DESCRIPTION**
A solenoid-operated, electrically-variable, three-port, pressure-compensated, spool-type, normally closed when de-energized, proportional flow control valve. It can be used as a priority-type flow regulator with pressure-compensated, regulated and bypass flow. It can also be used as a restrictive-type 2-way, pressure-compensated flow regulator when the bypass line (port ➁) is blocked.

**OPERATION**
The PV72-30 will regulate flow out of port ➂ regardless of system working pressure. With increasing current applied to the solenoid, the PV72-30 will increase output flow.

*Note:* When used as a bypass flow control in applications where the priority flow port will be blocked by external valving, bypass pressure drop will increase unless a small amount of leakage is provided for the priority port. Consult factory.

Operation of Manual Override:
To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.
To Disengage: Turn counterclockwise approximately 6 turns to positive stop.

**FEATURES**
- Excellent linearity and hysteresis.
- Hardened spool and cage for long life.
- Efficient wet armature construction.
- Optional coil voltages and terminations.
- Cartridges voltage interchangeable.
- Unitized, molded coil design.
- Coil waterproofing standard.
- Manual override option.

**RATINGS**
**Operating Pressure:** Port ➀: 240 bar (3500 psi); Ports ➁ and ➂: 207 bar (3000 psi)
**Regulated Flow Rate in 3-Port Mode:** Range A: 57 lpm (15 gpm) Range B: 38 lpm (10 gpm)
**Maximum Input Flow in 3-Port Mode:** Range A and B: 114 lpm (30 gpm)
**Maximum Flow Rate in 2-Port Mode:** Range A: 53 lpm (14 gpm) Range B: 31 lpm (8 gpm)

*Note:* For increased flow capacity in a 2-port flow control, see model PV72-20
**Internal Leakage:** 38 lpm (0.1 gpm) fully closed at 207 bar (3000 psi)

**Electrical:** 2 standard voltage ratings
- **Coil Voltage**
  - 12 VDC: 350 ± 100 mA Max. Control Current: 1600 ± 200 mA
  - 24 VDC: 175 ± 50 mA Max. Control Current: 800 ± 100 mA

**Filtration:** See page 9.010.1
**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)

**Installation:** No restrictions; See page 9.020.1.
**Cavity:** VC12-3; See page 9.112.1; **Cavity Tool:** CT12-3X-XX; See page 8.600.1
**Seal Kit:** SK12-3X-MM; See page 8.650.1

**PERFORMANCE**

**Flow vs. Current**
- Input Flow: 76 lpm/20 gpm
- 12V Coil; 110 Hz PWM
- 3-Ported ——— 2 Ported - - - -
- 32 cSt/150 ssu oil at 40°C

**Regulated Flow vs. Pressure**
- Input Flow: 76 lpm/20 gpm
- 12V Coil; 110 Hz PWM
- 32 cSt/150 ssu oil at 40°C

**Recommended Controllers** (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil</th>
<th>DIN PCB</th>
<th>Metal DIN Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>7114950</td>
<td>4000049</td>
<td>40000136</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>40000141</td>
<td>4000124</td>
<td>4000136</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000123</td>
<td>4000130</td>
<td>4000139</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
<td>4000140</td>
</tr>
</tbody>
</table>

**Flow vs. Pressure**
- @PREG 207 bar/3000 psi
-ųF 60/16
-ųF 45/12
-ųF 30/8
-ųF 15/4
-ųF 60/16
-ųF 45/12
-ųF 30/8
-ųF 15/4

2.374.1
**Normally Closed PV72-30**

### MATERIALS

**Cartridge:** Weight: 0.36 kg. (0.8 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 1.09 kg. (2.4 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.012.1. Steel and Ductile Iron bodies available; dimensions may differ; consult factory.

**Coil:** Weight: 0.32 kg. (0.7 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.1.

### TO ORDER

**PV72-30**

**Flow Range**
(Refer to Performance Curves.)

**Option(s)**
None (Blank)
Manual Override
Manual Override with Guard

**Seals**
Buna N (Std.)
Fluorocarbon

**Porting**
0 Cartridge Only
10T SAE 10
12T SAE 12
16T SAE 16
4B 1/2 in. BSP*
6B 3/4 in. BSP*

**Terminations Std. Coil**
DS Dual Spades
DG DIN 43650
DL Leadwires (2)
DL/W Leads w/Weatherpak® Connectors

**Terminations E-Coil**
ER Deutsch DT04-2P (IP69K Rated)

**Terminations Std. Coil**

**Terminations E-Coil**

**Voltage**
0 Less Coil
12 12 VDC
24 24 VDC

---

**DIMENSIONS**
PV76-30A  Proportional Flow Control Cartridge,

DESCRIPTION
A solenoid-operated, electrically-variable, three-port, pressure-compensated, spool-type, normally closed when de-energized, proportional flow control valve. It can be used as a priority-type flow regulator with pressure-compensated, regulated and bypass flow. It can also be used as a restrictive-type 2-way, pressure-compensated flow regulator when the bypass line (port ➁) is blocked.

OPERATION
The PV76-30A will regulate flow out of port ➂ regardless of system working pressure. With increasing current applied to the solenoid, output flow will increase.

Note: When used as a bypass flow control in applications where the priority flow port will be blocked by external valving, bypass pressure drop will increase unless a small amount of leakage is provided for the priority port. Consult factory.

Operation of Manual Override: To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift. To Disengage: Turn counterclockwise approximately 6 turns to positive stop.

FEATURES
• Excellent linearity and hysteresis characteristics.
• Hardened spool and cage for long life.
• Optional coil voltages and terminations.
• Efficient wet armature construction.

RATINGS
Operating Pressure: Inlet: 240 bar (3500 psi); Ports ➁ and ➂: 207 bar (3000 psi)
Regulated Flow Rate: Range A: 3-Ported: 94.6 lpm (25.0 gpm)
              Range A: 2-Ported: 85.2 lpm (22.5 gpm)
Nominal Input Flow: Bypass Open, 3-Ported: 121 lpm (32.0 gpm)
Maximum Input Flow: Bypass Open, 3-Ported: 151.4 lpm (40.0 gpm)
Internal Leakage: 0.38 lpm (0.10 gpm) at zero current
Electrical: 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current</th>
<th>Max. Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>300 ± 100 mA</td>
<td>1600 ± 100 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>150 ± 50 mA</td>
<td>800 ± 50 mA</td>
</tr>
</tbody>
</table>

Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
Installation: No restrictions; See page 9.020.1.
Cavity: VC16-3; See page 9.116.1; Cavity Tool: CT16-3X-XX; See page 8.600.1
Seal Kit: SK16-3X-MM; See page 8.650.1

PERFORMANCE

Recommended Controllers (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig. w/12V Coil</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>7114950</td>
<td>4000046</td>
<td>4000049</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000070</td>
<td>4000141</td>
<td>4000124</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000123</td>
<td>4000143</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>4000014</td>
<td>4000140</td>
<td>4000133</td>
<td>4000140</td>
</tr>
<tr>
<td>w/24V Coil</td>
<td>4000161</td>
<td>4000149</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>0-5 VDC</td>
<td>4000165</td>
<td>4000141</td>
<td>4000182</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000169</td>
<td>4000143</td>
<td>4000186</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>4000014</td>
<td>4000133</td>
<td>4000140</td>
<td>4000140</td>
</tr>
</tbody>
</table>
Normally Closed

PV76-30A

PERFORMANCE (continued)

2-WAY VALVE
Regulated Flow vs. Current
240 bar/3500 psi Inlet
207 bar/3000 psi at Port ③
12V Coil; 110 Hz PWM
32 cSt/150 sus oil at 40°C

FLOW (lpm/gpm)
113.5/30
94.6/25
75.7/20
56.8/15
37.9/10
18.9/5

PERCENT OF MAX. CONTROL CURRENT
10 20 30 40 50 60 70 80 90 100

2-WAY VALVE
Regulated Flow vs. Pressure Drop
240 bar/3500 psi Inlet
12V Coil; 110 Hz PWM
32 cSt/150 sus oil at 40°C

FLOW (lpm/gpm)
113.5/30
94.6/25
75.7/20
56.8/15
37.9/10
18.9/5

PRESSURE DROP bar/psi
35 103 172 242 3500

DIMENSIONS

MANUAL OVERRIDE OPTION "M"
MANUAL OVERRIDE OPTION "G"

INCH MILLIMETRE

1.98 101.6
1.74 44.1
2.00 50.8
4.00 101.6

TO ORDER

PV76-30A

Option(s)
None (Blank)
Manual Override M
Manual Override with Guard G

Seals
Buna N (Std.) N
Fluorocarbon V

Terminations Std. Coil
DS Dual Spades
DG DIN 43650
DL Leadwires (2)
DL/W Leads w/Weatherpak® connectors

Terminations E-Coil
ER Deutsch DT04-2P (IP69K Rated)

Voltage
0 Less Coil
12 12 VDC
24 24 VDC

MATERIALS

Cartridge: Weight: 0.54 kg. (1.19 lbs.);
Steel with hardened work surfaces.
Zinc-plated exposed surfaces. Buna
N O-rings and polyester elastomer
back-ups standard.

Standard Ported Body: Weight:
1.6 kg. (3.35 lbs.); Anodized high-
strength 6061 T6 aluminum alloy,
rated to 240 bar (3500 psi);
See page 8.016.1. Steel and Ductile
iron bodies available; dimensions
may differ; consult factory.

PV70 Series Coil: Weight: 0.32 kg.
(0.7 lbs.); Unitized thermoplastic
encapsulated, Class H high
temperature magnet-wire;
See page 3.200.7.
**PV42-M30 Proportional Flow Control Cartridge,**

**DESCRIPTION**
A solenoid-operated, two-stage, three-port, pressure-compensated, spool-type, normally closed when de-energized, proportional flow control valve. It can be used as a priority-type flow regulator with pressure-compensated, regulated and bypass flow.

**OPERATION**
The PV42-M30 will regulate flow out of port ➂ regardless of system working pressure at ➂ or at bypass port ➁. Two priority flow ranges are provided for better resolution: Range A for priority flow up to 190 lpm/50 gpm, and Range B for priority flow up to 132 lpm/35 gpm. For either range, the input flow at ➀ can be up to 225 lpm/60 gpm.

**Note:** When used as a bypass flow control in applications where the priority flow port will be blocked by external valving, bypass pressure drop will increase unless a small amount of leakage is provided for the priority port. Consult factory.

**Operation of Manual Override:** To Engage: Turn clockwise approximately 3 turns to reach start point. Continue another approximately 2 more turns to full shift. To Disengage: Turn counterclockwise approximately 5 turns to positive stop.

**FEATURES**
- Excellent linearity and hysteresis characteristics.
- Hardened spool and cage for long life.
- Optional coil voltages and terminations.
- Efficient wet armature construction.

**RATINGS**
**Operating Pressure:** Inlet: 240 bar (3500 psi); Ports ➂ and ➃: 207 bar (3000 psi)
**Regulated Flow Rate:** Range A: 190 lpm (50 gpm)
**Maximum Input Flow:** 225 lpm (60 gpm)
**Maximum Internal Leakage:** 1.52 lpm (0.40 gpm) at zero current

**Electrical:** 2 standard voltage ratings
- 12 VDC: 400 ± 100 mA
- 24 VDC: 200 ± 50 mA

**Filtration:** See page 9.010.1

**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)

**Installation:** No restrictions; See page 9.020.1.

**Cavity:** VC42-M3; See page 9.142.1; Cavity Tool: CT42-M3X-XX; See page 8.600.1

**Seal Kit:** SK42-3X-MM; See page 8.650.1

**PERFORMANCE**

**Range A, 3-Way Regulated Flow vs. Load**
- 240 bar/3500 psi, 190 lpm/50 gpm Inlet
- 12V Coil; 110 Hz PWM
- 32 cSt/150 sus oil at 40°C

**Recommended Controllers (See Section 3)**

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000161</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000165</td>
<td>4000141</td>
<td>4000182</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000169</td>
<td>4000143</td>
<td>4000186</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>4000144</td>
<td>4000133</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

**Recommended Controllers (See Section 3)**

- 0-5 VDC: 4000161
- 0-10 VDC: 4000165
- 4-20 mA: 4000169
- PWM: 4000144
**PV42-M30 Normally Closed**

**DIMENSIONS**

U.S. Patent 6,966,329

**PERFORMANCE (continued)**

- **Range B**
  - Regulated Flow vs. Current
  - 207 bar/3000 psi at Port "A"
  - at 125 lpm/33 gpm Input Flow
  - 12V Coil; 110 Hz PWM
  - 32 cSt/150 sus oil at 40°C

- **Range B, 3-Way**
  - Regulated Flow vs. Load
  - 240 bar/3500 psi, 125 lpm/33 gpm Inlet
  - 12V Coil; 110 Hz PWM
  - 32 cSt/150 sus oil at 40°C

**MATERIALS**

**Cartridge:** Weight: 0.89 kg (1.97 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

**Ported Body:** Consult factory.

**EHPR Series Coil:** Weight: 0.32 kg (0.7 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.8.

**TO ORDER**

**Flow Range**

- Up to 190 lpm (50 gpm) **A**
- Up to 132 lpm (35 gpm) **B**

**Option(s)**

- None (Blank) **M**
- Manual Override **G**
- Manual Override with Guard

**Terminations**

- DS Dual Spades
- DG DIN 43650
- DL Leadwires (2)
- DL/W Leads w/Weatherpak® Connectors
- DR Deutsch DT04-2P

**Voltage**

- 0 Less Coil
- 12 12 VDC
- 24 24 VDC

**Seals**

- Buna N (Std.) **N**
- Fluorocarbon **V**

**Connections**

- Connectors
- 0.88 ACROSS FLATS
  - TORQUE: 10–12 ft-lbs (14–16 Nm)
- 1.88 ACROSS FLATS
  - 47.6 MAX
  - 3.58
  - 3.11

**Manual Override Option**

- Option with Guard "G"
A solenoid-operated, electrically-variable, three-port, pressure-compensated, spool-type, normally open when de-energized, proportional flow control valve. It can be used as a priority-type flow regulator with pressure-compensated, regulated and bypass flow. It can also be used as a restrictive-type 2-way, pressure-compensated flow regulator when the bypass line (port ➀) is blocked.

The PV08-31 will regulate flow out of port ➀ regardless of system working pressure. With an increasing current applied to the solenoid, the PV08-31 will decrease output flow.

Note: When used as a bypass flow control in applications where the priority flow port will be blocked by external valving (dead-headed), a small bleed orifice is required at the priority port (port ➀). Consult factory.

• Excellent linearity and hysteresis characteristics.
• Hardened spool and cage for long life.
• Optional coil voltages and terminations.
• Efficient wet armature construction.

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current</th>
<th>Max. Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>250 ± 150 mA</td>
<td>1350 ± 150 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>125 ± 75 mA</td>
<td>700 ± 75 mA</td>
</tr>
</tbody>
</table>

Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
Installation: No restrictions; See page 9.020.1.
Cavity: VC08-3; See page 9.108.1
Cavity Tool: CT08-3X-XX; See page 8.600.1
Seal Kit: SK08-3X-MM; See page 8.650.1
Recommended Electronic Controllers: See page 2.001.1
**Cartridge:** Weight: 0.13 kg. (0.28 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 0.27 kg. (0.60 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.008.1. Steel and ductile iron bodies available; dimensions may differ; consult factory.

**EHPR Series Coil:** Weight: 0.32 kg. (0.7 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.8.

---

**Recommended Controllers (See Section 3)**

<table>
<thead>
<tr>
<th>Input Sig. w/12V Coil</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>7114950</td>
<td>4000046</td>
<td>4000049</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000070</td>
<td>4000114</td>
<td>4000124</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000123</td>
<td>4000143</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
<tr>
<td>w/24V Coil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-5 VDC</td>
<td>4000161</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000165</td>
<td>4000141</td>
<td>4000182</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000169</td>
<td>4000143</td>
<td>4000186</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

---

**DIMENSIONS**

**INCH MILLIMETRE**

**TO ORDER**

**PV08-31**

**Flow Range**
(Required. Refer to Performance Curves)

| Option(s) | None (Blank) |

**Porting**

<table>
<thead>
<tr>
<th>Porting</th>
<th>Cartridge Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Cartridge Only</td>
</tr>
<tr>
<td>6T</td>
<td>SAE 6</td>
</tr>
<tr>
<td>3B</td>
<td>3/8 in. BSP*</td>
</tr>
</tbody>
</table>

*BSP Body; U.K. Mfr. Only

**Seals**

<table>
<thead>
<tr>
<th>Seals</th>
<th>Buna N (Std.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fluorocarbon</td>
</tr>
</tbody>
</table>

**Voltage**

<table>
<thead>
<tr>
<th>Voltage</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12 VDC</td>
</tr>
<tr>
<td></td>
<td>24 VDC</td>
</tr>
</tbody>
</table>

**Terminations**

<table>
<thead>
<tr>
<th>Terminals</th>
<th>DS</th>
<th>DG</th>
<th>DL</th>
<th>DL/W</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dual Spades</td>
<td>DIN 43650</td>
<td>Leadwires (2)</td>
<td>Leads w/Weatherpak® Connectors</td>
</tr>
</tbody>
</table>

Coils with internal diode are available. Consult factory.
**PV70-31 Proportional Flow Control Cartridge,**

**DESCRIPTION**
A solenoid operated, electrically-variable, three-port, pressure-compensated, spool-type, normally open when de-energized, proportional flow control valve. It can be used as a priority-type flow regulator with pressure-compensated, regulated and bypass flow. It can also be used as a restrictive-type 2-way, pressure-compensated flow regulator when the bypass line (port ③) is blocked.

**OPERATION**
The PV70-31 will regulate flow out of port ② regardless of system working pressure. With an increasing current applied to the solenoid, the PV70-31 will decrease output flow.

**Note:** When used as a bypass flow control in applications where the priority flow port will be blocked by external valving, bypass pressure drop will increase unless a small amount of leakage is provided for the priority port. Consult factory.

**Operation of Manual Override:**
- **To Engage:** Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.
- **To Disengage:** Turn counterclockwise approximately 6 turns to positive stop.

**FEATURES**
- Excellent linearity and hysteresis characteristics.
- Hardened spool and cage for long life.
- Optional coil voltages and terminations.
- Efficient wet armature construction.
- Cartridges voltage interchangeable.
- Unitized, molded coil design.
- Coil waterproofing standard.
- Manual override option.

**RATINGS**

**Operating Pressure:**
- Inlet: 240 bar (3500 psi); Ports ① and ②: 207 bar (3000 psi)

**Regulated Flow Rate:**
- Bypass Blocked, Range A: 26 lpm (7 gpm)
- Bypass Blocked, Range B: 17 lpm (4.5 gpm)
- Bypass Open, Range A: 30 lpm (8 gpm)
- Bypass Open, Range B: 17 lpm (4.5 gpm)

**Maximum Input Flow:**
- Bypass Open, Range A: 50 lpm (13 gpm)
- Bypass Open, Range B: 26 lpm (7 gpm)

**Internal Leakage:** 197 cc/min. (12 cu. in./min.) fully closed at 207 bar (3000 psi)

**Electrical:** 2 standard voltage ratings

**Coil Voltage** | **Threshold Current** | **Max. Control Current**
---|---|---
12 VDC | 150 ± 70 mA | 1400 ± 200 mA
24 VDC | 75 ± 35 mA | 700 ± 100 mA

**Filtration:** See page 9.010.1

**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)

**Installation:** No restrictions; See page 9.020.1.

**Cavity:** VC10-3; See page 9.110.1

**Cavity Tool:** CT10-3X-XX; See page 8.600.1

**Seal Kit:** SK10-3X-MM; See page 8.650.1

**PERFORMANCE**

**Flow vs. Current**
- 207 bar/3000 psi; 12V Coil; 200 Hz PWM
- 32 cSt/150 ssu oil at 40°C
- Range A, 2-Ported
- Range A, 3-Ported
- Range B, 2-Ported
- Range B, 3-Ported

**PERCENT OF MAX. CONTROL CURRENT**

**FLOW lpm/gpm**
- 37.9/10
- 30.3/8
- 22.7/6
- 15.1/4
- 7.6/2

Performance information continued on following page.
Normally Open

PV70-31

PERFORMANCE

(Continued)

Regulated Flow vs. Pressure Drop
2-Ported; Flow Range A
240 bar/3500 psi Inlet
12V Coil; 200 Hz PWM
32 cSt/150 ssu oil at 40°C

FLOW [lpm/gpm]

PRESSURE DROP bar/psi

Regulated Flow vs. Pressure Drop
2-Ported; Flow Range B
240 bar/3500 psi Inlet
12V Coil; 200 Hz PWM
32 cSt/150 ssu oil at 40°C

FLOW [lpm/gpm]

PRESSURE DROP bar/psi

DIMENSIONS

MANUAL OVERRIDE
OPTION "M"

MANUAL OVERRIDE
OPTION "G"

2.70
27.0

ACROSS FLATS
TORQUE: 10–12 ft-lbs
(14–16 Nm)

1.13
28.6

ACROSS FLATS
TORQUE: 27 ft-lbs max.
(36.7 Nm)

0.74
18.8

INCH
MILLIMETRE

TERMINATIONS

DS Dual Spades
DG DIN 43650
DL Leadwires (2)
DL/W Leads w/Weatherpack® Connectors
ER Deutsch DT04-2P (IP69K Rated)

Coils with internal diode are available. Consult factory.

TO ORDER

PV70-31

Flow Range
A

Porting
B

Option(s)

None

(Blank)

Manual Override
M

Manual Override
with Guard
G

Seals

Buna N (Std.)

N

Fluorocarbon

V

Voltage

0 Less Coil

12 12 VDC

24 24 VDC

MATERIALS

Cartridge: Weight: 0.19 kg. (0.42 lbs.);
Steel with hardened work surfaces.
Zinc-plated exposed surfaces. Buna
N O-rings and polyester elastomer
back-ups standard.

Standard Ported Body: Weight: 0.36 kg. (0.80 lbs.);
Anodized high-strength 6061 T6 aluminum alloy,
rated to 240 bar (3500 psi); See
page 8.010.1. Steel and Ductile Iron
bodies available; dimensions may
differ; consult factory.

PV70 Series Coil: Weight: 0.32 kg.
(0.7 lbs.); Unitized thermoplastic
encapsulated, Class H high
temperature magnet-wire;
See page 3.200.7.

Voltage

0 Less Coil

12 12 VDC

24 24 VDC

Terminations Std. Coil

Terminations E-Coil

0.25
6.4

2.00
50.8

0.0 AMP

0.5 AMP

0.9 AMP

1.1 AMP

0.7 AMP

0.9 AMP

1.1 AMP

1.0 AMP
PV72-31 Proportional Flow Control Cartridge

DESCRIPTION
A solenoid operated, electrically-variable, three-port, pressure-compensated, spool-type, normally open when de-energized, proportional flow control valve. It can be used as a priority-type flow regulator with pressure-compensated, regulated and bypass flow. It can also be used as a restrictive-type 2-way, pressure-compensated flow regulator when the bypass line (port 2) is blocked.

OPERATION
The PV72-31 will regulate flow out of port 3 regardless of system working pressure. With an increasing current applied to the solenoid, the PV72-31 will decrease output flow.

Note: When used as a bypass flow control in applications where the priority flow port will be blocked by external valving, bypass pressure drop will increase unless a small amount of leakage is provided for the priority port. Consult factory.

Operation of Manual Override:
To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.
To Disengage: Turn counterclockwise approximately 6 turns to positive stop.

FEATURES
- Excellent linearity and hysteresis characteristics.
- Hardened spool and cage for long life.
- Efficient wet armature construction.
- Optional coil voltages and terminations.
- Cartridges voltage interchangeable.
- Unitized, molded coil design.
- Coil waterproofing standard.
- Manual override option.

RATINGS
Operating Pressure: Port 1: 240 bar (3500 psi); Ports 2 and 3: 207 bar (3000 psi)
Regulated Flow Rate in 3-Port Mode: Range A: 53 lpm (14 gpm)
Range B: 38 lpm (10 gpm)
Maximum Input Flow in 3-Port Mode: Range A and B: 114 lpm (30 gpm)
Maximum Flow Rate in 2-Port Mode: Range A: 42 lpm (11 gpm)
Range B: 31 lpm (8 gpm)
Note: For increased flow capacity in a 2-port flow control, see model PV72-21
Internal Leakage: .38 lpm (0.1 gpm) fully closed at 207 bar (3000 psi)

Electrical:
- 2 standard voltage ratings
  - 12 VDC
    - Threshold Current: 150 ± 100 mA
    - Max. Control Current: 1350 ± 150 mA
  - 24 VDC
    - Threshold Current: 75 ± 50 mA
    - Max. Control Current: 675 ± 75 mA

Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
Installation: No restrictions; See page 9.020.1.
Cavity: VC12-3; See page 9.112.1; Cavity Tool: CT12-3X-XX; See page 8.600.1
Seal Kit: SK12-3X-MM; See page 8.650.1

PERFORMANCE

- Flow vs. Current
  - Input Flow: 76 lpm/20 gpm
    - 12V Coil: 110 Hz PWM
    - 32 cSt/150 ssu oil at 40°C
- Regulated Flow vs. Pressure
  - Input Flow: 76 lpm/20 gpm
    - 12V Coil: 110 Hz PWM
    - 32 cSt/150 ssu oil at 40°C

Recommended Controllers (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>w/12V Coil</td>
<td>7111950</td>
<td>4000046</td>
<td>4000049</td>
<td>40000136</td>
</tr>
<tr>
<td>5-20 mA</td>
<td>4000070</td>
<td>4000123</td>
<td>4000124</td>
<td>40000137</td>
</tr>
<tr>
<td>PWM</td>
<td>40000144</td>
<td>40000143</td>
<td>40000130</td>
<td>40000139</td>
</tr>
<tr>
<td>w/24V Coil</td>
<td>40000161</td>
<td>4000194</td>
<td>40000174</td>
<td>40000136</td>
</tr>
<tr>
<td>5-10 VDC</td>
<td>40000165</td>
<td>4000141</td>
<td>4000182</td>
<td>40000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>40000169</td>
<td>4000143</td>
<td>4000186</td>
<td>40000139</td>
</tr>
<tr>
<td>PWM</td>
<td>40000144</td>
<td>40000133</td>
<td>40000140</td>
<td>40000140</td>
</tr>
</tbody>
</table>
**Normally Open**

**PV72-31**

### DIMENSIONS

![Diagram of PV72-31]

**MATERIALS**

**Cartridge:** Weight: 0.36 kg. (0.8 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 1.09 kg. (2.4 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.012.1. Steel and Ductile Iron bodies available; dimensions may differ; consult factory.

**Coil:** Weight: 0.32 kg. (0.7 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.1.

### TO ORDER

**PV72-31**

<table>
<thead>
<tr>
<th>Flow Range (Refer to Performance Curves.)</th>
<th>Porting</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>Cartridge Only</td>
</tr>
<tr>
<td>10T</td>
<td>SAE 10</td>
</tr>
<tr>
<td>12T</td>
<td>SAE 12</td>
</tr>
<tr>
<td>16T</td>
<td>SAE 16</td>
</tr>
<tr>
<td>4B</td>
<td>1/2 in. BSP*</td>
</tr>
<tr>
<td>6B</td>
<td>3/4 in. BSP*</td>
</tr>
</tbody>
</table>

**Seals**

- Buna N (Std.)
- Fluorocarbon

**Voltage**

- 0: Less Coil
- 12: 12 VDC
- 24: 24 VDC

**Terminations Std. Coil**

- DS: Dual Spades
- DG: DIN 43650
- DL: Leadwires (2)
- DL/W: Leads w/Weatherpak® Connectors

**Terminations E-Coil**

- ER: Deutsch DT04-2P (IP69K Rated)

Coils with internal diode are available. Consult factory.
PV76-31 Proportional Flow Control Cartridge

DESCRIPTION
A solenoid-operated, electrically-variable, three-port, pressure-compensated, spool-type, normally open when de-energized, proportional flow control valve. It can be used as a priority-type flow regulator with pressure-compensated, regulated and bypass flow. It can also be used as a restrictive-type 2-way, pressure-compensated flow regulator when the bypass line (port ②) is blocked.

OPERATION
The PV76-31 will regulate flow out of port ③ regardless of system working pressure. With an increasing current applied to the solenoid, output flow will decrease.

Note: When used as a bypass flow control in applications where the priority flow port will be blocked by external valving, bypass pressure drop will increase unless a small amount of leakage is provided for the priority port. Consult factory.

Operation of Manual Override: To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift. To Disengage: Turn counterclockwise approximately 6 turns to positive stop.

FEATURES
• Excellent linearity and hysteresis characteristics.
• Hardened spool and cage for long life.
• Optional coil voltages and terminations.
• Efficient wet armature construction.

RATINGS
Operating Pressure: Inlet: 240 bar (3500 psi); Ports ① and ③: 207 bar (3000 psi)
Regulated Flow Rate: 3-Ported: 75.7 lpm (20.0 gpm)
2-Ported: 79.5 lpm (21.0 gpm)
Maximum Input Flow: Bypass Open, 3-Ported: 151.4 lpm (40.0 gpm)
Internal Leakage: 0.38 lpm (0.10 gpm) at maximum current
Electrical: 2 standard voltage ratings

Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
Installation: No restrictions; See page 9.020.1.
Cavity: VC16-3; See page 9.116.1; Cavity Tool: CT16-3X-XX; See page 8.600.1
Seal Kit: SK16-3X-MM; See page 8.650.1

PERFORMANCE

Recommended Controllers (See Section 3)
Normally Open PV76-31

PERFORMANCE (continued)

2-WAY VALVE
Regulated Flow vs. Current
240 bar/3500 psi Inlet
207 bar/3000 psi at Port 
12V Coil; 110 Hz PWM
32 cSt/150 sus oil at 40°C

<table>
<thead>
<tr>
<th>PERCENT OF MAX. CONTROL CURRENT</th>
<th>FLOW lpm/gpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>113.9/30</td>
</tr>
<tr>
<td>20</td>
<td>113.9/30</td>
</tr>
<tr>
<td>30</td>
<td>113.9/30</td>
</tr>
<tr>
<td>40</td>
<td>113.9/30</td>
</tr>
<tr>
<td>50</td>
<td>113.9/30</td>
</tr>
<tr>
<td>60</td>
<td>113.9/30</td>
</tr>
<tr>
<td>70</td>
<td>113.9/30</td>
</tr>
<tr>
<td>80</td>
<td>113.9/30</td>
</tr>
<tr>
<td>90</td>
<td>113.9/30</td>
</tr>
<tr>
<td>100</td>
<td>113.9/30</td>
</tr>
</tbody>
</table>

DIMENSIONS

2-WAY VALVE
Regulated Flow vs. Pressure Drop
240 bar/3500 psi Inlet
12V Coil; 110 Hz PWM
32 cSt/150 sus oil at 40°C

<table>
<thead>
<tr>
<th>PRESSURE DROP bar/psi</th>
<th>FLOW lpm/gpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>113.9/30</td>
</tr>
<tr>
<td>50</td>
<td>113.9/30</td>
</tr>
<tr>
<td>100</td>
<td>113.9/30</td>
</tr>
<tr>
<td>150</td>
<td>113.9/30</td>
</tr>
<tr>
<td>200</td>
<td>113.9/30</td>
</tr>
<tr>
<td>250</td>
<td>113.9/30</td>
</tr>
<tr>
<td>300</td>
<td>113.9/30</td>
</tr>
<tr>
<td>350</td>
<td>113.9/30</td>
</tr>
<tr>
<td>400</td>
<td>113.9/30</td>
</tr>
</tbody>
</table>

MATERIALS

Cartridge: Weight: 0.54 kg. (1.19 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

Standard Ported Body: Weight: 1.6 kg. (3.35 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.016.1. Steel and Ductile Iron bodies available; dimensions may differ; consult factory.

PV70 Series Coil: Weight: 0.32 kg. (0.7 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.7.

TO ORDER

PV76-31

Porting
0 Cartridge Only
12T SAE 12
16T SAE 16

Option(s)
None (Blank)
Manual Override
M
Manual Override with Guard
G

Seals
Buna N (Std.)
N
fluorocarbon
V

Terminations Std. Coil
DS Dual Spades
DG DIN 43650
DL Leadwires (2)
DL/W Leads w/Weatherpak® Connectors

Terminations E-Coil
ER Deutsch DT04-2P (IP69K Rated)

Voltage
0 Less Coil
12 12 VDC
24 24 VDC
PV70-33 Proportional Flow Control Cartridge,

**DESCRIPTION**
A linear solenoid-driven, two-way normally closed, screw-in cartridge valve designed for use with a pressure compensator to function as an electrically stroked variable flow regulator.

**OPERATION**
With increasing electric current, the PV70-33 changes from full closed to full open with flow from port ➀ to port ➂. Port ➀ is used only to pressure balance the spool and should be plugged. The proportional valve is intended to function in tandem with standard HydraForce pressure compensators at pressure differentials of 21 bar (300 psid) or less, or alone in variable volume pressure-compensated circuits with load sense capability.

The valve is designed to work with industry-common controllers which typically feature current capability to 2 amps @ 12 VDC, PWM, and start/stop trim adjustments (I-min./I-max.). Consult factory for details and potential sourcing.

**Operation of Manual Override:**
To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.

To Disengage: Turn counterclockwise approximately 6 turns to positive stop.

**FEATURES**
- Excellent linearity and hysteresis characteristics.
- Optional control orifice sizes.
- Hardened spool and cage for long life.
- Optional coil voltages and terminations.
- Efficient wet armature construction.
- Cartridges voltage interchangeable.
- Unitized, molded coil design.
- Coil waterproofing standard.
- Manual override option.

**RATINGS**
**Operating Pressure:** 207 bar (3000 psi)
**Internal Leakage:** 197 cc/min. (12 cu. in./min.) fully closed at 207 bar (3000 psi)
**Electrical:** 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current (mA)</th>
<th>Max. Control Current (mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A &amp; B Range</td>
<td>C Range</td>
</tr>
<tr>
<td>12 VDC</td>
<td>300 ± 70</td>
<td>360 ± 70</td>
</tr>
<tr>
<td>24 VDC</td>
<td>150 ± 35</td>
<td>180 ± 35</td>
</tr>
</tbody>
</table>

Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
Installation: No restrictions; See page 9.020.1.
Cavity: VC10-3; See page 9.110.1
Cavity Tool: CT10-3X-XX; See page 8.600.1
Seal Kit: SK10-3X-MM; See page 8.650.1

**Recommended Controllers** (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>—</td>
<td>40000144</td>
<td>40000139</td>
<td>40000138</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>40000123</td>
<td>40000141</td>
<td>40000096</td>
<td>40000136</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>40000123</td>
<td>40000141</td>
<td>40000096</td>
<td>40000136</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>40000144</td>
<td>40000133</td>
<td>40000140</td>
</tr>
</tbody>
</table>

with 24V Coil

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000161</td>
<td>40000194</td>
<td>40000174</td>
<td>40000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000169</td>
<td>40000194</td>
<td>40000174</td>
<td>40000136</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>—</td>
<td>40000143</td>
<td>40000186</td>
<td>40000133</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>40000144</td>
<td>40000133</td>
<td>40000140</td>
</tr>
</tbody>
</table>
**PV70-33**

**Dimensions**

**Materials**

- **Cartridge:** Weight: 0.19 kg. (0.42 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.
- **Standard Ported Body:** Weight: 0.36 kg. (0.80 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.010.1. Steel and Ductile Iron bodies available; dimensions may differ; consult factory.
- **PV70 Series Coil:** Weight: 0.32 kg. (0.7 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.7.
- **Port Plug:** For SAE 6 Port: 6103006 For SAE 8 Port: 6103008; See page 8.500.1.

**To Order**

**Flow Range**

<table>
<thead>
<tr>
<th>Flow Range</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance Curves</td>
<td>Only</td>
<td>Cartridge</td>
<td>Only</td>
</tr>
</tbody>
</table>

**Porting**

<table>
<thead>
<tr>
<th>Option(s)</th>
<th>None</th>
<th>Manual Override</th>
<th>Manual Override with Guard</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Blank)</td>
<td>M</td>
<td>G</td>
<td></td>
</tr>
</tbody>
</table>

**Seals**

- Buna N (Std.)
- Fluorocarbon

**Terminals Std. Coil**

- DS: Dual Spades
- DG: DIN 43650
- DL: Leadwires (2)
- DL/W: Leads w/Weatherpack® Connectors

**Terminals E-Coil**

- ER: Deutsch DT04-2P (IP69K Rated)

**Voltage**

- 0: Less Coil
- 12: 12 VDC
- 24: 24 VDC
**ELECTRO-PROPORTIONAL VALVES—FLOW CONTROLS**

**PFR70-33x-E  Proportional Flow Regulator, N.C.,**

**DESCRIPTION**
A pressure-compensated electrically-variable two-port flow regulator that is normally closed when de-energized. This combination valve uses a PV70-33x proportional cartridge and an EC10-30 compensator.

**OPERATION**
This proportional valve/compensator package will regulate flow out of port ➁, regardless of system working pressure. With an increasing current applied to the solenoid, the PFR70-33x-E will increase output flow.

**FEATURES**
- Excellent linearity and hysteresis characteristics.
- Optional control orifice sizes.
- Hardened spool and cage for long life.
- Optional coil voltages and terminations.
- Efficient wet armature construction.
- Cartridges voltage interchangeable.
- Unitized, molded coil design.
- Coil waterproofing standard.
- Screw-in manual override option.

**RATINGS**
Operating Pressure: 207 bar (3000 psi)
Internal Leakage: 410 cc/min. (25 cu. in./min.) fully closed at 207 bar (3000 psi) out port ➁.

**Electrical:** 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current (mA)</th>
<th>Max. Control Current (mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A &amp; B Range</td>
<td>C Range</td>
</tr>
<tr>
<td>12 VDC</td>
<td>300 ± 70</td>
<td>360 ± 70</td>
</tr>
<tr>
<td>24 VDC</td>
<td>150 ± 35</td>
<td>180 ± 35</td>
</tr>
</tbody>
</table>

Operation of Manual Override:
To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.
To Disengage: Turn counterclockwise approximately 6 turns until positive stop is found.

**Filtration:** See page 9.010.1
**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
**Installation:** No restrictions; See page 9.020.1

**PERFORMANCE CURVES  Regulated Flow Delivered Out Port ➁:**

**Flow vs. Current (207 bar/3000 psi Load)**
- PV70-33B with EC10-30
- 11 bar/160 psi spring ——
- 5.5 bar/80 psi spring - - -
- 100 Hz Dither

**Flow vs. Current (207 bar/3000 psi Load)**
- PV70-33C with EC10-30
- 11 bar/160 psi spring ——
- 5.5 bar/80 psi spring - - -
- 100 Hz Dither

Attention Manifold Designers:
To obtain these high flow capabilities using proportional flow controls and compensators, optimized cavity drillings are required. Please consult factory.
2-Port, Pressure Compensated  PFR70-33x-E

DIMENSIONS

NOTE: The N.O. PV70-35 may not be substituted in this manifold due to port logic factors.

MATERIALS


Standard Ported Body: Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi). Ductile iron and steel bodies available; dimensions may differ; consult factory

Coil: Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

Package Weight: 2.27 kg. (5 lbs.).

Seal Kit: SK10-3x-MM (PV); SK10-3x-TB (EC)

TO ORDER

PFR70-33__ - E__ - 8T__ -__

*PV Orifice Range
Orifice Range A (Blank)
Orifice Range B M
Orifice Range C

Override Option
None
Screw Type

*Compensator Spring
5.52 bar (80 psi) 80
11.03 bar (160 psi) 160

*Select Orifice Range and Compensator Spring by referring to the Performance Curves on the preceding page.

Seals
Buna N (Std.) N
Fluorocarbon V

Terminations
DS Dual Spades
DG DIN 43650
DL Leadwires (2)
DL/W Leads w/Weatherpak® Connectors
DR Deutsch DT04-2P

Voltage
0 Less Coil
12 12 VDC
24 24 VDC

Coils with internal diode are available. Consult factory.

2.401.2
**DESCRIPTION**

A pressure-compensated electrically-variable three-port flow regulator that is a priority (bypass) type control. This combination valve uses a PV70-33x proportional cartridge and an EC10-40 compensator.

**OPERATION**

The PFR70-33x-F series will bypass all flow out port \(2\) when de-energized at the pressure compensator spring value. When energized, this proportional valve/compensator package will increase and regulate flow out of port \(1\), regardless of system working pressure, with an increasing current applied to the solenoid.

**FEATURES**

- Excellent linearity and hysteresis characteristics.
- Optional control orifice sizes.
- Hardened spool and cage for long life.
- Optional coil voltages and terminations.
- Efficient wet armature construction.
- Cartridges voltage interchangeable.
- Unitized, molded coil design.
- Coil waterproofing standard.
- Screw-in manual override option.

**RATINGS**

**Operating Pressure:** 207 bar (3000 psi)

**Pressure Rise:** Pressure at \(1\) begins to rise higher than the compensating pressure differential when bypass flow exceeds 26.5 lpm (7 gpm).

**Internal Leakage:** 410 cc/min. (25 cu. in./min.) fully closed at 207 bar (3000 psi) out port \(2\).

**Electrical:** 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Max. Control Current (mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>A &amp; B Range</td>
</tr>
<tr>
<td></td>
<td>300 ± 70</td>
</tr>
<tr>
<td>1500 ± 200</td>
<td>1400 ± 200</td>
</tr>
<tr>
<td>24 VDC</td>
<td>150 ± 35</td>
</tr>
<tr>
<td>750 ± 100</td>
<td>700 ± 100</td>
</tr>
</tbody>
</table>

**Operation of Manual Override:**

To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.

To Disengage: Turn counterclockwise approximately 6 turns until positive stop is found.

**Filtration:** See page 9.010.1

**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)

**Installation:** No restrictions; See page 9.020.1

**Priority Port Flow Delivered Out Port \(2\):**

For 12 volt coils, double the current (amp) values shown.

**Attention Manifold Designers:** To obtain these high flow capabilities using proportional flow controls and compensators, optimized cavity drillings are required. Please consult factory.
DIMENSIONS

MATERIALS


Standard Ported Body: Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi). Ductile iron and steel bodies available; dimensions may differ; consult factory.

Coil: Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

Package Weight: 2.27 kg. (5 lbs.).

Seal Kit: SK10-3X-MM (PV);
SK10-4X-TMB (EC)

NOTE: The N.O. PV70-35 may not be substituted in this manifold due to port logic factors.

3-Port, Pressure Compensated

PFR70-33x-F

TO ORDER

PFR70-33 - F - 8T - -

*PV Orifice Range
Orifice Range A (Blank)
Orifice Range B M
Orifice Range C

Override Option
None
Screw Type

*Compensator Spring
2.76 bar (40 psi) 40
5.52 bar (80 psi) 80
11.03 bar (160 psi) 160

*Select Orifice Range and Compensator Spring by referring to the Performance Curves on the preceding page.

Terminations
DS Dual Spades
DG DIN 43650
DL Leadwires (2)
DL/W Leads w/Weatherpak® Connectors
DR Deutsch

Voltage
0 Less Coil
12 12 VDC
24 24 VDC

Seals
Buna N (Std.) N
Fluorocarbon V

Coils with internal diode are available. Consult factory.
**DESCRIPTION**

A pressure-compensated electrically-variable three-port flow regulator that is a priority (bypass) type control. This combination valve uses a PV70-33x proportional cartridge and an EC12-40 compensator.

**OPERATION**

The PFR70-33x-J series will bypass all flow when de-energized at the pressure compensator spring value. When energized, this proportional valve/compensator package will regulate flow out of port ➁, regardless of system working pressure, with an increasing current applied to the solenoid.

**FEATURES**

- Excellent linearity and hysteresis characteristics.
- Optional control orifice sizes.
- Hardened spool and cage for long life.
- Optional coil voltages and terminations.
- Efficient wet armature construction.
- Cartridges voltage interchangeable.
- Unitized, molded coil design.
- Coil waterproofing standard.
- Screw-in manual override option.

**RATINGS**

- **Operating Pressure:** 207 bar (3000 psi)
- **Pressure Rise:** Pressure at ➀ begins to rise higher than the compensating pressure differential when bypass flow exceeds 41.6 lpm (11 gpm).
- **Internal Leakage:** 410 cc/min. (25 cu. in./min.) fully closed at 207 bar (3000 psi) out port ➁.
- **Electrical:** 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>A &amp; B Threshold Current (mA)</th>
<th>C Threshold Current (mA)</th>
<th>A &amp; B Max. Control Current (mA)</th>
<th>C Max. Control Current (mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>300 ± 70</td>
<td>360 ± 70</td>
<td>1500 ± 200</td>
<td>1400 ± 200</td>
</tr>
<tr>
<td>24 VDC</td>
<td>150 ± 35</td>
<td>180 ± 35</td>
<td>750 ± 100</td>
<td>700 ± 100</td>
</tr>
</tbody>
</table>

**Operation of Manual Override:**

- To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.
- To Disengage: Turn counterclockwise approximately 6 turns until positive stop is found.

**Filtration:** See page 9.010.1

**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)

**Installation:** No restrictions; See page 9.020.1

**PERFORMANCE CURVES**

<table>
<thead>
<tr>
<th>LOAD bar/psi</th>
<th>FLOW lpm/gpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>41.4</td>
<td>38.1</td>
</tr>
<tr>
<td>66</td>
<td>34.9</td>
</tr>
<tr>
<td>120</td>
<td>31.8</td>
</tr>
<tr>
<td>180</td>
<td>28.7</td>
</tr>
<tr>
<td>240</td>
<td>25.6</td>
</tr>
<tr>
<td>300</td>
<td>22.5</td>
</tr>
<tr>
<td>360</td>
<td>19.4</td>
</tr>
<tr>
<td>420</td>
<td>16.3</td>
</tr>
<tr>
<td>500</td>
<td>13.2</td>
</tr>
<tr>
<td>600</td>
<td>10.1</td>
</tr>
<tr>
<td>720</td>
<td>7.0</td>
</tr>
<tr>
<td>840</td>
<td>3.9</td>
</tr>
<tr>
<td>1000</td>
<td>1.8</td>
</tr>
</tbody>
</table>

For 12 volt coils, double the current (amp) values shown.
3-Port, Pressure Compensated


Standard Ported Body: Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi). Steel and ductile iron bodies available; dimensions may differ; consult factory.

Coil: Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

Package Weight: 2.72 kg. (6 lbs.).

Seal Kit: SK10-3x-MM (PV)
SK12-4x-TMB (EC)

NOTE: The N.O. PV70-35 may not be substituted in this manifold due to port logic factors.

MATERIALS

TO ORDER

PFR70-33 - J - 10/12T

*PV Orifice Range

Orifice Range A (Blank)
Orifice Range B M
Orifice Range C

Override Option

Compensator Spring

6.9 bar (100 psi) 100
11.03 bar (160 psi) 160

Seals

Buna N (Std.) N
Fluorocarbon V

Terminations

DS Dual Spades
DG DIN 43650
DL Leadwires (2)
DL/W Leads w/Weatherpak® Connectors
DR Deutsch DT04-2P

Voltage

0 Less Coil
12 12 VDC
24 24 VDC

† Ports 1 & 3: SAE 12
Port 2: SAE 10

† Ports 1 & 3: SAE 12
Port 2: SAE 10

Coils with internal diode are available. Consult factory.

2.403.2
PV72-33  Proportional Flow Control Cartridge,

DESCRIPTION
A linear solenoid-driven, two-way normally closed, screw-in cartridge valve designed for use with a pressure compensator to function as an electrically stroked variable flow regulator.

OPERATION
With increasing electric current, the PV72-33 changes from full closed to full open with flow from port ➂ to port ➁. Port ➀ is used only to pressure balance the spool and should be plugged. The proportional valve is intended to function in tandem with standard HydraForce pressure compensators at pressure differentials of 12 bar (175 psid) or less, or alone in variable volume pressure-compensated circuits with load sense capability.

The valve is designed to work with industry-common controllers which typically feature current capability to 2 amps @ 12 VDC, PWM, and start/stop trim adjustments (I-min./I-max.). Consult factory for details and potential sourcing.

Operation of Manual Override:
To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.
To Disengage: Turn counterclockwise approximately 6 turns to positive stop.

FEATURES
• Excellent linearity and hysteresis characteristics.
• Optional control orifice sizes.
• Hardened spool and cage for long life.
• Optional coil voltages and terminations.

RATINGS
Operating Pressure: 207 bar (3000 psi)
Internal Leakage: 492 cc/min. (30 cu. in./min.) fully closed at 207 bar (3000 psi)

Electrical: 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current</th>
<th>Max. Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>300 ± 70 mA</td>
<td>1500 ± 100 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>150 ± 35 mA</td>
<td>750 ± 100 mA</td>
</tr>
</tbody>
</table>

Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
Installation: No restrictions; See page 9.020.1.
Cavity: VC12-3; See page 9.110.1
Cavity Tool: CT12-3X-XX; See page 8.600.1
Seal Kit: SK12-3X-MM; See page 8.650.1

Recommended Controllers (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig. w/12V Coil</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>7114950</td>
<td>4000046</td>
<td>4000049</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000070</td>
<td>4000141</td>
<td>4000124</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000123</td>
<td>4000143</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input Sig. w/24V Coil</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000161</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000165</td>
<td>4000141</td>
<td>4000182</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000169</td>
<td>4000143</td>
<td>4000186</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>
**DIMENSIONS**

**MATERIALS**

**Cartridge:** Weight: 0.19 kg. (0.42 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 0.36 kg. (0.80 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.012.1. Steel and Ductile Iron bodies available; dimensions may differ; consult factory.

**Coil:** Weight: 0.32 kg. (0.7 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.1.

**Port Plug:** For SAE 6 Port: 6103006 For SAE 8 Port: 6103008; See page 8.500.1.

**TO ORDER**

**PV72-33**

**Flow Range** (Refer to Performance Curves.)

<table>
<thead>
<tr>
<th>Flow Range</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td>Cartridge Only</td>
</tr>
<tr>
<td>10T</td>
<td></td>
<td>SAE 10</td>
</tr>
<tr>
<td>12T</td>
<td></td>
<td>SAE 12</td>
</tr>
<tr>
<td>16T</td>
<td></td>
<td>SAE 16</td>
</tr>
<tr>
<td>4B</td>
<td></td>
<td>1/2 in. BSP*</td>
</tr>
<tr>
<td>6B</td>
<td></td>
<td>3/4 in. BSP*</td>
</tr>
</tbody>
</table>

**Option(s)**

| None (Blank) | M | G |
|              |   | Manual Override |
|              |   | Manual Override with Guard |

**Seals**

| Buna N (Std.) | N |
| Fluorocarbon  | V |

**Terminations Std. Coil**

| DS | Dual Spades |
| DG | DIN 43650 |
| DL | Leadwires (2) |
| DL/W | Leads w/Weatherpak® Connectors |

**Terminations E-Coil**

| ER | Deutsch DT04-2P (IP69K Rated) |

Coils with internal diode are available. Consult factory.

**Voltage**

| 0 | Less Coil |
| 12 | 12 VDC |
| 24 | 24 VDC |
DESCRIPTION
A pressure-compensated electrically-variable three-port flow regulator that is a priority (bypass) type control. This combination valve uses a PV72-33x proportional cartridge and an EC12-40 compensator.

OPERATION
The PFR72-33x-J series will bypass all flow when de-energized at the pressure compensator spring value. When energized, this proportional valve/compensator package will regulate flow out of port ➁, regardless of system working pressure, with an increasing current applied to the solenoid.

FEATURES
- Excellent linearity and hysteresis characteristics.
- Optional control orifice sizes.
- Hardened spool and cage for long life.
- Optional coil voltages and terminations.
- Efficient wet armature construction.
- Cartridges voltage interchangeable.
- Unitized, molded coil design.
- Coil waterproofing standard.
- Screw-in manual override option.

RATINGS
Operating Pressure: 207 bar (3000 psi)
Pressure Rise: Pressure at ➀ begins to rise higher than the compensating pressure differential when bypass flow exceeds 41.6 lpm (11 gpm).
Internal Leakage: 492 cc/min. (30 cu. in./min.) fully closed at 207 bar (3000 psi) out port ➁.

Electrical: 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current</th>
<th>Max. Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>300 ± 70 mA</td>
<td>1500 ± 200 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>150 ± 35 mA</td>
<td>750 ± 100 mA</td>
</tr>
</tbody>
</table>

Operation of Manual Override:
To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.
To Disengage: Turn counterclockwise approximately 6 turns until positive stop is found.

Filtration: See page 9.010.1

Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)

Installation: No restrictions; See page 9.020.1

PERFORMANCE CURVES

Priority Port Flow Delivered Out Port ➁:
For 12 volt coils, double the current (amp) values shown.

Attention Manifold Designers:
To obtain these high flow capabilities using proportional flow controls and compensators, optimized cavity drillings are required. Please consult factory.
**Cartridge:** Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and back-ups standard.

**Standard Ported Body:** Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi). Steel and ductile iron bodies available; consult factory.

**Coil:** Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

**Package Weight:** 2.95 kg. (6.5 lbs.).

**Seal Kit:** SK12-3x-MM (PV) SK12-4x-TMB (EC)

---

**DIMENSIONS**

![Dimensions Diagram]

**NOTE:** The N.O. PV72-35 may not be substituted in this manifold due to port logic factors.

---

**MATERIALS**

**Cartridge:** Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and back-ups standard.

**Standard Ported Body:** Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi). Steel and ductile iron bodies available; consult factory.

**Coil:** Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

**Package Weight:** 2.95 kg. (6.5 lbs.).

**Seal Kit:** SK12-3x-MM (PV) SK12-4x-TMB (EC)

---

**TO ORDER**

<table>
<thead>
<tr>
<th>PFR72-33x-J</th>
<th>-J-</th>
<th>12T-</th>
<th>-</th>
</tr>
</thead>
</table>

**PV Orifice Range**

<table>
<thead>
<tr>
<th>Orifice Range</th>
<th>A</th>
<th>B</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Blank)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Override Option**

<table>
<thead>
<tr>
<th>Screw Type</th>
<th>None</th>
</tr>
</thead>
</table>

**Compensator Spring**

<table>
<thead>
<tr>
<th>Compensator Spring</th>
<th>4.14 bar (100 psi)</th>
<th>5.17 bar (100 psi)</th>
<th>6.89 bar (100 psi)</th>
<th>11.03 bar (160 psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection</td>
<td>60</td>
<td>75</td>
<td>100</td>
<td>160</td>
</tr>
</tbody>
</table>

**Terminations**

- **DS:** Dual Spades
- **DG:** DIN 43650
- **DL:** Leadwires (2)
- **DL/W:** Leads w/Weatherpak® Connectors
- **DR:** Deutsch DT04-2P

**Voltage**

- **0:** Less Coil
- **12:** 12 VDC
- **24:** 24 VDC

**Seals**

- **Buna N (Std.)**
- **Fluorocarbon**

*Select Orifice Range and Compensator Spring by referring to the Performance Curves on the preceding page.*
**DESCRIPTION**

A pressure-compensated electrically-variable two-port flow regulator that is normally closed when de-energized. This combination valve uses a PV72-33x proportional cartridge and an EC12-30 compensator.

**OPERATION**

This proportional valve/compensator package will regulate flow out of port ➁ regardless of system working pressure. With an increasing current applied to the solenoid, the PFR72-33x-L will increase output flow.

**FEATURES**

- Excellent linearity and hysteresis characteristics.
- Optional control orifice sizes.
- Hardened spool and cage for long life.
- Optional coil voltages and terminations.
- Efficient wet armature construction.
- Cartridges voltage interchangeable.
- Unitized, molded coil design.
- Coil waterproofing standard.
- Screw-in manual override option.

**RATINGS**

**Operating Pressure:** 207 bar (3000 psi)

**Internal Leakage:** 492 cc/min. (30 cu. in./min.) fully closed at 207 bar (3000 psi) out port ➁.

**Electrical:** 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current (mA)</th>
<th>Max. Control Current (mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>300 ± 200 mA</td>
<td>1500 ± 100 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>150 ± 35 mA</td>
<td>750 ± 100 mA</td>
</tr>
</tbody>
</table>

**Operation of Manual Override:**

To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.

To Disengage: Turn counterclockwise approximately 6 turns until positive stop is found.

**Filtration:** See page 9.010.1

**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)

**Installation:** No restrictions; See page 9.020.1

**PERFORMANCE CURVES**

**Regulated Flow Delivered Out Port ➁:**

24 Volt coil used; 100 Hz dither; PWM controller. For 12 volt coils, double the current (amp) values shown.
**MATERIALS**

**Cartridge:** Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and back-ups standard.

**Standard Ported Body:** Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi). Steel and ductile iron bodies available; dimensions may differ; consult factory.

**Coil:** Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

**Package Weight:** 3.18 kg. (7 lbs.).

**Seal Kit:** SK12-3x-MM (PV); SK12-3x-TB (EC)

**TO ORDER**

**PFR72-33 - L - 12T - **

**Override Option**

- *Overrive Option*
  - A (Blank)
  - B
  - M

**Compensator Spring**

- 6.9 bar (100 psi)
- 11.03 bar (160 psi)

*Select Orifice Range and Compensator Spring by referring to the Performance Curves on the preceding page.*

**Terminations**

- DS Dual Spades
- DG DIN 43650
- DL Leadwires (2)
- DL/W Leads w/Weatherpak® Connectors
- DR Deutsch DT04-2P

**Voltage**

- 0 Less Coil
- 12 12 VDC
- 24 24 VDC

**NOTE:** The N.O. PV72-35 may not be substituted in this manifold due to port logic factors.
DESCRIPTION
A solenoid operated, electrically-variable, two-way, pressure-compensated, spool-type, normally closed when de-energized, proportional flow control valve with reverse free flow check. It is a restrictive-type 2-way, pressure-compensated flow regulator; port 2 is blocked and not used.

OPERATION
When energized the PV70-34 will regulate flow from port ➀ to port ➂ regardless of system working pressure. With an increasing current applied to the solenoid, the PV70-34 will increase output flow. When the pressure at port ➂ exceeds the pressure at port ➀, the valve will free reverse flow from port ➂ to port ➀.

Operation of Manual Override:
To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.
To Disengage: Turn counterclockwise approximately 6 turns to positive stop.

FEATURES
• Excellent linearity and hysteresis characteristics.
• Hardened spool and cage for long life.
• Optional coil voltages and terminations.
• Efficient wet armature construction.

RATINGS
Operating Pressure: Inlet: 240 bar (3500 psi)
Regulated Flow Rate: 0 to 30 lpm (0 to 8 gpm)
Reverse Free Flow Cracking Pressure: 1 to 1.4 bar (15 to 20 psi)
Internal Leakage: 0.38 lpm (0.10 gpm) at zero current
Electrical: 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current</th>
<th>Max. Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>300 ± 100 mA</td>
<td>1500 ± 100 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>150 ± 50 mA</td>
<td>750 ± 50 mA</td>
</tr>
</tbody>
</table>

Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
Installation: No restrictions; See page 9.020.1.
Cavity: VC10-3 (Port ➀ does not need to be drilled); See page 9.110.1
Cavity Tool: CT10-3X-XX; See page 8.600.1
Seal Kit: SK10-3X-MM; See page 8.650.1

PERFORMANCE

Flow vs. Current
➀ to ➂ Energized
240 bar/3500 psi; 12V Coil; 110 Hz PWM
32 cSt/150 ssu oil at 40°C

Regulated Flow vs. Pressure Drop
➀ to ➂
240 bar/3500 psi Inlet
12V Coil; 110 Hz PWM
32 cSt/150 ssu oil at 40°C

Pressure Drop vs. Regulated Flow
➂ to ➀ De-energized
32 cSt/150 ssu oil at 40°C
### Recommended Controllers (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig. w/12V Coil</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>7114950</td>
<td>4000046</td>
<td>4000049</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000070</td>
<td>4000141</td>
<td>4000124</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000123</td>
<td>4000143</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input Sig. w/24V Coil</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000161</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000165</td>
<td>4000141</td>
<td>4000182</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000169</td>
<td>4000143</td>
<td>4000186</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

#### DIMENSIONS

**Manual Override Option “M”**

- 1.61 across flats
- 27.0 TORQUE: 10–12 ft-lbs (14–16 Nm) max.

**Manual Override Option “G”**

- 1.13 across flats
- 28.6 TORQUE: 27 ft-lbs (36.7 Nm)

#### MATERIALS

**Cartridge:** Weight: 0.19 kg (0.42 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 0.36 kg (0.80 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.010.1. Steel and Ductile Iron bodies available; dimensions may differ; consult factory.

**PV70 Series Coil:** Weight: 0.32 kg (0.7 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.7.

**Port Plug:** For SAE 6 Port: 6103006
For SAE 8 Port: 6103008; See page 8.500.1.

#### TO ORDER

**PV70-34**

- **Option(s)**
  - None (Blank)
  - Manual Override
  - Manual Override with Guard

**Seals**

- Buna N (Std.)
- Fluorocarbon

**Terminations Std. Coil**

- **Input Sig. w/12V Coil**
  - DS Dual Spades
  - DG DIN 43650
  - DL Leadwires (2)
  - DL/W Leads w/Weatherpak® Connectors

**Terminations E-Coil**

- ER Deutsch DT04-2P (IP69K Rated)

**Voltage**

- 0 Less Coil
- 12 12 VDC
- 24 24 VDC
**PV72-34 Proportional Flow Control Cartridge,**

**DESCRIPTION**

A solenoid operated, electrically-variable, two-way, pressure-compensated, spool-type, normally closed when de-energized, proportional flow control valve with reverse free flow check. It is a restrictive-type 2-way, pressure-compensated flow regulator; port ② is blocked and not used.

**OPERATION**

When energized the PV72-34 will regulate flow from port ① to port ③ regardless of system working pressure. With an increasing current applied to the solenoid, the PV72-34 will increase output flow. When the pressure at port ③ exceeds the pressure at port ①, the valve will free reverse flow from port ③ to port ①.

**Operation of Manual Override:**

To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.

To Disengage: Turn counterclockwise approximately 6 turns to positive stop.

**FEATURES**

- Excellent linearity and hysteresis characteristics.
- Hardened spool and cage for long life.
- Optional coil voltages and terminations.
- Efficient wet armature construction.

**RATINGS**

- **Operating Pressure:** Inlet: 240 bar (3500 psi)
- **Regulated Flow Rate:** 0 to 57 lpm (0 to 15 gpm)
- **Reverse Free Flow Cracking Pressure:** 0.7 to 1.0 bar (10 to 15 psi)
- **Internal Leakage:** 0.38 lpm (0.10 gpm) at zero current
- **Electrical:** 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current</th>
<th>Max. Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>300 ± 100 mA</td>
<td>1500 ± 100 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>150 ± 50 mA</td>
<td>750 ± 50 mA</td>
</tr>
</tbody>
</table>

- **Filtration:** See page 9.010.1
- **Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
- **Installation:** No restrictions; See page 9.020.1.
- **Cavity:** VC12-3 (Port ② does not need to be drilled); See page 9.112.1
- **Cavity Tool:** CT12-3X-XX; See page 8.600.1
- **Seal Kit:** SK12-3X-MM; See page 8.650.1

**PERFORMANCE**

Flow vs. Current

1. Energized
240 bar/3500 psi; 12V Coil; 110 Hz PWM
32 cSt/150 ssu oil at 40°C

Regulated Flow vs. Pressure Drop

1. to 3
240 bar/3500 psi Inlet
12V Coil; 110 Hz PWM
32 cSt/150 ssu oil at 40°C

Pressure Drop vs. Regulated Flow

3. to 1 De-energized
32 cSt/150 ssu oil at 40°C

2.414.1
Normally Closed

**PV72-34**

### MATERIALS

**Cartridge:** Weight: 0.36 kg. (0.8 lbs.);
Steel with hardened work surfaces.
Zinc-plated exposed surfaces.
Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 1.09 kg. (2.4 lbs.);
Anodized high-strength 6061 T6 aluminum alloy,
rated to 240 bar (3500 psi);
See page 8.012.1. Steel and Ductile Iron bodies available; dimensions may differ; consult factory.

**PV70 Series Coil:** Weight: 0.32 kg. (0.7 lbs.);
Unitized thermoplastic encapsulated, Class H high temperature magnet-wire;
See page 3.200.7.

**Port Plug:** For SAE 10 Port: 6103010
For SAE 12 Port: 6103012;
For SAE 16 Port: 6103016;
See page 8.500.1.

### DIMENSIONS

**TO ORDER**

**PV72-34**

**Terminations Std. Coil**
- DS Dual Spades
- DG DIN 43650
- DL Leadwires (2)
- DL/W Leads w/Weatherpak® Connectors

**Terminations E-Coil**
- ER Deutsch DT04-2P (IP69K Rated)

**Seals**
- Buna N (Std.)
- Fluorocarbon

**Voltage**
- 0 Less Coil
- 12 12 VDC
- 24 24 VDC

**Option(s)**
- None (Blank)
- Manual Override
- Manual Override with Guard

**Porting**
- 0 Cartridge Only
- 10T SAE 10
- 12T SAE 12
- 16T SAE 16
- 4B 1/2 in. BSP*
- 6B 3/4 in. BSP*

*BSP Body; U.K. Mfr. Only

**Torque:**
- 10–12 ft-lbs (14–16 Nm)
- 35 ft-lbs (47.4 Nm)

**Seals**
- Buna N (Std.)
- Fluorocarbon

**Voltage**
- 0 Less Coil
- 12 12 VDC
- 24 24 VDC

<table>
<thead>
<tr>
<th>Recommended Controllers (See Section 3)</th>
<th>DIN Coil</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Sig. w/12V Coil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-5 VDC</td>
<td>7114950</td>
<td>4000046</td>
<td>4000049</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000070</td>
<td>4000141</td>
<td>4000124</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>400123</td>
<td>4000143</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>400144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

| w/24V Coil                             |         |           |           |                |
| 0-5 VDC                                | 4000161 | 4000194   | 4000174   | 4000136        |
| 0-10 VDC                               | 4000165 | 4000141   | 4000182   | 4000137        |
| 4-20 mA                                 | 4000169 | 4000143   | 4000186   | 4000139        |
| PWM                                    | —       | 4000144   | 4000133   | 4000140        |
PV70-35 Proportional Flow Control Cartridge,

DESCRIPTION
A linear solenoid-driven, two-way normally open, screw-in cartridge valve designed for use with a pressure compensator to function as an electrically stroked variable flow regulator.

OPERATION
With increasing electric current, the PV70-35 changes from full open to full closed with flow from port 🗼 to port 🗼. Port 🗼 is used only to pressure balance the spool and should be plugged. The proportional valve is intended to function in tandem with standard HydraForce pressure compensators at pressure differentials of 21 bar (300 psid) or less, or alone in variable volume pressure-compensated circuits with load sense capability.

The valve is designed to work with industry-common controllers which typically feature current capability to 2 amps @ 12 VDC, PWM, and start/stop trim adjustments (I min./I max.). Consult factory for details and potential sourcing.

Operation of Manual Override:
To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.
To Disengage: Turn counterclockwise approximately 6 turns to positive stop.

FEATURES
• Excellent linearity and hysteresis characteristics.
• Optional control orifice sizes.
• Hardened spool and cage for long life.
• Optional coil voltages and terminations.

RATINGS
Operating Pressure: 207 bar (3000 psi)
Internal Leakage: 197 cc/min. (12 cu. in./min.) fully closed at 207 bar (3000 psi)
Electrical: 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current</th>
<th>Max. Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>300 ± 200 mA</td>
<td>1500 ± 200 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>150 ± 100 mA</td>
<td>750 ± 50 mA</td>
</tr>
</tbody>
</table>

Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
Installation: No restrictions; See page 9.020.1.
Cavity: VC10-3; See page 9.110.1
Cavity Tool: CT10-3X-XX; See page 8.600.1
Seal Kit: SK10-3X-MM; See page 8.650.1

Recommended Controllers (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil Mount</th>
<th>DIN Coil Mount</th>
<th>DIN Coil Mount</th>
<th>DIN Coil Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>w/12V Coil</td>
<td>w/24V Coil</td>
<td>w/12V Coil</td>
<td>w/24V Coil</td>
<td>w/12V Coil</td>
</tr>
<tr>
<td>0-5 VDC</td>
<td>4000070</td>
<td>40000165</td>
<td>40000169</td>
<td>40000169</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000070</td>
<td>40000165</td>
<td>40000169</td>
<td>40000169</td>
</tr>
<tr>
<td>0-20 mA</td>
<td>4000123</td>
<td>4000143</td>
<td>4000143</td>
<td>4000143</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000144</td>
<td>4000144</td>
</tr>
</tbody>
</table>

2.432.1
**DIMENSIONS**

**MATERIALS**

Cartridge: Weight: 0.19 kg. (0.42 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

Standard Ported Body: Weight: 0.36 kg. (0.80 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.010.1. Steel and Ductile Iron bodies available; dimensions may differ; consult factory.

PV70 Series Coil: Weight: 0.32 kg. (0.7 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.7.

Port Plug: For SAE 6 Port: 6103006 For SAE 8 Port: 6103008; See page 8.500.1.

**TO ORDER**

**PV70-35**

<table>
<thead>
<tr>
<th>Flow Range</th>
<th>Porting</th>
<th>Flow Range</th>
<th>Option(s)</th>
<th>Terminals Std. Coil</th>
<th>Terminals E-Coil</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Refer to Performance Curves.)</td>
<td>Cartridge Only</td>
<td>(Refer to Performance Curves.)</td>
<td>None (Blank) Manual Override Manual Override with Guard</td>
<td>DS Dual Spades</td>
<td>ER Deutsch DT04-2P (IP69K Rated)</td>
</tr>
<tr>
<td>A</td>
<td>0</td>
<td>B</td>
<td>M</td>
<td>DG DIN 43650</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>6T</td>
<td>C</td>
<td>Manual Override</td>
<td>DL Leadwires (2)</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>8T</td>
<td></td>
<td>Manual Override</td>
<td>DL/W Leads w/Weatherpak® Connectors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Seals**

|            | Buna N (Std.) | Fluorocarbon |
|            | N             | V             |

**Voltag**

|            | Less Coil | 12 VDC |
|            | 0         | 24 VDC |

**TORQUE:**

10–12 ft-lbs (14–16 Nm)

**ACROSS FLATS**

1.06 x 75.5 = 78.2 mm (30.8 in.)
ELECTRO-PROPORTIONAL VALVES—FLOW CONTROLS

**PFR70-35x-E  Proportional Flow Regulator, N.O.,**

**DESCRIPTION**
A pressure-compensated electrically-variable two-port flow regulator that is normally open when de-energized. This combination valve uses a PV70-35x proportional cartridge and an EC10-30 compensator.

**OPERATION**
This proportional valve/compensator package will regulate flow out of port ➁ regardless of system working pressure. With an increasing current applied to the solenoid, the PFR70-35x-E will decrease output flow.

**FEATURES**
- Excellent linearity and hysteresis characteristics.
- Optional control orifice sizes.
- Hardened spool and cage for long life.
- Optional coil voltages and terminations.
- Efficient wet armature construction.
- Cartridges voltage interchangeable.
- Unitized, molded coil design.
- Coil waterproofing standard.
- Screw-in manual override option.

**RATINGS**
**Operating Pressure:** 207 bar (3000 psi)
**Leakage:** 0.75 lpm (0.2 gpm) max. at 100% current applied
**Electrical:** 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current</th>
<th>Max. Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>300 ± 200 mA</td>
<td>1500 ± 100 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>150 ± 100 mA</td>
<td>750 ± 50 mA</td>
</tr>
</tbody>
</table>

**Operation of Manual Override:**
To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.
To Disengage: Turn counterclockwise approximately 6 turns until positive stop is found.

**Filtration:** See page 9.010.1
**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
**Installation:** No restrictions; See page 9.020.1

**Attention Manifold Designers:**
To obtain these high flow capabilities using proportional flow controls and compensators, optimized cavity drillings are required. Please consult factory.

**PERFORMANCE CURVES  Regulated Flow Delivered Out Port ➁:**
24 Volt coil used; 100 Hz dither; PWM controller. For 12 volt coils, double the current (amp) values shown.

---

Flow vs. Current (No Load)
PV70-35A with EC10-30
11 bar/160 psi spring ———
5.5 bar/80 psi spring - - - -
100 Hz Dither

Flow vs. Current (No Load)
PV70-35B with EC10-30
11 bar/160 psi spring ———
5.5 bar/80 psi spring - - - -
100 Hz Dither

Flow vs. Current (No Load)
PV70-35C with EC10-30
11 bar/160 psi spring ———
5.5 bar/80 psi spring - - - -
100 Hz Dither
**MATERIALS**

**Cartridge:** Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and back-ups standard.

**Standard Ported Body:** Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi). Steel and ductile iron bodies available; dimensions may differ; consult factory.

**Coil:** Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

**Package Weight:** 2.27 kg. (5 lbs.).

**Seal Kit:** SK10-3x-MM (PV); SK10-3x-TB (EC)

**NOTE:** The N.O. PV70-33 may not be substituted in this manifold due to port logic factors.

**DIMENSIONS**

**TO ORDER**

**PFR70-35x-E**

**Override Option**
- Override Option
- None
- Screw Type

**Compensator Spring**
- 5.52 bar (80 psi) 80
- 11.03 bar (160 psi) 160

**Seals**
- Buna N (Std.) N
- Fluorocarbon V

**Terminations**
- DS Dual Spades
- DG DIN 43650
- DL Leadwires (2)
- DL/W Leads with Weatherpak® Connectors
- DR Deutsch DT04-2P

**Voltage**
- 0 Less Coil
- 12 12 VDC
- 24 24 VDC

*Select Orifice Range and Compensator Spring by referring to the Performance Curves on the preceding page.*
PV72-35 Proportional Flow Control Cartridge,

**DESCRIPTION**
A linear solenoid-driven, two-way normally open, screw-in cartridge valve designed for use with a pressure compensator to function as an electrically stroked variable flow regulator.

**OPERATION**
With increasing electric current, the PV72-35 changes from full open to full closed with flow from port ➁ to port ➂. Port ➀ is used only to pressure balance the spool and should be plugged. The proportional valve is intended to function in tandem with standard HydraForce pressure compensators at pressure differentials of 21 bar (300 psid) or less, or alone in variable volume pressure-compensated circuits with load sense capability.

The valve is designed to work with industry-common controllers which typically feature current capability to 2 amps @ 12 VDC, PWM, and start/stop trim adjustments (I-min./I-max.). Consult factory for details and potential sourcing.

**Operation of Manual Override:**
To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.
To Disengage: Turn counterclockwise approximately 6 turns to positive stop.

**FEATURES**
- Excellent linearity and hysteresis characteristics.
- Optional control orifice sizes.
- Hardened spool and cage for long life.
- Optional coil voltages and terminations.
- Efficient wet armature construction.
- Cartridges voltage interchangeable.
- Unitized, molded coil design.
- Coil waterproofing standard.
- Manual override option.

**RATINGS**
**Operating Pressure:** 207 bar (3000 psi)
**Internal Leakage:** 328 cc/min. (20 cu. in./min.) fully closed at 207 bar (3000 psi)

**Electrical:** 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current</th>
<th>Max. Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>300 ± 200 mA</td>
<td>1500 ± 100 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>150 ± 100 mA</td>
<td>750 ± 50 mA</td>
</tr>
</tbody>
</table>

**Filtration:** See page 9.010.1
**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)

**Installation:** No restrictions; See page 9.020.1.
**Cavity:** VC12-3; See page 9.110.1
**Cavity Tool:** CT12-3X-XX; See page 8.600.1
**Seal Kit:** SK12-3X-MM; See page 8.650.1

**Recommended Controllers** (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig. w/12V Coi</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>7114950</td>
<td>40000046</td>
<td>4000049</td>
<td>4000138</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000070</td>
<td>4000141</td>
<td>4000124</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000123</td>
<td>4000143</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input Sig. w/24V Coi</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000161</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000165</td>
<td>4000141</td>
<td>4000182</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000169</td>
<td>4000143</td>
<td>4000186</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>
**Cartridge:**
- Weight: 0.19 kg. (0.42 lbs.)
- Steel with hardened work surfaces.
- Zinc-plated exposed surfaces.
- Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:**
- Weight: 0.36 kg. (0.80 lbs.)
- Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.012.1. Steel and Ductile Iron bodies available; dimensions may differ; consult factory.

**Coil:**
- Weight: 0.32 kg. (0.7 lbs.)
- Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.1.

**Port Plug:**
- For SAE 6 Port: 6103006
- For SAE 8 Port: 6103008;

---

**MATERIALS**

Cartridge: Weight: 0.19 kg. (0.42 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

Standard Ported Body: Weight: 0.36 kg. (0.80 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.012.1. Steel and Ductile Iron bodies available; dimensions may differ; consult factory.

Coil: Weight: 0.32 kg. (0.7 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.1.

Port Plug: For SAE 6 Port: 6103006
- For SAE 8 Port: 6103008;

**DIMENSIONS**

**FLOW RANGE**

A
- Cartridge

B
- Performance Curves.

**PORTING**

10T
- SAE 10
12T
- SAE 12
16T
- SAE 16
4B
- 1/2 in. BSP*
6B
- 3/4 in. BSP*

**OPTION(S)**

None (Blank)
- Manual
- Override
- Manual
- Override with Guard

**SEALS**

Buna N (Std.)
- Fluorocarbon

**TO ORDER**

PV72-35

**TERMINATIONS Std. Coil**

DS
- Dual Spades
DG
- DIN 43650
DL
- Leadwires (2)
DL/W
- Leads w/Weatherpak® Connectors

**TERMINATIONS E-Coil**

ER
- Deutsch DT04-2P (IP69K Rated)

**_VOLTAGE**

0
- Less Coil
12
- 12 VDC
24
- 24 VDC
**DESCRIPTION**

A pressure-compensated electrically-variable two-port flow regulator that is normally open when de-energized. This combination valve uses a PV72-35x proportional cartridge and an EC12-30 compensator.

**OPERATION**

This proportional valve/compensator package will regulate flow out of port ② regardless of system working pressure. With an increasing current applied to the solenoid, the PFR72-35x-L will decrease output flow.

**FEATURES**

- Excellent linearity and hysteresis characteristics.
- Optional control orifice sizes.
- Hardened spool and cage for long life.
- Optional coil voltages and terminations.
- Efficient wet armature construction.
- Cartridges voltage interchangeable.
- Unitized, molded coil design.
- Coil waterproofing standard.
- Screw-in manual override option.

**RATINGS**

- **Operating Pressure:** 207 bar (3000 psi)
- **Leakage:** 0.75 lpm (0.2 gpm) max. at 100% current applied
- **Electrical:** 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current</th>
<th>Max. Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>300 ± 200 mA</td>
<td>1500 ± 100 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>150 ± 100 mA</td>
<td>750 ± 50 mA</td>
</tr>
</tbody>
</table>

**Operation of Manual Override:**

To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.
To Disengage: Turn counterclockwise approximately 6 turns until positive stop is found.

**Filtration:** See page 9.010.1

**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)

**Installation:** No restrictions; See page 9.020.1

**PERFORMANCE CURVES**  Regulated Flow Delivered Out Port ②:

24 Volt coil used; 100 Hz dither; PWM controller. For 12 volt coils, double the current (amp) values shown.
2-Port, Pressure Compensated

**PFR72-35x-L**

### DIMENSIONS

![Dimensions Diagram]

### MATERIALS

**Cartridge:** Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and back-ups standard.

**Standard Ported Body:** Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi). Steel and ductile iron bodies available; dimensions may differ; consult factory.

**Coil:** Unitized thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

**Package Weight:** 3.18 kg. (7 lbs.).

**Seal Kit:** SK12-3x-MM (PV); SK12-3x-TB (EC)

### TO ORDER

```
PFR72-35 - L - 12T - -
```

**PV Orifice Range**

- Orifice Range A (Blank)
- Orifice Range B
- Orifice Range M

**Override Option**

- None
- Screw Type

**Compensator Spring**

- 6.9 bar (100 psi) 100
- 11.03 bar (160 psi) 160

**Seals**

- Buna N (Std.) N
- Fluorocarbon V

**Terminations**

- DS Dual Spades
- DG DIN 43650
- DL Leadwires (2)
- DL/W Leads w/Weatherpak® Connectors
- DR Deutsch DT04-2P

**Voltage**

- 0 Less Coil
- 12 12 VDC
- 24 24 VDC

**NOTE:** The N.O. PV72-33 may not be substituted in this manifold due to port logic factors.

*Select Orifice Range and Compensator Spring by referring to the Performance Curves on the preceding page.*
DESCRIPTION
A solenoid-operated, electrically-variable, pressure-compensated, spool-type, normally closed when de-energized, proportional, bi-directional, flow control valve. An internal compensator spool provides compensated flow across the proportional orifice regardless of flow direction.

OPERATION
The ZL70-30 provides regulated flow from port ➁ to port ➂, or regulated flow from port ➂ to port ➁. Port ➀ should be blocked. Regulated flow is proportional to electric current applied to the solenoid.

Operation of Manual Override:
To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.
To Disengage: Turn counterclockwise approximately 6 turns until positive stop is found.

FEATURES
• Excellent linearity and hysteresis characteristics.
• Hardened spool and cage for long life.
• Optional coil voltages and terminations.
• Efficient wet armature construction.
• Manual Override option.

RATINGS
Maximum Operating Pressure: 240 bar (3500 psi)
Regulated Flow: Range A: 0–20 lpm (0–5.3 gpm); Range B: 0–10 lpm (0–2.6 gpm)
Internal Leakage: 0.38 lpm (0.10 gpm) maximum at zero current
Electrical: 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current</th>
<th>Max. Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>250 ± 100 mA</td>
<td>1400 ± 100 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>125 ± 50 mA</td>
<td>750 ± 50 mA</td>
</tr>
</tbody>
</table>

Temperature: -40 to 120°C with Buna N seals
Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
Installation: No restrictions; See page 9.020.1.
Cavity: VC10-3; See page 9.110.1
Cavity Tool: CT10-3X-XX; See page 8.600.1
Seal Kit: SK10-3X-MM; See page 8.650.1

PERFORMANCE

FLOW RANGE “A”
Regulated Flow vs. Current
240 bar/3500 psi Inlet
207 bar/3000 psi at Regulated Port
12V Coil; 110 Hz PWM
12 VDC, 32 cSt/150 sus oil at 40°C

FLOW RANGE “A”
Regulated Flow vs. Pressure Drop
240 bar/3500 psi Inlet
12 VDC, 32 cSt/150 sus oil at 40°C

Recommended Controllers (See Section 3)

Input Sig. | DIN Coil Mount | PCB Board | Metal Box | DIN Rail Mount |
---|---|---|---|---|
0-5 VDC | 4000046 | 4000048 | 4000049 | 4000138 |
0-10 VDC | 4000070 | 4000141 | 4000124 | 4000137 |
4-20 mA | 4000123 | 4000143 | 4000130 | 4000139 |
PWM — | 4000144 | 4000133 | 4000137 | 4000140 |

w/24V Coil

0-5 VDC | 4000161 | 4000194 | 4000174 | 4000136 |
0-10 VDC | 4000165 | 4000141 | 4000182 | 4000137 |
4-20 mA | 4000169 | 4000143 | 4000186 | 4000139 |
PWM — | 4000144 | 4000133 | 4000137 | 4000140 |
**Cartridge:** Weight: 0.32 kg. (0.7 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 0.59 kg. (1.3 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.010.1. Steel and ductile iron bodies available; dimensions may differ; consult factory.

**PV70 Series Coil:** Weight: 0.32 kg. (0.7 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.7.

**MATERIALS TO ORDER**

**ZL70-30**

**Range**
- 0–20 lpm (0–5.3 gpm) A
- 0–10 lpm (0–2.6 gpm) B

**Option(s)**
- Manual Override M

**Porting**
- Cartridge Only 0
- SAE 6 6T
- SAE 8 8T
- SAE 10 10T

**Terminations**
- DS Dual Spades
- DG DIN 43650
- DL Leadwires (2)
- DL/W Leads w/Weatherpak® Connectors
- DR Deutsch DT04-2P

**Voltage**
- 0 Less Coil
- 12 12 VDC
- 24 24 VDC

**Seals**
- N Buna N (Std.)
- V Fluorocarbon

**PERFORMANCE (continued)**

FLOW RANGE “B”
Regulated Flow vs. Pressure Drop
240 bar/3500 psi Inlet
0 to 12
12 to 24
12V Coil; 110 Hz PWM
32 cSt/150 sus oil at 40°C

FLOW RANGE “B”
Regulated Flow vs. Current
207 bar/3000 psi at Regulated Port
0 to 12
12 to 44
12V Coil; 110 Hz PWM
32 cSt/150 sus oil at 40°C

**DIMENSIONS**

**U.S. Patent 6,167,906**

**Manual Override Option**

**ACROSS FLATS**
TORQUE: 0–12 ft-lbs (14–16 Nm)

**ACROSS FLATS**
TORQUE: 0–12 ft-lbs (14–16 Nm)

**PERFORMANCE**

**FLOW RANGE “B”**
Regulated Flow vs. Current
240 bar/3500 psi Inlet
0 to 12
12 to 44
12V Coil; 110 Hz PWM
32 cSt/150 sus oil at 40°C

**FLOW RANGE “B”**
Regulated Flow vs. Pressure Drop
240 bar/3500 psi Inlet
0 to 12
12 to 44
12V Coil; 110 Hz PWM
32 cSt/150 sus oil at 40°C

**FLOW RANGE “B”**
Regulated Flow vs. Pressure Drop
207 bar/3000 psi at Regulated Port
0 to 44
44 to 12
12V Coil; 110 Hz PWM
32 cSt/150 sus oil at 40°C

**FLOW RANGE “B”**
Regulated Flow vs. Current
207 bar/3000 psi at Regulated Port
0 to 44
44 to 12
12V Coil; 110 Hz PWM
32 cSt/150 sus oil at 40°C

**FLAT ACROSS TORQUE:**
27 ft-lbs (36.7 Nm)

**FLAT ACROSS TORQUE:**
10–12 ft-lbs (14–16 Nm)

**PRESSURE** bar/psi
103
1500
172
2500
3500

**FLOW** lpm/gpm
11.4/3.0
9.5/2.5
7.6/2.0
5.7/1.5
3.8/1.0
1.9/0.5

**FLOW** lpm/gpm
11.4/3.0
9.5/2.5
7.6/2.0
5.7/1.5
3.8/1.0
1.9/0.5

**PRESSURE** bar/psi
500
103
1500
172
2500
3500

**FLOW** lpm/gpm
11.4/3.0
9.5/2.5
7.6/2.0
5.7/1.5
3.8/1.0
1.9/0.5

**FLOW** lpm/gpm
11.4/3.0
9.5/2.5
7.6/2.0
5.7/1.5
3.8/1.0
1.9/0.5

**PRESSURE** bar/psi
500
103
1500
172
2500
3500

**FLOW** lpm/gpm
11.4/3.0
9.5/2.5
7.6/2.0
5.7/1.5
3.8/1.0
1.9/0.5

**FLOW** lpm/gpm
11.4/3.0
9.5/2.5
7.6/2.0
5.7/1.5
3.8/1.0
1.9/0.5

**PRESSURE** bar/psi
500
103
1500
172
2500
3500

**FLOW** lpm/gpm
11.4/3.0
9.5/2.5
7.6/2.0
5.7/1.5
3.8/1.0
1.9/0.5

**FLOW** lpm/gpm
11.4/3.0
9.5/2.5
7.6/2.0
5.7/1.5
3.8/1.0
1.9/0.5

**PRESSURE** bar/psi
500
103
1500
172
2500
3500

**FLOW** lpm/gpm
11.4/3.0
9.5/2.5
7.6/2.0
5.7/1.5
3.8/1.0
1.9/0.5

**FLOW** lpm/gpm
11.4/3.0
9.5/2.5
7.6/2.0
5.7/1.5
3.8/1.0
1.9/0.5

**PRESSURE** bar/psi
500
103
1500
172
2500
3500

**FLOW** lpm/gpm
11.4/3.0
9.5/2.5
7.6/2.0
5.7/1.5
3.8/1.0
1.9/0.5

**FLOW** lpm/gpm
11.4/3.0
9.5/2.5
7.6/2.0
5.7/1.5
3.8/1.0
1.9/0.5

**PRESSURE** bar/psi
500
103
1500
172
2500
3500

**FLOW** lpm/gpm
11.4/3.0
9.5/2.5
7.6/2.0
5.7/1.5
3.8/1.0
1.9/0.5

**FLOW** lpm/gpm
11.4/3.0
9.5/2.5
7.6/2.0
5.7/1.5
3.8/1.0
1.9/0.5

**PRESSURE** bar/psi
500
103
1500
172
2500
3500

**FLOW** lpm/gpm
11.4/3.0
9.5/2.5
7.6/2.0
5.7/1.5
3.8/1.0
1.9/0.5

**FLOW** lpm/gpm
11.4/3.0
9.5/2.5
7.6/2.0
5.7/1.5
3.8/1.0
1.9/0.5

**PRESSURE** bar/psi
500
103
1500
172
2500
3500

**FLOW** lpm/gpm
11.4/3.0
9.5/2.5
7.6/2.0
5.7/1.5
3.8/1.0
1.9/0.5

**FLOW** lpm/gpm
11.4/3.0
9.5/2.5
7.6/2.0
5.7/1.5
3.8/1.0
1.9/0.5

**PRESSURE** bar/psi
500
103
1500
172
2500
3500

**FLOW** lpm/gpm
11.4/3.0
9.5/2.5
7.6/2.0
5.7/1.5
3.8/1.0
1.9/0.5

**FLOW** lpm/gpm
11.4/3.0
9.5/2.5
7.6/2.0
5.7/1.5
3.8/1.0
1.9/0.5

**PRESSURE** bar/psi
500
103
1500
172
2500
3500
A solenoid-operated, electrically-variable, pressure-compensated, spool-type, normally closed when de-energized, proportional, bi-directional flow control valve. An internal compensator spool provides compensated flow across the proportional orifice regardless of flow direction.

**OPERATION**

The ZL72-30 provides regulated flow in both directions: from port ① to port ③, or from port ③ to port ①. Port ② should be blocked. Regulated flow is proportional to electric current applied to the solenoid.

**Operation of Manual Override:**

To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.

To Disengage: Turn counterclockwise approximately 6 turns until positive stop is found.

**FEATURES**

- Excellent linearity and hysteresis characteristics.
- Hardened spool and cage for long life.
- Efficient wet armature construction.
- Optional coil voltages and terminations.

**RATINGS**

**Maximum Operating Pressure:** 240 bar (3500 psi)

**Regulated Flow:** 0-50 lpm (0-13 gpm)

**Internal Leakage:** 0.38 lpm (0.10 gpm) maximum at 0 current

**Electrical:** 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current</th>
<th>Max. Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>250 ± 100 mA</td>
<td>1500 ± 200 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>125 ± 50 mA</td>
<td>750 ± 100 mA</td>
</tr>
</tbody>
</table>

**Temperature:** -40 to 120°C with Buna N seals

**Filtration:** See page 9.010.1

**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)

**Installation:** No restrictions; See page 9.020.1.

**Cavity:** VC12-3; See page 9.112.1

**Cavity Tool:** CT12-3X-XX; See page 8.600.1

**Seal Kit:** SK12-3X-MM; See page 8.650.1

**PERFORMANCE**

**Regulated Flow vs. Current**

240 bar/3500 psi; 12V Coil; 110 Hz PWM

32 cSt/150 ssu oil at 40°C

**Regulated Flow vs. Pressure Drop**

240 bar/3500 psi; 12V Coil; 110 Hz PWM

32 cSt/150 ssu oil at 40°C

**Recommended Controllers** (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>w/12V Coil</td>
<td>7114950</td>
<td>4000046</td>
<td>4000049</td>
<td>400136</td>
</tr>
<tr>
<td></td>
<td>4000070</td>
<td>4000141</td>
<td>4000124</td>
<td>400137</td>
</tr>
<tr>
<td></td>
<td>4000123</td>
<td>4000143</td>
<td>4000130</td>
<td>400139</td>
</tr>
<tr>
<td></td>
<td>4000144</td>
<td>4000140</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

| w/24V Coil | 4000161        | 4000194   | 4000174   | 4000136         |
|           | 4000165        | 4000141   | 4000182   | 4000137         |
|           | 4000169        | 4000143   | 4000186   | 4000139         |
|           | —              | 4000144   | 4000133   | 4000140         |
**Materials**

**Cartridge:** Weight: 0.32 kg. (0.7 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 0.59 kg. (1.3 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.012.1. Steel and ductile iron bodies available; dimensions may differ; consult factory.

**Coil:** Weight: 0.32 kg. (0.7 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.1.

**Ordering Information**

**ZL72-30**

- **Option(s)**
  - None (Blank)
  - Manual Override M

- **Porting**
  - Cartridge Only 0
  - SAE 6 6T
  - SAE 8 8T
  - SAE 10 10T

- **Terminations**
  - DS Dual Spades
  - DG DIN 43650
  - DL Leadwires (2)
  - DL/W Leads w/Weatherpak® Connectors
  - DR Deutsch DT04-2P

- **Voltage**
  - 0 Less Coil
  - 12 12 VDC
  - 24 24 VDC

- **Seals**
  - N Buna N (Std.)
  - V Fluorocarbon

---

**Dimensions**

U.S. Patent 6,167,906

---

** HydraForce **
**DESCRIPTION**
A solenoid-operated, electrically-variable, three-port, pressure-compensated, spool-type, normally open when de-energized, proportional, bi-directional, flow control valve. An internal compensator spool provides compensated flow across the proportional orifice regardless of flow direction.

**OPERATION**
The ZL70-31 provides regulated flow from port ➁ to port ➂, or regulated flow from port ➂ to port ➁. Port ➀ should be blocked. Regulated flow is inversely proportional to electric current applied to the solenoid.

**Operation of Manual Override:**
- **To Engage:** Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.
- **To Disengage:** Turn counterclockwise approximately 6 turns until positive stop is found.

**FEATURES**
- Excellent linearity and hysteresis characteristics.
- Hardened spool and cage for long life.
- Optional coil voltages and terminations.
- Efficient wet armature construction.
- Manual Override option.

**RATINGS**
- **Maximum Operating Pressure:** 240 bar (3500 psi)
- **Regulated Flow:** Range A: 0–19 lpm (0–5.0 gpm); Range B: 0–9.5 lpm (0–2.5 gpm)
- **Internal Leakage:** 0.38 lpm (0.10 gpm) maximum at zero current
- **Electrical:** 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current</th>
<th>Max. Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>50 ± 50 mA</td>
<td>1300 ± 100 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>25 ± 25 mA</td>
<td>650 ± 50 mA</td>
</tr>
</tbody>
</table>

- **Temperature:** -40 to 120°C with Buna N seals
- **Filtration:** See page 9.010.1
- **Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
- **Installation:** No restrictions; See page 9.020.1.
- **Cavity:** VC10-3; See page 9.110.1
- **Cavity Tool:** CT10-3X-XX; See page 8.600.1
- **Seal Kit:** SK10-3X-MM; See page 8.650.1

**PERFORMANCE**

**FLOW RANGE “A”**
- Regulated Flow vs. Current
- 240 bar/3500 psi Inlet
- 207 bar/3000 psi at Regulated Port
- ➁ to ➂ ➋ to ➃ ➋ to ➂
- 12V Coil; 110 Hz PWM
- 32 cSt/150 sus oil at 40°C

**FLOW RANGE “A”**
- Regulated Flow vs. Pressure Drop
- 240 bar/3500 psi Inlet
- ➁ to ➂ ➋ to ➃ ➋ to ➂
- 12V Coil; 110 Hz PWM
- 32 cSt/150 sus oil at 40°C

**Recommended Controllers** (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>7114950</td>
<td>4000046</td>
<td>4000049</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000070</td>
<td>4000124</td>
<td>4000137</td>
<td></td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000123</td>
<td>4000143</td>
<td>4000130</td>
<td>4000139</td>
</tr>
</tbody>
</table>

w/24V Coil

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000161</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000165</td>
<td>4000141</td>
<td>4000182</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000169</td>
<td>4000143</td>
<td>4000186</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>
**Normally Open**

**ZL70-31**

### PERFORMANCE (continued)

**FLOW RANGE “B”**
Regulated Flow vs. Current
240 bar/3500 psi Inlet
127 bar/3000 psi at Regulated Port
12 V Coil; 110 Hz PWM
32 cSt/150 sus oil at 40°C

**FLOW RANGE “B”**
Regulated Flow vs. Pressure Drop
240 bar/3500 psi Inlet
12 V Coil; 110 Hz PWM
32 cSt/150 sus oil at 40°C

### DIMENSIONS

U.S. Patent 6,167,906

**MANUAL OVERRIDE OPTION**

1.06
ACROSS FLATS
TORQUE:
27 ft-lbs
(37 Nm)

1.13
ACROSS FLATS
TORQUE:
27 ft-lbs
(36.7 Nm)
max.

### MATERIALS

**Cartridge:** Weight: 0.32 kg. (0.7 lbs.);
Steel with hardened work surfaces.
Zinc-plated exposed surfaces.
Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 0.59 kg. (1.3 lbs.);
Anodized high-strength T6 aluminum alloy, rated to 240 bar (3500 psi);
See page 8.010.1. Steel and ductile iron bodies available; dimensions may differ; consult factory.

**PV70 Series Coil:** Weight: 0.32 kg. (0.7 lbs.);
Unitized thermoplastic encapsulated, Class H high temperature magnet-wire;
See page 3.200.7.

### TO ORDER

**ZL70-31**

**Range**
0–9.5 lpm (0–2.5 gpm)

**Option(s)**
None (Blank)
Manual Override M

**Porting**
Cartridge Only 0
SAE 6 6T
SAE 8 8T
SAE 10 10T

**Terminations**
DS Dual Spades
DG DIN 43650
DL Leadwires (2)
DL/W Leads w/Weatherpack Connectors
DR Deutsch DT04-2P

**Voltage**
0 Less Coil
12 12 VDC
24 24 VDC

**Seals**
N Buna N (Std.)
V Fluorocarbon

---

Coils with internal diode are available. Consult factory.
**ZL72-31 Proportional, Bi-Directional Flow Control,**

**DESCRIPTION**
A solenoid-operated, electrically-variable, pressure-compensated, spool-type, normally open when de-energized, proportional, bi-directional flow control valve. An internal compensator spool provides compensated flow across the proportional orifice regardless of flow direction.

**OPERATION**
The ZL72-31 provides regulated flow in both directions: from port ➀ to port ➁, or from port ➁ to port ➀. Port ➀ should be blocked. Regulated flow is inversely proportional to electric current applied to the solenoid.

**Operation of Manual Override:**
- **To Engage:** Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift.
- **To Disengage:** Turn counterclockwise approximately 6 turns until positive stop is found.

**FEATURES**
- Excellent linearity and hysteresis characteristics.
- Hardened spool and cage for long life.
- Efficient wet armature construction.
- Optional coil voltages and terminations.
- Cartridges voltage interchangeable.
- Unitized, molded coil design.
- Coil waterproofing standard.
- Manual override option.

**RATINGS**
**Maximum Operating Pressure:** 240 bar (3500 psi)
**Regulated Flow:** 0-50 lpm (0-13 gpm)
**Internal Leakage:** 0.38 lpm (0.10 gpm) maximum at 1.5 amp
**Electrical:** 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current</th>
<th>Max. Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>150 ± 50 mA</td>
<td>1250 ± 100 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>75 ± 25 mA</td>
<td>625 ± 50 mA</td>
</tr>
</tbody>
</table>

**Temperature:** -40 to 120°C with Buna N seals

**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)

**Installation:** No restrictions; See page 9.020.1.

**Cavity:** VC12-3; See page 9.112.1

**Cavity Tool:** CT12-3X-XX; See page 8.600.1

**Seal Kit:** SK12-3X-MM; See page 8.650.1

**PERFORMANCE**

**Regulated Flow vs. Current**
240 bar/3500 psi; 12V Coil; 110 Hz PWM
32 cSt/150 ssu oil at 40°C

**Regulated Flow vs. Pressure Drop**
240 bar/3500 psi; 12V Coil; 110 Hz PWM
32 cSt/150 ssu oil at 40°C

**Recommended Controllers** (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>7114950</td>
<td>4000046</td>
<td>4000049</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000070</td>
<td>4000141</td>
<td>4000124</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000123</td>
<td>4000143</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>4000144</td>
<td>4000133</td>
<td>4000133</td>
<td>4000140</td>
</tr>
<tr>
<td>w/24V Coil</td>
<td>40000161</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>0-5 VDC</td>
<td>40000165</td>
<td>4000141</td>
<td>4000124</td>
<td>4000137</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>40000169</td>
<td>4000143</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>4000144</td>
<td>4000133</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>
**MATERIALS**

**Cartridge:** Weight: 0.19 kg. (0.42 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 0.36 kg. (0.80 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.012.1. Steel and ductile iron bodies available; dimensions may differ; consult factory.

**Coil:** Weight: 0.32 kg. (0.7 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.1.

**TO ORDER**

<table>
<thead>
<tr>
<th>Option(s)</th>
<th>ZL72-31</th>
<th>-</th>
<th>-</th>
<th>-</th>
<th>-</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Porting</td>
<td>Cartridge Only</td>
<td>0</td>
<td>SAE 6</td>
<td>6T</td>
<td>SAE 8</td>
<td>8T</td>
</tr>
<tr>
<td></td>
<td>Manual Override</td>
<td>M</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>None (Blank)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Terminations**

- **DS** Dual Spades
- **DG** DIN 43650
- **DL** Leadwires (2)
- **DL/W** Leads w/Weatherpak® Connectors
- **DR** Deutsch DT04-2P

**Voltage**

- 0 Less Coil
- 12 12 VDC
- 24 24 VDC

**Seals**

- **N** Buna N (Std.)
- **V** Fluorocarbon

**DIMENSIONS**

[Diagram with dimensions and tolerances]
ZL70-33 Proportional, Bi-Directional Flow Control

DESCRIPTION
A solenoid-operated, electrically-variable, three-port, pressure-compensated, spool-type, normally closed when de-energized, proportional, bi-directional, priority-type flow control valve. An internal compensator spool provides compensated flow across the proportional orifice regardless of flow direction.

OPERATION
The ZL70-33 provides regulated flow from port ➀ to port ➂ with bypass at port ➁; or regulated flow from port ➂ to port ➁ with port ➀ blocked externally, typically with a check valve (see symbol drawing). Regulated flow is proportional to electric current applied to the solenoid.

Application Notes: The ZL70-33 may be used for single-acting cylinder applications where lowering is provided by gravity force. A minimum load (defined on performance curve as minimum pressure at port ➂) is required for uninterrupted lowering.

The hydraulic circuit must include a check valve and a poppet-type solenoid valve (SV08-20 type) connected as shown on the circuit symbol and placed close to the ZL70-33 valve, if possible in the same manifold. See Application Guide.

Operation of Manual Override: To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift. To Disengage: Turn counterclockwise approximately 6 turns until positive stop is found.

FEATURES
- Excellent linearity and hysteresis.
- Efficient wet armature construction.
- Hardened spool and cage for long life.
- Manual Override option.
- Optional coil voltages and terminations.

RATINGS
Maximum Operating Pressure: 240 bar (3500 psi)
Regulated Flow: Range A: 0–19 lpm (0–5.0 gpm); Range B: 0–9.5 lpm (0–2.5 gpm)
Input Flow: Range A: 0–25.5 lpm (0–6.5 gpm); Range B: 0–15 lpm (0–4.0 gpm)
Internal Leakage: 0.38 lpm (0.10 gpm) maximum at zero current

Temperature: -40 to 120°C with Buna N seals
Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
Installation: No restrictions; See page 9.020.1.
Cavity: VC10-L3; See page 9.110.1; Cavity Tool: CT10-3X-XX; See page 8.600.1
Seal Kit: SK10-3X-MM; See page 8.650.1

Recommended Controllers (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig. w/12V Coil</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>7114950</td>
<td>4000046</td>
<td>4000049</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000070</td>
<td>4000141</td>
<td>4000124</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000123</td>
<td>4000143</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input Sig. w/24V Coil</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000161</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000165</td>
<td>4000141</td>
<td>4000124</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000169</td>
<td>4000143</td>
<td>4000130</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>
### Cartridge:
- Weight: 0.32 kg (0.7 lbs)
- Steel with hardened work surfaces
- Zinc-plated exposed surfaces
- Buna N O-rings and polyester elastomer back-ups standard

### Standard Ported Body:
- Weight: 0.59 kg (1.3 lbs)
- Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi)
- Steel and ductile iron bodies available; dimensions may differ; consult factory.

### PV70 Series Coil:
- Weight: 0.32 kg (0.7 lbs)
- Unitized thermoplastic encapsulated, Class H high temperature magnet-wire
- Standard Ported Body: See page 8.010.1

### FLOW RANGE "B"
- Regulated Flow vs. Current
- Flow: 15 lpm/4.0 gpm
- 12V Coil; 110 Hz PWM
- 32 cSt/150 sus oil at 40°C

### PERFORMANCE (continued)

### DIMENSIONS
- U.S. Patent 6,116,263

### MATERIALS
- Cartridge: Weight: 0.32 kg (0.7 lbs)
- Standard Ported Body: Weight: 0.59 kg (1.3 lbs)
- PV70 Series Coil: Weight: 0.32 kg (0.7 lbs)

### TO ORDER
- ZL70-33
- Range:
  - 0–19 lpm (0–5.0 gpm) A
  - 0–9.5 lpm (0–2.5 gpm) B
- Option(s):
  - None (Blank) M
- Porting:
  - Cartridge Only 0
  - SAE 6 6T
  - SAE 8 8T
- Terminations:
  - DS Dual Spades
  - DG DIN 43650
  - DL Leadwires (2)
  - DL/W Leads w/Weatherpak® Connectors
  - DR Deutsch DT04-2P
- Voltage:
  - 0 Less Coil
  - 12 12 VDC
  - 24 24 VDC
- Seals:
  - N Buna N (Std.)
  - V Fluorocarbon

Coils with internal diode are available. Consult factory.
DESCRIPTION
A solenoid-operated, electrically-variable, three-port, pressure-compensated, spool-type, normally closed when de-energized, proportional, bi-directional, priority-type flow control valve. An internal compensator spool provides compensated flow across the proportional orifice regardless of flow direction.

OPERATION
The ZL72-33 provides regulated flow from port ① to port ③ with bypass at port ②; or regulated flow from port ③ to port ② with port ① blocked externally, typically with a check valve (see symbol drawing). Regulated flow is proportional to electric current applied to the solenoid.

Application Notes: The ZL72-33 may be used for single-acting cylinder applications where lowering is provided by gravity force. A minimum load (defined on performance curve as minimum pressure at port ③) is required for uninterrupted lowering.

The hydraulic circuit must include a check valve and a poppet-type solenoid valve connected as shown on the circuit symbol and placed close to the ZL72-33 valve, if possible in the same manifold. Consult factory.

Operation of Manual Override: To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift. To Disengage: Turn counterclockwise approximately 6 turns until positive stop is found.

FEATURES
• Excellent linearity and hysteresis characteristics.
• Hardened spool and cage for long life.
• Efficient wet armature construction.
• Optional coil voltages and terminations.

• Cartridges voltage interchangeable.
• Unitized, molded coil design.
• Coil waterproofing standard.
• Manual override option.

RATINGS
- Maximum Operating Pressure: 240 bar (3500 psi)
- Regulated Flow: 0–50 lpm (0–13 gpm)
- Internal Leakage: 0.38 lpm (0.10 gpm) maximum at 0 current
- Electrical: 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current</th>
<th>Max. Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>250 ± 100 mA</td>
<td>1500 ± 200 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>125 ± 50 mA</td>
<td>750 ± 100 mA</td>
</tr>
</tbody>
</table>

- Temperature: -40 to 120°C with Buna N seals
- Filtration: See page 9.010.1
- Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
- Installation: No restrictions; See page 9.020.1.
- Cavity: VC12-3; See page 9.112.1; Cavity Tool: CT12-3X-XX; See page 8.600.1
- Seal Kit: SK12-3X-MM; See page 8.650.1

PERFORMANCE

Regulated Flow vs. Current
240 bar/3500 psi; 12V Coil; 110 Hz PWM
32 cSt/150 ssu oil at 40°C

Regulated Flow vs. Pressure Drop
240 bar/3500 psi; 12V Coil; 110 Hz PWM
32 cSt/150 ssu oil at 40°C

Recommended Controllers (See Section 3)
**Compatable with**

**ZL72-33**

**MATERIALS**

**Cartridge:** Weight: 0.34 kg. (0.7 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 0.98 kg. (2.15 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.012.1. Steel and ductile iron bodies available; dimensions may differ; consult factory.

**Coil:** Weight: 0.32 kg. (0.7 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.1.

**DIMENSIONS**

U.S. Patent 6,116,263

**TO ORDER**

**Option(s)**

None (Blank)  M

**Porting**

Cartridge Only  0  10T  12T  16T

**Terminations**

DS  Dual Spades
DG  DIN 43650
DL  Leadwires (2)
DL/W  Leads w/Weatherpak® Connectors
DR  Deutsch DT04-2P

**Voltage**

0  Less Coil  12  12 VDC  24  24 VDC

**Seals**

N  Buna N (Std.)  V  Fluorocarbon

**Note:**

Coils with internal diode are available. Consult factory.
**ELECTRO-PROPORTIONAL VALVES—FLOW CONTROL**

### ZL70-36 Proportional, Bi-Directional Flow Control

**DESCRIPTION**
A solenoid-operated, electrically-variable, three-port, pressure-compensated, spool-type, normally closed when de-energized, proportional, bi-directional, priority-type flow control valve.

**OPERATION**
The ZL70-36 provides priority regulated flow from port ➀ to port ➂ with bypass at port ➁; or regulated flow from port ➂ to port ➁ with port ➀ blocked externally, typically with a check valve (see symbol drawing). Regulated flow is proportional to electric current applied to the solenoid.

**Application Notes:**
The ZL70-36 may be used for single-acting cylinder applications where lowering is provided by gravity force. The ZL70-36 has no minimum load restrictions provided the load is enough to overcome cylinder friction and other frictions in the system. At low loads, the lowering speed can be slower than at heavier load if pressure drop is less than the compensation value of the valve.

The hydraulic circuit must include a check valve and a poppet-type solenoid valve (SV08-20 type) connected as shown on the circuit symbol and placed close to the ZL70-36 valve, if possible in the same manifold. See Application Guide.

**Operation of Manual Override:**
To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift. To Disengage: Turn counterclockwise approximately 6 turns until positive stop is found.

**FEATURES**
- Excellent linearity and hysteresis.
- Efficient wet armature construction.
- Hardened spool and cage for long life.
- Manual Override option.
- Optional coil voltages and terminations.

**RATINGS**
- **Maximum Operating Pressure:** 240 bar (3500 psi)
- **Regulated Flow:** Range A: 0–19 lpm (0–5.0 gpm); Range B: 0–9.5 lpm (0–2.5 gpm)
- **Input Flow:** Range A: 0–25.5 lpm (0–6.5 gpm); Range B: 0–15 lpm (0–4.0 gpm)
- **Internal Leakage:** 0.38 lpm (0.10 gpm) maximum at zero current

**Electrical:**
- 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current</th>
<th>Max. Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 V DC</td>
<td>300 ± 100 mA</td>
<td>1400 ± 100 mA</td>
</tr>
<tr>
<td>24 V DC</td>
<td>150 ± 50 mA</td>
<td>700 ± 50 mA</td>
</tr>
</tbody>
</table>

**Temperature:** -40 to 120°C with Buna N seals

**Filtration:** See page 9.010.1

**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)

**Installation:** No restrictions; See page 9.020.1.

**Cavity:** VC10-L3; See page 9.110.1; **Cavity Tool:** CT10-3X-XX; See page 8.600.1

**Seal Kit:** SK10-3X-MM; See page 8.650.1

**PERFORMANCE**

**FLOW RANGE “A”**
Regulated Flow vs. Current
Input Flow: 24.6 lpm/6.5 gpm; Port ➀ to 207 bar/3000 psi at Port 3
Input Flow: 24.5 lpm/6.5 gpm; Port ➀ to Tank
12V Coil; 110 Hz PWM; 32 cSt/150 sus oil at 40°C

**FLOW RANGE “A”**
Regulated Flow vs. Pressure
Inlet Flow: 24.5 lpm/6.5 gpm; Port ➀ to Tank
12V Coil; 110 Hz PWM; 32 cSt/150 sus oil at 40°C

**Threshold**
- 1.4 amp
- 1.0 amp
- 0.8 amp
- 0.5 amp

**Recommended Controllers** (See Section 3)

- **Input Sig. w/12V Coil**
  - 0-5 VDC: 4000046, 4000049, 4000136
  - 0-10 VDC: 4000070, 4000141, 4000124, 4000137
  - 4-20 mA: 4000143, 4000130, 4000139
  - PWM: 4000144, 4000133, 4000140

- **Input Sig. w/24V Coil**
  - 0-5 VDC: 4000161, 4000194, 4000174, 4000136
  - 0-10 VDC: 4000165, 4000141, 4000182, 4000137
  - 4-20 mA: 4000169, 4000143, 4000186, 4000139
  - PWM: 4000144, 4000133, 4000140
**Cartridge:** Weight: 0.32 kg. (0.7 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 0.59 kg. (1.3 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.010.1. Steel and ductile iron bodies available; dimensions may differ; consult factory.

**PV70 Series Coil:** Weight: 0.32 kg. (0.7 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.7.

**MATERIALS TO ORDER**

**ZL70-36**

**PERFORMANCE** (continued)

**FLOW RANGE “B”**
Regulated Flow vs. Current
Input Flow: 15 lpm/4.0 gpm
Port ② connected to Tank
① to ③ 207 bar/3000 psi at Port 3
② to ③ 240 bar/3500 psi at Port 3
12V Coil; 110 Hz PWM
32 cSt/150 sus oil at 40°C

**FLOW RANGE “B”**
Regulated Flow vs. Pressure
Inlet Flow: 15 lpm/4.0 gpm
Port ② connected to Tank
① to ③ 207 bar/3000 psi at Port 3
② to ③ 240 bar/3500 psi at Port 3
12V Coil; 110 Hz PWM
32 cSt/150 sus oil at 40°C

**DIMENSIONS**
U.S. Patent 6,116,263

**TO ORDER**

**ZL70-36**

<table>
<thead>
<tr>
<th>Range</th>
<th>Option(s)</th>
<th>Porting</th>
<th>Voltage</th>
<th>Seals</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–19 lpm</td>
<td>Manual Override</td>
<td>Cartridge Only</td>
<td>0</td>
<td>N</td>
</tr>
<tr>
<td>(0–5.0 gpm)</td>
<td>M</td>
<td>SAE 6 6T</td>
<td>12</td>
<td>Buna N (Std.)</td>
</tr>
<tr>
<td>0–9.5 lpm</td>
<td></td>
<td>SAE 8 8T</td>
<td>24</td>
<td>Fluorocarbon</td>
</tr>
<tr>
<td>(0–2.5 gpm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Terminations**

- DS Dual Spades
- DG DIN 43650
- DL Leadwires (2)
- DL/W Leads w/Weatherpak® Connectors
- DR Deutsch DT04-2P

**Voltage**

- 0 Less Coil
- 12 12 VDC
- 24 24 VDC

**Seals**

- N Buna N (Std.)
- V Fluorocarbon

**Pressures bar/psi**

- 103
- 1500
- 172
- 2500
- 242
- 35
- 500

**Flows lpm/gpm**

- 13.2/3.5
- 11.4/3.0
- 9.4/2.5
- 7.6/2.0
- 5.7/1.5
- 3.8/1.0
- 1.9/0.5

**Porting**

- Cartridge Only
- SAE 6
- SAE 8

**Porting Across Flats**

- 1.06
- 27.0

**Torque:**

- 10–12 ft-lbs
- 14–16 Nm

**Dimensions**

- Inch
- Millimetre

**U.S. Patent 6,116,263**

**Regulated Flow vs. Current**

- 10–12 lpm/3.5 gpm
- 0–9.5 lpm/2.5 gpm

**Regulated Flow vs. Pressure**

- 103
- 1500
- 172
- 2500
- 242
- 35
- 500

**Pressure bar/psi**

- 103
- 1500
- 172
- 2500
- 242
- 35
- 500

**Flow lpm/gpm**

- 13.2/3.5
- 11.4/3.0
- 9.4/2.5
- 7.6/2.0
- 5.7/1.5
- 3.8/1.0
- 1.9/0.5

**Torque:**

- 10–12 ft-lbs
- 14–16 Nm

**Manual Override Option**
**ZL72-36 Proportional, Bi-Directional Flow Control,**

**DESCRIPTION**
A solenoid-operated, electrically-variable, three-port, pressure-compensated, spool-type, normally closed when de-energized, proportional, bi-directional, priority-type flow control valve.

**OPERATION**
The ZL72-36 provides priority regulated flow to port ➂ with input at port ➀, and bypass at port ➁; or regulated flow from port ➂ to port ➁ with input at port ➀ blocked. Regulated flow is proportional to electric current applied to the solenoid.

**Application Notes:** The ZL72-36 may be used for single-acting cylinder applications where lowering is provided by gravity force. There are no minimum load restrictions, provided the load is enough to overcome cylinder friction and other frictions in the system. At low load the lowering speed can be slower than at heavier load if pressure drop is less than the compensation value of the valve.

The hydraulic circuit must include a check valve and a poppet-type solenoid valve (SV10-20 type) connected as shown on the circuit symbol and placed close to the ZL72-36 valve, if possible in the same manifold. See Application Guide.

**Operation of Manual Override:** To Engage: Turn clockwise approximately 1 turn to reach start point. Continue another approximately 5 turns to full shift. To Disengage: Turn counterclockwise approximately 6 turns until positive stop is found.

**FEATURES**
- Excellent linearity and hysteresis.
- Optional coil voltages and terminations.
- Hardened spool and cage for long life.
- Manual override option.
- Efficient wet armature construction.

**RATINGS**
- **Maximum Operating Pressure:** 240 bar (3500 psi)
- **Regulated Flow:** 0-45 lpm (0-12 gpm)
- **Internal Leakage:** 0.38 lpm (0.10 gpm) at zero current

**Electrical:** 2 standard voltage ratings

<table>
<thead>
<tr>
<th>Coil Voltage</th>
<th>Threshold Current</th>
<th>Max. Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 VDC</td>
<td>300 ± 100 mA</td>
<td>1600 ± 100 mA</td>
</tr>
<tr>
<td>24 VDC</td>
<td>150 ± 50 mA</td>
<td>800 ± 50 mA</td>
</tr>
</tbody>
</table>

- **Temperature:** -40 to 120°C with Buna N seals
- **Filtration:** See page 9.010.1
- **Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
- **Installation:** No restrictions; See page 9.020.1
- **Cavity:** VC12-3; See page 9.112.1; **Cavity Tool:** CT12-3X-XX; See page 8.600.1
- **Seal Kit:** SK12-3X-MM; See page 8.650.1

**PERFORMANCE**

**Regulated Flow vs. Current**
Inlet Flow: 57 lpm/15 gpm
Port ➁ to ➂, 207 bar/3000 psi at ➃
12V Coil; 110 Hz PWM
32 cSt/150 ssu oil at 40°C

**Regulated Flow vs. Pressure**
Inlet Flow: 57 lpm/15 gpm
Port ➁ to ➂, 12 bar/psi
12V Coil; 110 Hz PWM
32 cSt/150 ssu oil at 40°C
**MATERIALS**

**Cartridge:** Weight: 0.34 kg. (0.7 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 0.98 kg. (2.15 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.012.1. Steel and ductile iron bodies available; dimensions may differ; consult factory.

**Coil:** Weight: 0.32 kg. (0.7 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.1.

**DIMENSIONS**

U.S. Patent 6,116,263

**TO ORDER**

<table>
<thead>
<tr>
<th>Option(s)</th>
<th>ZL72-36</th>
</tr>
</thead>
<tbody>
<tr>
<td>None (Blank)</td>
<td>Manual Override M</td>
</tr>
</tbody>
</table>

**Porting**

Cartridge Only

<table>
<thead>
<tr>
<th>Porting</th>
<th>0</th>
<th>10T</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAE 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAE 12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAE 16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Terminations (VDC)**

<table>
<thead>
<tr>
<th>Voltage</th>
<th>0</th>
<th>12</th>
<th>24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less Coil</td>
<td>12 VDC</td>
<td>24 VDC</td>
<td></td>
</tr>
</tbody>
</table>

**Seals**

<table>
<thead>
<tr>
<th>Seals</th>
<th>N</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buna N (Std.)</td>
<td></td>
<td>Fluorocarbon</td>
</tr>
</tbody>
</table>

**TORQUE:**

- Manual Override: 10–12 ft-lbs max. (14–16 Nm)
- cartridge only: 35 ft-lbs max. (47.4 Nm)

**MANUAL OVERRIDE OPTION**

Coils with internal diode are available. Consult factory.
**DESCRIPTION**
A screw-in, cartridge-style, direct acting, poppet-type hydraulic relief valve, which can be infinitely adjusted across a prescribed range using a variable electric input. Pressure output is proportional to DC current input. This valve is intended for use as a pressure limiting device in demanding applications.

**OPERATION**
The TS08-20 blocks flow from ➀ to ❼ until sufficient pressure is present at ➀ to offset the electrically induced solenoid force. With no current applied to the solenoid, the valve will free flow from ➀ to ❼.

Note: Back pressure on port ❼ becomes additive to the pressure setting at a 1:1 ratio.

**FEATURES**
- 12 and 24 volt coils standard.
- Optional waterproof E-Coils rated up to IP69K.
- Industry common cavity.
- Waterproofed coils standard.

**RATINGS**
- Maximum Inlet Pressure: 34.5 bar (500 psi)
- Maximum Control Current: 0.65 amps for 12 VDC coil; 0.33 amps for 24 VDC coil
- Control Signal: DC or PWM (Significant improvements in valve performance occur with superimposed dither, with either control method.)
- Dither Frequency: 250 Hz or higher
- Hysteresis with Dither 250 Hz: 3.0% (7% maximum without dither)
- Operational Relief Pressure Range from Zero to Maximum Control Current:
  - A: 0–34.5 bar (0–500 psi); B: 0–20.7 bar (0–300 psi)
- Rated Flow: A: 3.8 lpm/1 gpm @ 1.4 bar/20 psi pressure drop
  - B: 3.8 lpm/1 gpm @ 0.8 bar/12 psi pressure drop
- Step Response: $T_{on} < 27$ ms; $T_{off} < 50$ ms
- Flow Path: Free Flow: ➀ to ❼ coil de-energized; Relieving: ➀ to ❼ coil energized
- Temperature: -40 to 120°C (-40 to 250°F) with standard Buna N seals
- Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
- Installation Recommendation: When possible, the valve should be mounted below the reservoir oil level. This will maintain oil in the armature preventing trapped air instability. If this is not feasible, mount the valve horizontally for best results.
- Cavity: VC08-2; See page 9.108.1; Cavity Tool: CT08-2XX; See page 8.600.1
- Seal Kit: SK08-2X-B; See page 8.650.1
- Coil Nut: Part No. 7004410; For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut info.

**Symbols**

**USASI/ISO:**

**PERFORMANCE**

**Pressure Drop vs. Flow Characteristic**
For Flow ➀ to ❼ with Coil De-energized

**Relief Pressure vs. Flow Characteristic**
Typical Relieving Pressure ➀ to ❼ at Various %’s of Maximum Control Current
Pressure Range “A” (20.7 bar/300 psi); Cartridge in Body

**Recommended Controllers** (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig. w/12V or 24V Coil</th>
<th>DIN Coil Mount</th>
<th>PCB Board Mount</th>
<th>Metal Box Mount</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000161</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000165</td>
<td>4000141</td>
<td>4000182</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000169</td>
<td>4000143</td>
<td>4000186</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>
**MATERIALS**

**Cartridge:** Weight: 0.15 kg. (0.33 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 0.16 kg. (0.35 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.008.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

**Standard Coil:** Weight: 0.11 kg. (0.25 lbs.); Unitized, thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

**E-Coil:** Weight: 0.14 kg. (0.3 lbs.); Perfect wound, fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors; **Note:** See page 3.400.1 for all E-Coil retrofit applications.

---

**DIMENSIONS**

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Termination Std. Coil</th>
<th>Termination E-Coil</th>
<th>Porting</th>
<th>Seals</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>DS Dual Spades</td>
<td>ER Deutsch DT04-2P</td>
<td>Cartridge Only</td>
<td>Buna N (Std.)</td>
</tr>
<tr>
<td>10</td>
<td>DG DIN 43650</td>
<td>EY Metri-Pack® 150</td>
<td>SAE 6 6T</td>
<td>Fluorocarbon</td>
</tr>
<tr>
<td>12</td>
<td>DL Leadwires (2)</td>
<td></td>
<td>SAE 8 8T</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DR Deutsch DT04-2P (IP69K Rated)</td>
<td></td>
<td>3/8 in. BSP* 3B</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1/2 in. BSP* 4B</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td>*BSP Body; U.K. Mfr. Only</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Seals**

- Buna N (Std.)
- Fluorocarbon

**Voltage**

- 0: Less Coil
- 10 VDC (0.80 amps max.)
- 12 VDC (0.65 amps max.)
- 20 VDC (0.40 amps max.)
- 24 VDC (0.33 amps max.)

**E-Coil**

Ratings: Coils with internal diode are available. Consult factory.
DESCRIPTION
A screw-in, cartridge-style, direct acting, poppet-type hydraulic relief valve, which can be infinitely adjusted across a prescribed range using a variable electric input. Pressure output is proportional to DC current input. This valve is intended for use as a pressure limiting device in demanding applications.

OPERATION
The TS38-20 blocks flow from ➀ to ⃣ until sufficient pressure is present at ➀ to offset the electrically induced solenoid force. With no current applied to the solenoid, the valve will free flow from ➀ to ⃣.

Note: Back pressure on port ⃣ becomes additive to the pressure setting at a 1:1 ratio.

FEATURES
• Airbleed standard.
• 12 and 24 volt coils standard.
• Industry common cavity.

RATINGS
Maximum Port Pressure: 241 bar (3500 psi)
Maximum Control Current: 1.10 amps for 12 VDC coil; 0.55 amps for 24 VDC coil
Control Signal: DC or PWM (Significant improvements in valve performance occur with superimposed dither, with either control method.)
Dither Frequency: 150 Hz or higher
Hysteresis with Dither 250 Hz: 3.3% (7% maximum without dither)
Operational Relief Pressure Range from Zero to Maximum Control Current:
A: 0–207 bar (0–3000 psi); B: 0–138 bar (0–2000 psi); C: 0–69 bar (0–1000 psi)
Rated Flow: AS: 11.4 lpm/3 gpm @ 20 bar/290 psi pressure drop
BS: 11.4 lpm/3 gpm @ 10 bar/150 psi pressure drop
CS: 11.4 lpm/3 gpm @ 5.5 bar/80 psi pressure drop
Step Response: TON <50 ms; TOFF <7 ms
Flow Path: Free Flow: ➀ to ⃣ coil de-energized; Relieving: ➀ to ⃣ coil energized
Temperature: -40 to 120°C (-40 to 250°F) with standard Buna N seals
Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
Installation Recommendation: When possible, the valve should be mounted below the reservoir oil level. This will maintain oil in the armature preventing trapped air instability. If this is not feasible, mount the valve horizontally for best results.
Cavity: VC08-2; See page 9.108.1; Cavity Tool: CT08-2XX; See page 8.600.1
Seal Kit: SK08-2X-B; See page 8.650.1
Coil Nut: Part No. 4540560; For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut info.

Recommended Controllers (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig. w/12V or 24V Coil</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000161</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000165</td>
<td>4000141</td>
<td>4000186</td>
<td>4000139</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000169</td>
<td>4000143</td>
<td>4000133</td>
<td>4000140</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Typical Relief Pressure vs. Flow Characteristic
Typical Relieving Pressure ➀ to ⃣
Pressure Range A: (207 bar/3000 psi);
B: (138 bar/2000 psi); C: (69 bar/1000 psi); Cartridge in Body
**MATERIALS**

**Cartridge:** Weight: 0.25 kg. (0.55 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 0.16 kg. (0.35 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.008.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

**Standard Coil:** Weight: 0.32 kg. (0.7 lbs.); Unitized, thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

**E-Coil:** Weight: 0.41 kg. (0.9 lbs.); Fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors; **Note:** See page 3.400.1 for all E-Coil retrofit applications.

---

**TO ORDER**

**TS38-20**

**Maximum Relief Pressure**
- AS 207 bar (3000 psi)
- BS 138 bar (2000 psi)
- CS 69 bar (1000 psi)

<table>
<thead>
<tr>
<th>Option</th>
<th>Termination Std. Coil</th>
</tr>
</thead>
<tbody>
<tr>
<td>None (Blank)</td>
<td>DS Dual Spades</td>
</tr>
<tr>
<td>Manual Override</td>
<td>DG DIN 43650</td>
</tr>
<tr>
<td></td>
<td>DL Leadwires (2)</td>
</tr>
<tr>
<td></td>
<td>DL/W Leads w/Weatherpak® Connectors</td>
</tr>
<tr>
<td></td>
<td>DR Deutsch DT04-2P</td>
</tr>
</tbody>
</table>

**Termination E-Coil**
- ER Deutsch DT04-2P (IP69K Rated)
- EY Metri-Pack® 150 (IP69K Rated)

**Voltage**
- 0 Less Coil
- 10 VDC (1.30 amps max.)
- 12 VDC (1.10 amps max.)
- 20 VDC (0.65 amps max.)
- 24 VDC (0.55 amps max.)

**Seals**
- Buna N (Std.) N
- Fluorocarbon V

**Porting**
- Cartridge Only 0
- SAE 6 6T
- SAE 8 8T
- 3/8 in. BSP* 3B
- 1/2 in. BSP* 4B

*BSP Body; U.K. Mfr. Only
**TS38-21 Proportional Electric Relief Valve**

**DESCRIPTION**
A screw-in, cartridge-style, single-stage, poppet-type pressure relieving valve, which can be infinitely adjusted across a prescribed range using a variable electric input. Pressure output is inversely proportional to DC current input.

**OPERATION**
The TS38-21 blocks flow from Port ① to ② until sufficient pressure is present at Port ① to open the valve by overcoming the preset spring force. With no current applied, the valve will relieve at ±50 psi of the spring maximum. Applying current to the coil reduces the induced spring force thereby reducing the valve setting.

**FEATURES**
- 12 and 24 volt coils standard.
- Optional waterproof E-Coils rated up to IP69K.
- Industry common cavity.
- Hardened parts for long life.

**RATINGS**
- Maximum Operating Pressure: 240 bar (3500 psi)
- Maximum Control Current: 1.10 amps for 12 VDC coil; 0.55 amps for 24 VDC coil
- Relief Pressure Range from Zero to Maximum Control Current:
  - Minimum Pressure is factory adjustable.
  - (A) 207–6.9 bar (3000–100 psi)
  - (B) 138–6.9 bar (2000–100 psi)
  - (C) 69–6.9 bar (1000–100 psi)
- Rated Flow: 1.1 lpm/0.3 gpm; ΔP = 10 bar (150 psi), cartridge only, ① to ② coil energized
- Flow Path: Free Flow: ① to ② coil energized; Relieving: ① to ② coil de-energized
- Temperature: -40 to 120°C (-40 to 250°F) with standard Buna N seals
- Filtration: See page 9.010.1
- Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
- Installation Recommendation: When possible, the valve should be mounted below the reservoir oil level. This will maintain oil in the armature preventing trapped air instability. If this is not feasible, mount the valve horizontally for best results.
- Cavity: VC08-2; See page 9.108.1; Cavity Tool: CT08-2XX; See page 8.600.1
- Seal Kit: SK08-2X-B; See page 8.650.1
- Coil Nut: Part No. 4540550; For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut info.

**PERFORMANCE**

**PRESSURE DROP VS. FLOW CHARACTERISTIC**
Flow from Port ① to Port ② with Coil Energized
Body and Line Pressure Drop: 0.34 bar/5 psi at 1.90 lpm/0.5 gpm

**TYPICAL RELIEF PRESSURE VS. FLOW CHARACTERISTIC**
Typical Relieving Pressure Port ① to Port ②
No Current Applied; Cartridge in Body
**MATERIALS**

**Cartridge:** Weight: 0.25 kg. (0.55 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 0.16 kg. (0.35 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.008.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

**Standard Coil:** Weight: 0.32 kg. (0.7 lbs.); Unitized, thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

**E-Coil:** Weight: 0.41 kg. (0.9 lbs.); Fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors; Note: See page 3.400.1 for all E-Coil retrofit applications.

**TO ORDER**

**TS38-21**

<table>
<thead>
<tr>
<th>Maximum Operating Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>207 bar (3000 psi) A</td>
</tr>
<tr>
<td>138 bar (2000 psi) B</td>
</tr>
<tr>
<td>69 bar (1000 psi) C</td>
</tr>
</tbody>
</table>

**Porting**

<table>
<thead>
<tr>
<th>Cartridge Only</th>
<th>SAE 6</th>
<th>SAE 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>6T</td>
<td>8T</td>
</tr>
<tr>
<td>3/8 in. BSP*</td>
<td>3B</td>
<td>1/2 in. BSP*</td>
</tr>
<tr>
<td>4B</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* BSP Body; U.K. Mfr. Only

**Seals**

<table>
<thead>
<tr>
<th>Buna N (Std.)</th>
<th>Fluorocarbon</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>V</td>
</tr>
</tbody>
</table>

**Voltage**

<table>
<thead>
<tr>
<th>0</th>
<th>10 VDC (1.30 amps max.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>12 VDC (1.10 amps max.)</td>
</tr>
<tr>
<td>20</td>
<td>20 VDC (0.65 amps max.)</td>
</tr>
<tr>
<td>24</td>
<td>24 VDC (0.55 amps max.)</td>
</tr>
</tbody>
</table>

**Termination Std. Coil**

<table>
<thead>
<tr>
<th>DS</th>
<th>Dual Spades</th>
</tr>
</thead>
<tbody>
<tr>
<td>DG</td>
<td>DIN 43650</td>
</tr>
<tr>
<td>DL</td>
<td>Leadwires (2)</td>
</tr>
<tr>
<td>DL/W</td>
<td>Leads w/Weatherpack® Connectors</td>
</tr>
<tr>
<td>DR</td>
<td>Deutsch DT04-2P</td>
</tr>
</tbody>
</table>

**Termination E-Coil**

| ER | Deutsch DT04-2P (IP69K Rated) |
|    | EY | Metri-Pack® 150 (IP69K Rated) |

Coils with internal diode are available. Consult factory.
TS58-21F Proportional Electric Relief Valve

DESCRIPTION
A screw-in, cartridge-style, single-stage, poppet-type pressure relieving valve, which can be infinitely adjusted across a prescribed range using a variable electric input. Pressure output is inversely proportional to DC current input.

OPERATION
The TS58-21F blocks flow from ① to ② until sufficient pressure is present at ① to open the valve by overcoming the preset spring force. With no current applied, the valve will relieve at ±50 psi of the spring maximum. Applying current to the coil reduces the induced spring force thereby reducing the valve setting.

FEATURES
• 12 and 24 volt coils standard.
• Optional waterproof E-Coils rated up to IP69K.
• Industry common cavity.
• Hardened parts for long life.

RATINGS
Maximum Operating Pressure: 393 bar (5700 psi)
Maximum Control Current: 1.30 amps for 12 VDC coil; 0.65 amps for 24 VDC coil
Relief Pressure Range from Zero to Maximum Control Current:
344.7–6.9 bar (5000–100 psi)
Rated Flow: 1.9 lpm/0.5 gpm; ΔP = 6.9 to 9 bar (100 to 130 psi), cartridge only, ① to ② coil energized
Flow Path: Free Flow: ① to ② coil energized; Relieving: ① to ② coil de-energized
Temperature: -40° to 100°C (-40° to 212° F) with standard Buna N seals
-26° to 204°C (-15° to 400°F) with Fluorocarbon seals;
-54° to 104°C (-65° to 225°F) with Polyurethane seals
Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 sus); See Temperature and Oil Viscosity page 9.060.1
Installation Recommendation: When possible, the valve should be mounted below the reservoir oil level. This will maintain oil in the armature preventing trapped air instability. If this is not feasible, mount the valve horizontally for best results.
Cavity: VC08-2; See page 9.108.1; Cavity Tool: CT08-2XX; See page 8.600.1
Seal Kit: SK08-2X-B; See page 8.650.1
Coil Nut: Part No. 4540550

PERFORMANCE

Pressure Drop vs. Flow Characteristic
Flow from Port 1 to Port 2 with Coil Energized

Typical Relieving Pressure
Port 1 to Port 2; No Current Applied; Upper & Lower Limit

Performance info. continued on following page.
TS58-21F

PERFORMANCE (continued)

RELIEF PRESSURE vs. CURRENT 200 Hz PWM
Relieving Pressure Port 1 to Port 2 at 0.38 lpm/0.1 gpm

DIMENSIONS
U.S. Patent 6,267,350

TO ORDER

TS58-21F

MATERIALS

Cartridge: Weight: 0.16 kg. (0.35 lbs.)
Steel with hardened work surfaces.
Zinc-plated exposed surfaces.
Buna N O-rings and polyester elastomer back-ups standard.

Ported Body: Weight: 0.54 kg.
(1.2 lbs.), Ductile iron standard;
rated to 345 bar (5000 psi);
See page 8.008.1.

Standard Coil: Weight: 0.32 kg.
(0.7 lbs.) Unitized, thermoplastic encapsulated, Class H high
temperature magnetwire.
See page 3.200.1

E-Coil: Weight: 0.41 kg. (0.9 lbs.)
Fully encapsulated with rugged external metal shell; Rated up to
IP69K with integral connectors.
Note: See page 3.400.1 for all E-Coil retrofit applications.

TO ORDER

Recommended Electronic Controllers:
Model EFDR2 Multi-Input Fan Drive Controller.
For more information go to:
http://www.hydraforce.com/Electro/fandrive.htm
or
Recommended Electronic Controllers
catalog page 2.001.1 (Table 2)

Recommended Electronic Controllers:
Model EFDR2 Multi-Input Fan Drive Controller.
For more information go to:
http://www.hydraforce.com/Electro/fandrive.htm
or
Recommended Electronic Controllers
catalog page 2.001.1 (Table 2)

DIMENSIONS
U.S. Patent 6,267,350

Performance vs. Current 200 Hz PWM
Relieving Pressure Port 1 to Port 2 at 0.38 lpm/0.1 gpm

Recommended Electronic Controllers:
Model EFDR2 Multi-Input Fan Drive Controller.
For more information go to:
http://www.hydraforce.com/Electro/fandrive.htm
or
Recommended Electronic Controllers
catalog page 2.001.1 (Table 2)

Recommended Electronic Controllers:
Model EFDR2 Multi-Input Fan Drive Controller.
For more information go to:
http://www.hydraforce.com/Electro/fandrive.htm
or
Recommended Electronic Controllers
catalog page 2.001.1 (Table 2)

Recommended Electronic Controllers:
Model EFDR2 Multi-Input Fan Drive Controller.
For more information go to:
http://www.hydraforce.com/Electro/fandrive.htm
or
Recommended Electronic Controllers
catalog page 2.001.1 (Table 2)

Recommended Electronic Controllers:
Model EFDR2 Multi-Input Fan Drive Controller.
For more information go to:
http://www.hydraforce.com/Electro/fandrive.htm
or
Recommended Electronic Controllers
catalog page 2.001.1 (Table 2)
DESCRIPTION
A screw-in, cartridge-style, pilot-operated, spool-type hydraulic relief valve, which can be infinitely adjusted across a prescribed range using a variable electric input. Pressure output is proportional to DC current input. This valve is intended for use as a pressure limiting device in demanding applications.

OPERATION
The TS10-26 blocks flow from ➀ to ➁ until sufficient pressure is present at ➀ to open the pilot section by offsetting the electrically induced solenoid force. With no current applied to the solenoid, the valve will relieve at approximately 100 psi.

The TS10-26 has an optional manual override feature. This allows the valve to be set when the electric supply is lost. The manual setting is added to the electric setting, so when using the manual override feature to establish a minimum setting, care is required to prevent the system from becoming over-pressurized.

FEATURES
• Optional Manual Override with Airbleed.
• Optional waterproof E-Coils rated up to IP69K.
• 12 and 24 volt coils standard.
• Industry common cavity.

RATINGS
Maximum Operating Pressure: 241 bar (3500 psi)
Maximum Control Current: 1.10 amps for 12 VDC coil; 0.55 amps for 24 VDC coil
Relief Pressure Range from Zero to Maximum Control Current:
A: 6.9–207 bar (100–3000 psi)
B: 6.9–159 bar (100–2300 psi)
C: 6.9–117 bar (100–1700 psi)
Rated Flow: 94.6 lpm (25 gpm), ΔP=13.1 bar (190 psi), Cartridge only, ➀ to ② coil de-energized
Maximum Pilot Flow: 0.76 lpm (0.2 gpm)
Hysteresis: Less than 3%
Flow Path: Free Flow: ➀ to ② coil de-energized; Relieving: ➀ to ② coil energized
Temperature: -40 to 120°C (-40 to 250°F) with standard Buna N seals
Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
Installation Recommendation: When possible, the valve should be mounted below the reservoir oil level. This will maintain oil in the armature preventing trapped air instability. If this is not feasible, mount the valve horizontally for best results.
Cavity: VC10-2; See page 9.110.1; Cavity Tool: CT10-2XX; See page 8.600.1
Seal Kit: SK10-2N-B; See page 8.650.1
Coil Nut: Part No. 4540560;
For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut info.

Recommended Controllers (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>w/12V or 24V Coil</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000161</td>
<td>4000194</td>
<td>4000174</td>
<td>4000134</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000165</td>
<td>4000141</td>
<td>4000182</td>
<td>4000137</td>
<td>4000138</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000169</td>
<td>4000143</td>
<td>4000186</td>
<td>4000139</td>
<td>4000140</td>
</tr>
</tbody>
</table>
MATERIALS

Cartridge: Weight: 0.25 kg. (0.55 lbs.);
Steel with hardened work surfaces.
Zinc-plated exposed surfaces. Buna N
O-rings and polyester elastomer back-
ups standard. Optional polyurethane
seals with fluorocarbon back-up
recommended for pressures over
240 bar (3500 psi).

Standard Ported Body: Weight: 0.16 kg.
(0.35 lbs.); Anodized high-strength 6061
T6 aluminum alloy; rated to 240 bar
(3500 psi); See page 8.010.1. Ductile
iron and steel bodies available; dimen-
sions may differ; consult factory.

Standard Coil: Weight: 0.32 kg. (0.7 lbs.);
Unitized, thermoplastic encapsulated,
Class H high temperature magnetwire;
See page 3.200.1.

E-Coil: Weight: 0.41 kg. (0.9 lbs.); Fully
encapsulated with rugged external metal
shell; Rated up to IP69K with integral
connectors; Note: See page 3.400.1 for
all E-Coil retrofit applications.

TO ORDER

<table>
<thead>
<tr>
<th>Option</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>None (Blank)</td>
<td>0</td>
</tr>
<tr>
<td>Manual Override</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>24</td>
</tr>
</tbody>
</table>

Termination Std. Coil
- DS Dual Spades
- DG DIN 43650
- DL Leadwires (2)
- DL/W Leads w/Weatherpak® Connectors
- DR Deutsch DT04-2P

Termination E-Coil
- ER Deutsch DT04-2P (IP69K Rated)
- EY Metri-Pack® 150 (IP69K Rated)

Seals
- Buna N (Std.)
- Fluorocarbon

Patent Pending

CAUTION:
Manual override must
be fully backed out
(turn CCW using 3/16" hex key wrench) when
operating electrically.

INITIAL SETUP:
Before operating valve,
use the manual override
to manually set pressure
to 200 to 300 psi. Back
out bleed screw 2 to 4
rotations to allow all trapped
air to escape. Screw in the bleed
screw. Before operating electrically,
back out manual override (CCW)
until positive stop is reached.

Torque
7–10 ft-lbs
(9.5–13.6 Nm) max.
DESCRIPTION
A screw-in, cartridge-style, pilot-operated, spool-type hydraulic relief valve, which can be infinitely adjusted across a prescribed range using a variable electric input. Pressure output is proportional to DC current input. This valve is intended for use as a pressure limiting device in demanding applications.

OPERATION
The TS12-26 blocks flow from ➀ to ➁ until sufficient pressure is present at ➀ to open the pilot section by offsetting the electrically induced solenoid force. With no current applied to the solenoid, the valve will relieve at approximately 100 psi.

FEATURES
• Airbleed standard.
• Manual Override option.
• 12 and 24 volt coils standard.

RATINGS
Maximum Operating Pressure: 241 bar (3500 psi)
Maximum Control Current: 1.10 amps for 12 VDC coil; 0.55 amps for 24 VDC coil
Relief Pressure Range from Zero to Maximum Control Current:
A: 5.2–207 bar (75–3000 psi)
B: 3.4–138 bar (50–2000 psi)
C: 2.1–70 bar (30–1000 psi)
Rated Flow: 189 lpm (50 gpm); See Performance Charts
Maximum Pilot Flow: A: 1.9 lpm (.5 gpm); B: 1.3 lpm (.35 gpm); C: .9 lpm (.25 gpm)
Hysteresis: Less than 3%
Flow Path: Free Flow: ➀ to ➁ coil de-energized; Relieving: ➀ to ➁ coil energized
Temperature: -40 to 120°C (-40 to 250°F) with standard Buna N seals
Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)

Installation Recommendation: When possible, the valve should be mounted below the reservoir oil level. This will maintain oil in the armature preventing trapped air instability. If this is not feasible, mount the valve horizontally for best results.

Cavity: VC12-2; See page 9.112.1; Cavity Tool: CT12-2XX; See page 8.600.1
Seal Kit: SK12-2X-B; See page 8.650.1
Coil Nut: Part No. 4540560;
For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut info.
**Piloted Spool**

**INITIAL SETUP:**
Before operating valve, back out bleed screw 2 to 4 rotations to allow all trapped air to escape.
Then screw in the bleed screw.

**MATERIALS TO ORDER**

**Cartridge:** Weight: 0.56 kg (1.23 lbs.); Steel with hardened work surfaces.
Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight:
0.36 kg (0.80 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.012.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

**Standard Coil:** Weight:
0.32 kg (0.7 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.1.

**E-Coil:** Weight:
0.41 kg (0.9 lbs.); Fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors; Note: See page 3.400.1 for all E-Coil retrofit applications.

**DIMENSIONS**

**COIL MUST BE INSTALLED WITH LETTERING UP**

**TORQUE**
7–10 ft-lbs (9.5–13.6 Nm) max.

**Termination Std. Coil**
- DS Dual Spades
- DG DIN 43650
- DL Leadwires (2)
- DL/W Leads w/Weatherpack Connectors
- DR Deutsch DT04-2P
- ER Deutsch DT04-2P (IP69K Rated)
- EY Metri-Pack® 150 (IP69K Rated)

**Voltage**
- 0 Less Coil
- 10 10 VDC (1.30 amps max.)
- 12 12 VDC (1.10 amps max.)
- 20 20 VDC (0.65 amps max.)
- 24 24 VDC (0.55 amps max.)

**Seals**
- Buna N (Std.) N
- Fluorocarbon V

**TS12-26**

**Maximum Relief Pressure**
- 207 bar (3000 psi) A
- 140 bar (2000 psi) B
- 70 bar (1000 psi) C

**Option(s)**
- None (Blank)
- Manual Override M

**Porting**
- Cartridge Only 0
- SAE 10 10T
- SAE 12 12T
- 1/2 in. BSP* 4B
- 3/4 in. BSP* 6B

*BSP Body; U.K. Mfr. Only

**To Order**

- Termination Std. Coil
- Voltage
- Seals

**Patent Pending**
DESCRIPTION
A screw-in, cartridge-style, pilot-operated, spool-type pressure relief valve, which can be infinitely adjusted across a prescribed range using a variable electric input. Pressure output is inversely proportional to DC current input. This valve is intended for use as a pressure limiting device in demanding applications.

OPERATION
The TS08-27 blocks flow from ➀ to ➁ until sufficient pressure is present at ➀ to open the valve by overcoming the preset induced spring force. With no current applied, the valve will relieve at ±50 psi of the spring maximum. Applying current to the coil reduces the induced spring force thereby reducing the valve setting. The regulated pressure is inversely proportional to the input electrical current.

Note: This valve is ideal for hydraulic fan drive applications. Consult factory for electronic controllers specifically designed for fan drive applications.

FEATURES
• 12 and 24 volt coils standard.
• Industry common cavity.
• Hardened parts for long life.

RATINGS
Maximum Operating Pressure: 241 bar (3500 psi)
Maximum Control Current: 1.20 amps for 12 VDC coil; 0.60 amps for 24 VDC coil
Relief Pressure Range from Zero to Maximum Control Current:
Minimum Pressure is factory adjusted.
A: 207–4.1 bar (3000–60 psi)
B: 138–4.1 bar (2000–60 psi)
Rated Flow: 19 lpm/5 gpm; ΔP = 7.8 bar (113.3 psi) ±10%, cartridge only,
➀ to ➁ coil energized
Maximum Pilot Flow: 0.76 lpm (0.2 gpm)
Hysteresis: Less than 3%
Flow Path: Free Flow: ➀ to ➁ coil energized; Relieving: ➀ to ➁ coil de-energized
Pressure Rise: A: 40 psi/gpm; B: 50 psi/gpm; C: 28 psi/gpm
Temperature: -40 to 120°C (-40 to 250°F) with standard Buna N seals
Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
Installation Recommendation: When possible, the valve should be mounted below the reservoir oil level. This will maintain oil in the armature preventing trapped air instability. If this is not feasible, mount the valve horizontally for best results.
Cavity: VC08-2; See page 9.108.1; Cavity Tool: CT08-2XX; See page 8.600.1
Seal Kit: SK08-2X-B; See page 8.650.1

PERFORMANCE

PRESSURE DROP VS. FLOW CHARACTERISTIC
Flow from Port ➀ to Port ➁ with Coil Energized, at Maximum Set Current

TYPICAL RELIEF PRESSURE VS. FLOW CHARACTERISTIC
Typical Relieving Pressure Port ➀ to Port ➁; Cartridge in Body
PERFORMANCE

RELIEF PRESSURE vs. CURRENT (DC) CHARACTERISTIC
Relieving Pressure Port ➀ to Port ➁ 5.68 lpm (1.5 gpm) Flow using 12VDC Coil, 200 Hz PWM

% of MAXIMUM CONTROL CURRENT

PRESSURE (PSI) 3200 3000 2800 2600 2400 2200 2000 1800 1600 1400 1200 1000 800 600 400 200 0
CURRENT (AMPS) 0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2

Recommended Controllers (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000161</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000165</td>
<td>4000141</td>
<td>4000182</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000169</td>
<td>4000143</td>
<td>4000186</td>
<td>4000139</td>
</tr>
</tbody>
</table>

MATERIALS

Cartridge: Weight: 0.15 kg. (0.33 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

Standard Ported Body: Weight: 0.16 kg. (0.35 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.008.1. Steel and ductile iron bodies available; dimensions may differ; consult factory.

EHPR Series Coil: Weight: 0.11 kg. (0.25 lbs.); Unitized, thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

DIMENSIONS

U.S. Patent 6,267,350

TS08-27

Maximum Operating Pressure

A 207 bar (3000 psi)
B 138 bar (2000 psi)

Porting

Cartridge Only 0
SAE 6 6T
SAE 8 8T
3/8 in. BSP* 3B
1/2 in. BSP* 4B
* BSP Body; U.K. Mfr. Only

Terminations

DS Dual Spades
DG DIN 43650
DL Leadwires (2)
DL/W Leads w/Weatherpak® Connectors
DR Deutsch DT04-2P

Voltage

0 Less Coil
12 12 VDC (1.10 amps max.)
24 24 VDC (0.55 amps max.)

Seals

N Buna N (Std.)
V Fluorocarbon
DESCRIPTION
A screw-in, cartridge-style, pilot-operated, spool-type hydraulic relief valve, which can be infinitely adjusted across a prescribed range using a variable electric input. Pressure output is inversely proportional to DC current input. This valve is intended for use as a pressure limiting device in demanding applications.

OPERATION
The TS10-27 blocks flow from 1 to 2 until sufficient pressure is present at 1 to open the valve by overcoming the preset induced spring force. With no current applied, the valve will relieve at ±50 psi of the range maximum. Applying current to the coil decreases the induced spring force, thereby reducing the valve setting.

Note: This valve is ideal for hydraulic fan drive applications. Consult factory for electronic controllers specifically designed for fan drive applications.

FEATURES
• 12 and 24 volt coils standard.
• Industry common cavity.
• Optional waterproof E-Coils rated up to IP69K.

RATINGS
Maximum Operating Pressure: 241 bar (3500 psi)
Maximum Control Current: 1.10 amps for 12 VDC coil; 0.55 amps for 24 VDC coil

Relief Pressure Range from Zero to Maximum Control Current:
A: 207–10.3 bar (3000–150 psi)
B: 138–10.3 bar (2000–150 psi)
C: 69–10.3 bar (1000–150 psi)

Rated Flow: 75.7 lpm (20 gpm), ΔP=14.8 bar (215 psi), Cartridge only, 1 to 2 coil energized

Maximum Pilot Flow: 0.76 lpm (0.2 gpm)

Hysteresis: Less than 3%
Flow Path: Free Flow: 1 to 2 coil energized; Relieving: 1 to 2 coil de-energized

Temperature: -40 to 120°C (-40 to 250°F) with standard Buna N seals

Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)

Installation Recommendation: When possible, the valve should be mounted below the reservoir oil level. This will maintain oil in the armature preventing trapped air instability. If this is not feasible, mount the valve horizontally for best results.

Cavity: VC10-2; See page 9.110.1; Cavity Tool: CT10-2XX; See page 8.600.1
Seal Kit: SK10-2X-B; See page 8.650.1
Coil Nut: Part No. 4540550;
For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut info.
Piloted Spool

MATERIALS TO ORDER

**TS10-27**

2.862.2

**Maximum Relief Pressure**

- A: 207 bar (3000 psi)
- B: 138 bar (2000 psi)
- C: 69 bar (1000 psi)

**Porting**

- Cartridge Only
- SAE 6: 6T
- SAE 8: 8T
- 3/8 in. BSP: 3B
- 1/2 in. BSP: 4B

**Seals**

- Buna N (Std.): N
- Fluorocarbon: V

**Termination Std. Coil**

- DS: Dual Spades
- DG: DIN 43650
- DL: Leadwires (2)
- DL/W: Leads w/Weatherpack® Connectors
- DR: Deutsch DT04-2P

**Termination E-Coil**

- ER: Deutsch DT04-2P (IP69K Rated)
- EY: Metri-Pack® 150 (IP69K Rated)

**Voltage**

- 0: Less Coil
- 10: 10 VDC (1.30 amps max.)
- 12: 12 VDC (1.10 amps max.)
- 20: 20 VDC (0.65 amps max.)
- 24: 24 VDC (0.55 amps max.)

**Materials**

- **Cartridge:** Weight: 0.18 kg. (0.4 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard. Optional polyurethane seals with fluorocarbon back-up recommended for pressures over 240 bar (3500 psi).

- **Standard Ported Body:** Weight: 0.16 kg. (0.35 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.010.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

- **Standard Coil:** Weight: 0.27 kg. (0.6 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.1.

- **E-Coil:** Weight: 0.41 kg. (0.9 lbs.); Fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors; **Note:** See page 3.400.1 for all E-Coil retrofit applications.
**TS12-27  Proportional Electric Relief Valve**

**DESCRIPTION**
A screw-in, cartridge-style, pilot-operated, spool-type hydraulic relief valve, which can be infinitely adjusted across a prescribed range using a variable electric input. Pressure output is inversely proportional to DC current input. This valve is intended for use as a pressure limiting device in demanding applications.

**OPERATION**
The TS12-27 blocks flow from ➀ to ➁ until sufficient pressure is present at ➀ to open the pilot section by overcoming the induced spring force. Applying current to the coil proportionally decreases the pressure required to open the valve from ➀ to ➁.

Note: This valve is ideal for hydraulic fan drive applications. Consult factory for electronic controllers specifically designed for fan drive applications.

**FEATURES**
- Hardened parts for long life.
- 12 and 24 volt coils standard.
- Industry common cavity.
- Optional waterproof E-Coils rated up to IP69K.

**RATINGS**
- **Maximum Operating Pressure:** 241 bar (3500 psi)
- **Maximum Control Current:** 1.10 amps for 12 VDC coil; 0.55 amps for 24 VDC coil
- **Relief Pressure Range from Zero to Maximum Control Current:**
  - A: 207–10.34 bar (3000–150 psi)
  - B: 138–10.34 bar (2000–150 psi)
  - C: 69–10.34 bar (1000–150 psi)
- **Rated Flow:** 186.3 lpm (50 gpm), ➊ to ➋ coil energized
- **Maximum Pilot Flow:** 0.76 lpm (.2 gpm)
- **Hysteresis:** Less than 3%
- **Flow Path:** Free Flow: ➊ to ➋ coil energized; Relieving: ➊ to ➋ coil de-energized
- **Temperature:** -40 to 120°C (-40 to 250°F) with standard Buna N seals
- **Filtration:** See page 9.010.1
- **Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
- **Installation Recommendation:** When possible, the valve should be mounted below the reservoir oil level. This will maintain oil in the armature preventing trapped air instability. If this is not feasible, mount the valve horizontally for best results.
- **Cavity:** VC12-2; See page 9.112.1; **Cavity Tool:** CT12-2XX; See page 8.600.1
- **Seal Kit:** SK12-2X-B; See page 8.650.1
- **Coil Nut:** Part No. 4540550; For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut info.

**PERFORMANCE**
- **Pressure Drop vs. Flow Characteristic**
- **Relief Pressure vs. Current (DC) Characteristic, 200 Hz PWM**
- **Recommended Controllers** (See Section 3)

**SYMBOLS**

**USASI/ISO:**

**ELECTRO-PROPORTIONAL VALVES—PRESSURE CONTROLS**

**U.S. Patent**
6,267,350
**MATERIALS**

**Cartridge:**
- Weight: 0.56 kg (1.23 lbs).
- Steel with hardened work surfaces.

**Standard Ported Body:**
- Weight: 0.36 kg (0.80 lbs.).
- Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.012.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

**Standard Coil:**
- Weight: 0.32 kg (0.7 lbs.).
- Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.1.

**E-Coil:**
- Weight: 0.41 kg (0.9 lbs.).
- Fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors; Note: See page 3.400.1 for all E-Coil retrofit applications.

**TO ORDER**

<table>
<thead>
<tr>
<th>Maximum Relief Pressure</th>
<th>TS12-27</th>
</tr>
</thead>
<tbody>
<tr>
<td>207 bar (3000 psi)</td>
<td>A</td>
</tr>
<tr>
<td>140 bar (2000 psi)</td>
<td>B</td>
</tr>
<tr>
<td>70 bar (1000 psi)</td>
<td>C</td>
</tr>
</tbody>
</table>

**Porting**
- Cartridge Only: 0
- SAE 10: 10T
- SAE 12: 12T
- 1/2 in. BSP*: 4B
- 3/4 in. BSP*: 6B

**Seals**
- Buna N (Std.): N
- Fluorocarbon: V

**Termination Std. Coil**
- DS: Dual Spades
- DG: DIN 43650
- DL: Leadwires (2)
- DL/W: Leads w/Weatherpak® Connectors
- DR: Deutsch DT04-2P

**Termination E-Coil**
- ER: Deutsch DT04-2P (IP69K Rated)
- EY: Metri-Pack® 150 (IP69K Rated)

**Voltage**
- 0: Less Coil
- 10: 10 VDC (1.30 amps max.)
- 12: 12 VDC (1.10 amps max.)
- 20: 20 VDC (0.65 amps max.)
- 24: 24 VDC (0.55 amps max.)

Coils with internal diode are available. Consult factory.
**DESCRIPTION**

A screw-in, cartridge-style, pilot-operated, spool-type reducing/relieving valve, which can be infinitely adjusted across a prescribed range using a variable electric input. Pressure output is proportional to DC current input. This valve is intended for use as a pressure control device in demanding applications.

**OPERATION**

The TS80-30 allows free flow from ① to ③ when no current is applied to the coil. When the coil is energized, ② is connected to ①. Increasing current applied to the coil will increase the control (reduced) pressure proportionally. If pressure at ① exceeds the setting induced by the coil, pressure from ① is relieved to ③.

Note: Back pressure on port ③ becomes additive to the pressure setting at a 1:1 ratio.

**FEATURES**

- Airbleed standard.
- 12 and 24 volt coils standard.
- Industry common cavity.
- Optional waterproof E-Coils rated up to IP69K.

**RATINGS**

- Maximum Inlet Pressure: 40 bar (580 psi)
- Maximum Control Current: 0.65 amps for 12 VDC coil; 0.33 amps for 24 VDC coil
- Reducing/Relieving Pressure Range from Zero to Maximum Control Current: 0–20 bar (0–290 psi)
- Rated Flow: 20.8 lpm (6.0 gpm), ∆P=7.6 bar (110 psi), Cartridge only, ① to ③ coil de-energized
- Maximum Pilot Flow: 0.76 lpm (0.2 gpm)
- Hysteresis: Less than 3%
- Flow Path: Free Flow: ① to ③ coil de-energized; Reduced: ② to ① coil energized; Relieving: ① to ③ coil energized
- Temperature: -40 to 120°C (-40 to 250°F), with standard Buna N seals
- Filtration: See page 9.010.1
- Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)

**Installation Recommendation:** When possible, the valve should be mounted below the reservoir oil level. This will maintain oil in the armature preventing trapped air instability. If this is not feasible, mount the valve horizontally for best results.

**Cavity:** VC10-3; See page 9.110.1; **Cavity Tool:** CT10-3XX; See page 8.600.1

**Seal Kit:** SK10-3X-BM; See page 8.650.1

**Coil Nut:** Part No. 7004410; For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut info.

**Note:** This product, the TS80-30, is obsolete effective Oct. 2005. Consult the Hydraforce applications group for alternatives that will meet your system requirements.
MATERIALS

**Cartridge:** Weight: 0.25 kg. (0.55 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyester elastomer back-ups standard.

**Standard Ported Body:** Weight: 0.16 kg. (0.35 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.010.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

**Standard Coil:** Weight: 0.27 kg. (0.6 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.1.

**E-Coil:** Weight: 0.14 kg. (0.3 lbs.); Perfect wound, fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors; **Note:** See page 3.400.1 for all E-Coil retrofit applications.

TO ORDER

**TS80-30**

<table>
<thead>
<tr>
<th>Porting</th>
<th>-</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cartridge Only</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>SAE 6</td>
<td>6T</td>
<td></td>
</tr>
<tr>
<td>SAE 8</td>
<td>8T</td>
<td></td>
</tr>
<tr>
<td>3/8 in. BSP*</td>
<td>3B</td>
<td></td>
</tr>
<tr>
<td>1/2 in. BSP*</td>
<td>4B</td>
<td></td>
</tr>
</tbody>
</table>

**Seals**

- Buna N (Std.)
- Fluorocarbon

**Termination Std. Coil**

- DS Dual Spades
- DG DIN 43650
- DL Leadwires (2)
- DL/W Leads w/Weatherpack® Connectors
- DR Deutsch DT04-2P
- ER Deutsch DT04-2P (IP69K Rated)
- EY Metri-Pack® 150 (IP69K Rated)

**Voltage**

- 10 VDC (0.80 amps max.)
- 12 VDC (0.65 amps max.)
- 20 VDC (0.40 amps max.)
- 24 VDC (0.33 amps max.)

**Note:** This product, the TS80-30, is obsolete effective Oct. 2005. Consult the Hydraforce applications group for alternatives that will meet your system requirements.
### DESCRIPTION
A screw-in, cartridge-style, pilot-operated, spool-type reducing/relieving valve, which can be infinitely adjusted across a prescribed range using a variable electric input. Pressure output is proportional to DC current input. This valve is intended for use as a pressure control device in demanding applications.

### OPERATION
Without applied current, the TS98-30 allows bidirectional flow from ③ to ④ while blocking ①. When the coil is energized, ③ is connected to ②, and pressure at ③ is controlled proportional to the amount of current applied to the coil. If pressure at ③ exceeds the setting induced by the coil, pressure is relieved to ④.

Back pressure on port ④ becomes additive to the pressure setting at a 1:1 ratio.

Note: This product may be customized for special OEM performance characteristics. Consult factory.

### FEATURES
- 12 and 24 volt coils standard.
- Optional waterproofed E-Coils rated up to IP69K.

### RATINGS
- **Maximum Inlet Pressure at Port ②:** 24 bar (350 psi)
- **Maximum Control Current:** 0.70 amps for 12 VDC coil; 0.35 amps for 24 VDC coil
- **Deadband:** 0.150 amps @ 12 VDC; 0.075 amps @ 24 VDC
- **Hysteresis:** 3.0% PWM
- **Reducing/Relieving Pressure Range from Zero to Maximum Control Current:** 0–20.7 bar (0–300 psi)
- **Rated Flow:** 30 lpm (8 gpm) at 45 psid port ③ to ④ with coil de-energized
- **Maximum Pilot Flow:** 0.4 lpm (0.12 gpm)
- **Flow Path:** 
  - Free Flow: ③ to ④ bidirectional coil de-energized; 
  - Reduced: ① to ③ coil energized; 
  - Relieving: ① to ④ coil energized; 
  - Port ① is not plumbed externally

### Filtration:
See page 9.010.1

### Fluids:
Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)

### Installation Recommendation:
When possible, the valve should be mounted below the reservoir oil level. This will maintain oil in the armature preventing trapped air instability. If this is not feasible, mount the valve horizontally for best results.

### Cavity:
VC98-3; See page 9.110.1; Cavity Tool: CT98-3XX; See page 8.600.1

### Seal Kit:
SK90-3V; See page 8.650.1

### Coil Nut:
Part No. 7004410; For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut info.

---

**Reducing/Relieving Pressure vs. Flow Characteristic**
Regulated Pressure Range: 0–20 bar (0–290 psi) with 24 bar (350 psi) Input Pressure
Pressure at ③ for Various Control Currents (ΔP Shown for Cartridge & Body)
**DESCRIPTION**

A screw-in, cartridge-style, pilot-operated, spool-type reducing/relieving valve, which can be infinitely adjusted across a prescribed range using a variable electric input. Pressure output is proportional to DC current input. This valve is intended for use as a pressure control device in demanding applications.

**OPERATION**

Without applied current, the TS90-31 allows flow from ③ to ④ while blocking ①. When the coil is energized, ③ is connected to ②, and pressure at ③ is controlled proportional to the amount of current applied to the coil. If pressure at ③ exceeds the setting induced by the coil, pressure is relieved to ④.

Back pressure on port ④ becomes additive to the pressure setting at a 1:1 ratio.

Note: This product may be customized for special OEM performance characteristics. Consult factory.

**FEATURES**

- 12 and 24 volt coils standard.
- Optional waterproofed E-Coils rated up to IP69K.

**RATINGS**

- Maximum Operating Pressure at Ports 1 and 2: 207 bar (3000 psi)
- Maximum Tank Pressure at Port 4: 69 bar (1000 psi)
- Regulated Pressure Range from Zero to Max. Control Current: 0 to 137.9 bar (2000 psi)
- Maximum Control Current: E-Coils: 0.88 amps for 12 VDC coil; 0.44 amps for 24 VDC coil; D-Coils: 0.68 amps for 12 VDC coil; 0.34 amps for 24 VDC coil
- Deadband: 0.150 amps @ 12 VDC; 0.075 amps @ 24 VDC
- Hysteresis: 3.0% PWM
- Rated Flow: 38 lpm (10 gpm)
- Maximum Pilot Flow: 0.85 lpm (0.23 gpm) with No Current
- Flow Path: Free Flow: ③ to ④ coil de-energized; Reduced: ② to ③ coil energized; Relieving: ③ to ④ coil energized; Port ① is not plumbed externally
- Temperature: -40 to 100°C (-40 to 212°F) with standard Buna N seals; -26 to 204°C (-15 to 400°F) with Fluorocarbon seals
- Filtration: See page 9.010.1
- Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 sus); See Temperature and Oil Viscosity page 9.060.1
- Installation Recommendation: When possible, the valve should be mounted below the reservoir oil level. This will maintain oil in the armature preventing trapped air instability. If this is not feasible, mount the valve horizontally for best results.
- Cavity: VC98-3; See page 9.110.1
- Cavity Tool: CT98-3XX; See page 8.600.1
- Seal Kit: SK90-3X-BM; See page 8.650.1
- Coil Nut: Part No. 4540560

**PERFORMANCE**

**Symbols**

USASI/ISO:

- ①
- ②
- ③
- ④

**Graphs**

- Typical Pressure Drop vs. Flow
- Reducing Pressure vs. Current
- Inlet Pressure 172 bar (2500 psi) at No Flow Control Current (amps) with 100 Hz Dither
- Reducing/Relieving Pressure vs. Flow

**HYDRAFORCE.com**
**DESCRIPTION**
A solenoid-operated, 5-way, 3-position, proportional, screw-in hydraulic cartridge valve with integral load-sense port.

**OPERATION**
When de-energized, the SP10-57C blocks flow to all ports. When coil #1 is energized, flow is allowed from ④ to ①, and from ⑤ to ③. When coil #2 is energized, flow is allowed from ④ to ③, and from ① to ②. Load sense is connected to port ④ when the spool is in shifted positions.

**Note:** If low voltage is expected on the machine, 12 or 24 volt systems will require the use of 10 volt or 20 volt coils respectively. See “SP Valves and Coil Operating Parameters,” page 2.002.1.

**FEATURES**
- Continuous-duty rated solenoid.
- Hardened precision spool and cage for long life.
- Optional coil voltages and terminations
- Cartridges are voltage interchangeable.
- Optional manual override.
- Optional waterproof E-Coils rated up to IP69K.

**RATINGS**
- **Operating Pressure:** 250 bar (3625 psi) with standard Buna N seals
- **Flow:** 22.7 lpm (6 gpm) max. See performance chart
- **Internal Leakage:** 246 cc/minute (15 cu. in./minute) max. at 207 bar (3000 psi)
- **Temperature:** -40 to 120°C with standard Buna seals
- **Coil Duty Rating:** Continuous from 85% to 115% of nominal voltage
- **Filtration:** See page 9.010.1
- **Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 sus); See Temperature and Oil Viscosity, page 9.060.1
- **Installation:** No restrictions; See page 9.020.1
- **Cavity:** VC10-5X; See page 9.110.1; **Cavity Tool:** CT10-5XX; See page 8.600.1
- **Seal Kit:** SK10-5X-MMMM; See page 8.650.1
- **Coil Nut:** Part No. 7004400; **Coil Spacer** for E-Coils: Part No. 4539700

**PERFORMANCE** *(Cartridge Only)*
- ⑤ to ② or ③ to ④ at 100% current, S1 or S2 energized: ————
- ④ to ① or ② to ③ at 100% current, S1 or S2 energized: __________

32 cSt/150 sus oil at 40°C

**Recommended Electronic Controllers:**
See page 2.001.1 or our Electronics catalog.

**ELECTRO-PROPORTIONAL VALVES—DIRECTIONAL CONTROL**

**SP10-57C Spool, 5-Way, 3-Position . . .**

**SYMBOLS**

**USASI:**

**ISO:**

**Recommended Electronic Controllers:**
See page 2.001.1 or our Electronics catalog.
for Load Sense Applications

SP10-57C

PERFORMANCE (Continued)

Pressure Compensation

Inlet to Work Port

FLOW (lpm/gpm)

Differential Pressure  bar/psi

22.76
18.95
15.14
11.43
7.62
3.81

1.0 AMP

0.75 AMP

0.50 AMP

COILS MUST BE INSTALLED WITH LETTERING UP

Manual Override "B"

Manual Override "M"

TORQUE: 5–7 ft-lbs (6.8–9.5 Nm) max.

TORQUE: 24–26 ft-lbs (32.5–35.3 Nm) max.

MATERIALS

Cartridge: Weight: 0.36 kg. (0.80 lbs.) Steel with hardened work surfaces. Zinc-plated exposed surfaces; Buna N O-rings and back-ups standard.

Standard Ported Body: Weight: 0.41 kg. (0.85 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 207 bar (3000 psi); Ductile iron bodies available: dimensions may differ. See page 8.010.1.

Standard Coil: Weight each: 0.27 kg. (0.60 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnetwire. See page 3.200.1.

E-Coil: Weight each: 0.41 kg. (0.9 lbs.); Perfect wound, fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors. See page 3.400.1 for all E-Coil retrofit applications.

TERMINATION (VDC)

Std. Coil

DS Dual Spades
DG DIN 43650
DL Leadwires (2)
DL/W Leads w/Weatherpak®
Connectors
DR Deutsch DT04-2P

DR Deutsch DT04-2P

E-Coil

ER Deutsch DT04-2P

(EIP69K Rated)

(EY Metri-Pack® 150

(EIP69K Rated)

Termination (VDC)

Coils with internal diode are available. Consult factory.

TO ORDER

SP10-57C

Option

None (Blank)
Manual Override B
Manual Override M

For Manual Override options see page 1.001.1

Porting

Cartridge Only
SAE 6
SAE 8

Seals

Buna N (Std.)
Fluorocarbon
Polyurethane

Voltage Std. Coil

0 Less Coil**
10 10 VDC†
12 12 VDC
20 20 VDC
24 24 VDC

**Includes Std. Coil Nut
† DS, DW or DL terminations only.

Termination (VDC)

E-Coil

10 10 VDC
12 12 VDC
20 20 VDC
24 24 VDC

Termination (VDC)

E-Coil

10 10 VDC
12 12 VDC
20 20 VDC
24 24 VDC

Termination (VDC)

E-Coil

10 10 VDC
12 12 VDC
20 20 VDC
24 24 VDC

Termination (VDC)

E-Coil

10 10 VDC
12 12 VDC
20 20 VDC
24 24 VDC

Termination (VDC)

E-Coil

10 10 VDC
12 12 VDC
20 20 VDC
24 24 VDC

Termination (VDC)

E-Coil

10 10 VDC
12 12 VDC
20 20 VDC
24 24 VDC

Termination (VDC)

E-Coil

10 10 VDC
12 12 VDC
20 20 VDC
24 24 VDC
Valve, Internally Piloted

**PERFORMANCE (continued)**

**DIMENSIONS**

MATERIALS

**Cartridge:** Weight: 0.25 kg. (0.55 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. O-rings standard.

**Standard Ported Body:** Weight: 0.34 kg. (0.75 lbs.) Anodized high-strength 6061 T6 aluminum alloy, rated to 207 bar (3000 psi). Ductile iron bodies available; dimensions may differ. See page 8.010.1

**Standard Coil:** Weight: 0.32 kg. (0.70 lbs.) Unitized thermoplastic encapsulated, Class H high temperature magnet-wire. See page 3.200.1

**E-Coil:** Weight: 0.41 kg. (0.9 lbs.) Perfect wound, fully encapsulated with rugged external metal shell. Rated up to IP69K with integral connectors. Note: See page 3.400.1 for all E-Coil retrofit applications.

**Recommended Electronic Controllers:**
See page 2.001.1 or our Electronics catalog.

**TO ORDER**

**TS90-31 -**

<table>
<thead>
<tr>
<th>Porting</th>
<th>Cartridge Only</th>
<th>SAE 6</th>
<th>SAE 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seals</td>
<td>Buna N</td>
<td></td>
<td>Fluorocarbon V</td>
</tr>
<tr>
<td>Voltage</td>
<td>Less Coil 0</td>
<td>12 VDC (0.88 amps max.)</td>
<td>24 VDC (0.44 amps max.)</td>
</tr>
</tbody>
</table>

**Termination Std. D-Coil**

- DS Dual Spades
- DG DIN 43650
- DL Leadwires (2)
- DL/W Leads w/Weatherpak® Connectors
- DR Deutsch DT04-2P

**Termination E-Coil**

- EG DIN 43650 (IP65 Rated)
- EL Leadwires (2) (IP69K Rated)
- ER Deutsch DT04-2P (IP69K Rated)
- EY Metri-Pack® 150 (IP69K Rated)
- EJ Amp Jr. Timer (IP69K Rated)

Coils with internal diode are available. Consult factory.

**Note:** This valve uses a 10-size coil and the VC98-3 cavity, which is a variation of a 10-size cavity.
**Valve w/Internally Piloted Spool TS98-30**

**DIMENSIONS**

(continued)

**MATERIALS**

**Cartridge:** Weight: 0.25 kg. (0.55 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. O-rings standard.

**Standard Ported Body:** Weight: 0.34 kg. (0.75 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.010.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

**Standard Coil:** Weight: 0.27 kg. (0.60 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.1.

**E-Coil:** Weight: 0.14 kg. (0.3 lbs.); Perfect wound, fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors; Note: See page 3.400.1 for all E-Coil retrofit applications.

**Recommended Controllers** (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig. w/12 or 24V Coil</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000161</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000168</td>
<td>4000194</td>
<td>4000182</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000169</td>
<td>4000143</td>
<td>4000186</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

**TO ORDER**

<table>
<thead>
<tr>
<th>Porting</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cartridge Only</td>
<td>0 VDC (0.84 amps max.)</td>
</tr>
<tr>
<td>SAE 6</td>
<td>10 VDC (0.70 amps max.)</td>
</tr>
<tr>
<td>SAE 8</td>
<td>12 VDC (0.70 amps max.)</td>
</tr>
<tr>
<td></td>
<td>20 VDC (0.42 amps max.)</td>
</tr>
<tr>
<td></td>
<td>24 VDC (0.35 amps max.)</td>
</tr>
</tbody>
</table>

**Termination Std. Coil**

<table>
<thead>
<tr>
<th>Termination Std. Coil</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS Dual Spades</td>
</tr>
<tr>
<td>DG DIN 43650</td>
</tr>
<tr>
<td>DL Leadwires (2)</td>
</tr>
<tr>
<td>DL/W Leads w/Weatherpak® Connectors</td>
</tr>
<tr>
<td>DR Deutsch DT04-2P</td>
</tr>
</tbody>
</table>

**Termination E-Coil**

<table>
<thead>
<tr>
<th>Termination E-Coil</th>
</tr>
</thead>
<tbody>
<tr>
<td>ER Deutsch DT04-2P (IP69K Rated)</td>
</tr>
<tr>
<td>EY Metri-Pack® 150 (IP69K Rated)</td>
</tr>
</tbody>
</table>

Coils with internal diode are available. Consult factory.
**DESCRIPTION**

A screw-in, cartridge-style, pilot-operated, spool-type reducing/relieving valve, which can be infinitely adjusted across a prescribed range using a variable electric input. Pressure output is proportional to DC current input. This valve is intended for use as a pressure control device in demanding applications.

**OPERATION**

Without applied current, the TS98-31 allows bidirectional flow from ³ to ⁴ while blocking ². When the coil is energized, ³ is connected to ², and pressure at ³ is controlled proportional to the amount of current applied to the coil. If pressure at ³ exceeds the setting induced by the coil, pressure is relieved to ⁴.

Back pressure on port ⁴ becomes additive to the pressure setting at a 1:1 ratio.

Note: This product may be customized for special OEM performance characteristics. Consult factory.

**FEATURES**

- 12 and 24 volt coils standard.
- Optional waterproof E-Coils rated up to IP69K.

**RATINGS**

- Maximum Inlet Pressure at Port ²: 207 bar (3000 psi)
- Maximum Control Current: 0.70 amps for 12 VDC coil; 0.35 amps for 24 VDC coil
- Deadband: 0.150 amps @ 12 VDC; 0.075 amps @ 24 VDC
- Hysteresis: 3.0% PWM
- Reducing/Relieving Pressure Range from Zero to Maximum Control Current: 0–138 bar (0–2000 psi)
- Rated Flow: 11.4 lpm (3 gpm) at 45 psid port ⁴ with coil de-energized
- Maximum Pilot Flow: 0.4 lpm (0.12 gpm)

**PERFORMANCE**

Pressure Drop vs. Flow Characteristic
For Flow ³ to ⁴ with Coil De-energized

Reduced Pressure vs. Current Characteristic
For a Regulated Pressure Range of 0–134.5 bar (0–1950 psi) with Input Pressure at ²

Reducing/Relieving Pressure vs. Flow Characteristic
Regulated Pressure Range: 0–134.5 bar (0–1950 psi) with 137.9 bar (2000 psi) Input Pressure at ³ for Various Control Currents (JP Shown for Cartridge & Body)

**Symbols**

USASI/ISO:

**Flow Symbols**

FLOW (gpm)

0.05 1 1.5 2 2.5 3 3.5

FLOW (lpm)

1.0 1.5 2 2.5 3 4 5

PRESSURE (bar)

20 40 60 80 100 120 140

PRESSURE (psi)

300 500 700 900 1100 1300 1500

FLOW (lpm)

10 15 20 25 30 35

PRESSURE (bar)

30 60 90 120 150 180 210

PRESSURE (psi)

450 900 1350 1800 2250 2700 3150

FLOW (lpm)

10 15 20 25 30 35
Valve w/Internally Piloted Spool  TS98-31

**PERFORMANCE**

Typical Frequency Response Curves

[Graph showing frequency response curves with different signal levels and phase angles.]

**DIMENSIONS**

[Diagram showing dimensions of the valve with labeled parts like DIA, Flats, and Torque.]

**MATERIALS**

**Cartridge:** Weight: 0.25 kg. (0.55 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. O-rings standard.

**Standard Ported Body:** Weight: 0.34 kg. (0.75 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.010.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

**Standard Coil:** Weight: 0.27 kg. (0.60 lbs.); Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.1.

**E-Coil:** Weight: 0.14 kg. (0.3 lbs.); Perfect wound, fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors;

**Note:** See page 3.400.1 for all E-Coil retrofit applications.

**TO ORDER**

<table>
<thead>
<tr>
<th>Porting</th>
<th>Termination Std. Coil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cartridge Only</td>
<td>DS  Dual Spades</td>
</tr>
<tr>
<td>SAE 6</td>
<td>DG  DIN 43650</td>
</tr>
<tr>
<td>SAE 8</td>
<td>DL  Leadwires (2)</td>
</tr>
</tbody>
</table>

**Seals**

| Fluorocarbon | DR  Deutsch DT04-2P |

**Voltage**

| Less Coil | ER  Deutsch DT04-2P (IP69K Rated) |
| 10 VDC (0.84 amps max.) | EY  Metri-Pack® 150 (IP69K Rated) |
| 12 VDC (0.70 amps max.) | |
| 20 VDC (0.42 amps max.) | |
| 24 VDC (0.35 amps max.) | |

Consult factory for other voltages.

**TERMINATION**

- Standard Coil View
- E-Coil View

**INCH MILLIMETRE**

[Dimensions and annotations for the valve's design.]
**TS10-36 Proportional Electric Reducing/Relieving**

**DESCRIPTION**
A screw-in, cartridge-style, pilot-operated, spool-type reducing/relieving valve, which can be infinitely adjusted across a prescribed range using a variable electric input. Pressure output is proportional to DC current input. This valve is intended for use as a pressure limiting device in demanding applications.

**OPERATION**
The TS10-36 allows flow from ② to ① until sufficient pressure is present at ① to open the pilot section by offsetting the electrically induced solenoid force. Increasing electric current will increase the control (reduced) pressure at ①. With no current applied to the solenoid, the valve will maintain pressure at ① at approximately 100 psi, regardless of pressure at ②.

The TS10-36 has an optional manual override feature. This allows the valve to be set when the electric supply is lost. The manual setting is added to the electric setting, so when using the manual override feature to establish a minimum setting, care is required to prevent the system from becoming over-pressurized.

**FEATURES**
- Manual override option.
- Airbleed option.
- 12 and 24 volt coils standard.
- Optional waterproof E-Coils rated up to IP69K.

**RATINGS**
- Maximum Operating Pressure: 241 bar (3500 psi)
- Maximum Control Current: 1.10 amps for 12 VDC coil; 0.55 amps for 24 VDC coil
- Relief Pressure Range from Zero to Maximum Control Current:
  - A: 6.9–207 bar (100–3000 psi)
  - B: 6.9–159 bar (100–2300 psi)
  - C: 6.9–117 bar (100–1700 psi)
- Rated Flow: 56.8 lpm (15 gpm), ΔP=22.8 bar (330 psi), Cartridge only, ① to ② coil de-energized
- Maximum Pilot Flow: 0.76 lpm (0.2 gpm)
- Flow Path: Free Flow: ① to ③ coil de-energized; Reduced: ② to ① coil energized; Relieving: ① to ③ coil energized
- Temperature: -40 to 120°C (-40 to 250°F), with standard Buna N seals
- Filtration: See page 9.010.1
- Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
- Installation Recommendation: When possible, the valve should be mounted below the reservoir oil level. This will maintain oil in the armature preventing trapped air instability. If this is not feasible, mount the valve horizontally for best results.
- Cavity: VC10-3; See page 9.110.1; Cavity Tool: CT10-3XX; See page 8.600.1
- Seal Kit: SK10-3N-BM; See page 8.650.1
- Coil Nut: Part No. 4540560;
  For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut info.

**PERFORMANCE**

<table>
<thead>
<tr>
<th>RELIEVING/REDUCING PRESSURE</th>
<th>FLOW (gpm)</th>
<th>PRESSURE (bar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>125% Max. Control Current</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>100% Max. Control Current</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>75% Max. Control Current</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>50% Max. Control Current</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>25% Max. Control Current</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RELIEVING/REDUCING PRESSURE</th>
<th>FLOW (lpm)</th>
<th>PRESSURE (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>150% Max. Control Current</td>
<td>60</td>
<td>125</td>
</tr>
<tr>
<td>100% Max. Control Current</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>75% Max. Control Current</td>
<td>60</td>
<td>75</td>
</tr>
<tr>
<td>50% Max. Control Current</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>25% Max. Control Current</td>
<td>60</td>
<td>25</td>
</tr>
</tbody>
</table>

For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut info.
Valve w/Internally Piloted Spool

**TS10-36**

**PERFORMANCE (continued)**

Relief Pressure vs. Current (DC) Characteristic

- 200 Hz PWM Reducing Pressure

<table>
<thead>
<tr>
<th>Pressure (bar/psi)</th>
<th>% of Maximum Control Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>300</td>
<td>20%</td>
</tr>
<tr>
<td>600</td>
<td>40%</td>
</tr>
<tr>
<td>900</td>
<td>60%</td>
</tr>
<tr>
<td>1200</td>
<td>80%</td>
</tr>
<tr>
<td>1500</td>
<td>100%</td>
</tr>
</tbody>
</table>

**MATERIALS**

**Cartridge:**
- Weight: 0.25 kg. (0.55 lbs.);
- Steel with hardened work surfaces.
- Zinc-plated exposed surfaces.
- Buna N O-rings and polyester elastomer back-ups standard. Optional polyurethane seals with fluorocarbon back-ups recommended for pressures over 240 bar (3500 psi).

**Standard Ported Body:**
- Weight: 0.16 kg. (0.35 lbs.);
- Anodized high-strength 6061 T6 aluminum alloy rated to 240 bar (3500 psi); See page 8.010.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

**Standard Coil:**
- Weight: 0.27 kg. (0.6 lbs.);
- Unitized thermoplastic encapsulated, Class H high temperature magnet-wire; See page 3.200.1.

**E-Coil:**
- Weight: 0.41 kg. (0.9 lbs.);
- Fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors; Note: See page 3.400.1 for all E-Coil retrofit applications.

**DIMENSIONS**

**TO ORDER**

**Torsion Characteristic**

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Maximum Relief Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>207 bar (3000 psi)</td>
</tr>
<tr>
<td>10</td>
<td>159 bar (2300 psi)</td>
</tr>
<tr>
<td>20</td>
<td>117 bar (1700 psi)</td>
</tr>
</tbody>
</table>

**Termination Std. Coil**

- DS: Dual Spades
- DG: DIN 43650
- DL: Leadwires (2)
- DL/W: Leads w/Weatherpak® Connectors
- DR: Deutsch DT04-2P

**Termination E-Coil**

- ER: Deutsch DT04-2P (IP69K Rated)
- EY: Metri-Pack® 150 (IP69K Rated)

**Seals**

- Buna N (Std.)
- Fluorocarbon

**Option**

- None (Blank)
- Manual Override

**Porting**

- Cartridge Only
- SAE 6 6T
- SAE 8 8T
- 3/8 in. BSP 3B
- 1/2 in. BSP 4B

*BSP Body: U.K. Mfr. Only

**CAUTION:**
- Manual override must be fully backed out (turn CCW using 3/16" hex key wrench) when operating electrically.

**INITIAL SETUP:**
- Before operating valve, use the manual override to manually set pressure to 200 to 300 psi. Back out bleed screw 2 to 4 rotations to allow all trapped air to escape.
- Screw in the bleed screw. Before operating electrically, back out manual override (CCW) until positive stop is reached.
**DESCRIPTION**

A screw-in, cartridge-style, pilot-operated, spool-type reducing/relieving valve, which can be infinitely adjusted across a prescribed range using a variable electric input. Pressure output is proportional to DC current input. This valve is intended for use as a pressure limiting device in demanding applications.

**OPERATION**

The TS12-36 allows flow from ② to ➀ until pressure at ➀ equals the setting determined by the coil current. Port ③ is typically connected to the reservoir. If external load increases the pressure at ➀ beyond this setting, pressure is relieved by allowing flow from ➀ to ③. Minimum pressure at ➀ without any current is 100 psi.

If external circuitry allows the pressure at ② to fall below the pressure at ➀, the valve will allow free flow from ➀ to ② regardless of the setting of the valve or the amount of current in the coil.

**FEATURES**

- Optional airbleed screw.
- 12 and 24 volt coils, standard or optional waterproofed.

**RATINGS**

- **Maximum Operating Pressure:** Ports ➀ and ②: 276 bar (4000 psi)
- **Maximum Tank Pressure:** Port ③: 68.9 bar (1000 psi); Note: Tank pressure is additive to regulated pressure.
- **Reduced Pressure Range from Zero to Maximum Controlled Current:**
  - A: 6.9–207 bar (100–3000 psi);
  - B: 6.9–172 bar (100–2500 psi)
  - C: 6.9–138 bar (100–2000 psi)
- **Maximum Pilot Flow and Leakage:** 0.49 lpm (0.13 gpm) with max. control current and with inlet pressure at 276 bar (4000 psi) at regulated flow of 3.8 lpm (1 gpm).
- **Flow Path:**
  - Free Flow: ➀ to ③ coil de-energized;
  - Reducing: ② to ➀ coil energized;
  - Relieving: ➀ to ③ coil energized
- **Performance Life:** Less than 5% change in the slope of the pressure vs current characteristics over one million cycles.
- **Hysteresis:** Less than 3%.
- **Temperature:** -40 to 120°C (-40 to 250°F) with Buna N seals.
- **Filtration:** See page 9.010.1
- **Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
- **Installation Recommendation:** When possible, the valve should be mounted below the reservoir oil level. This will maintain oil in the armature preventing trapped air instability. If this is not feasible, mount the valve horizontally for best results.
- **Cavity:** VC12-3; See page 9.110.1;
- **Cavity Tool:** CT12-3XX; See page 8.600.1
- **Seal Kit:** SK12-3X-BM; See page 8.650.1
- **Coil Nut:** Part No. 4526330;
  - For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut info.

For E-coils manufactured prior to 1-1-04, see page 3.400.1 for coil nut info.
Valve w/Internally Piloted Spool TS12-36

PERFORMANCE (cont’d)

Typical Frequency Response Curves
Flow at 0 gpm; Inlet Pressure at 241 bar (3500 psi)
Pressure Range at 50% ±40%

Typical Step Response Curve
Flow at 0 gpm, Inlet Pressure at 241 bar (3500 psi)
Voltage Set to Produce 1.1 amps at Steady State Test Coil (12 VDC)

Recommended Controllers (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig.</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4001016</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4001015</td>
<td>4000141</td>
<td>4000182</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4001019</td>
<td>4000143</td>
<td>4000186</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

MATERIALS

Cartridge: Weight: 0.30 kg. (0.66 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Buna N O-rings and polyether elastomer back-ups standard. Optional polyurethane seals with fluorocarbon back-up recommended for pressures over 240 bar (3500 psi).

Standard Ported Body: Weight: 0.23 kg. (0.50 lbs.); Anodized high-strength 6061 T6 aluminum alloy, rated to 240 bar (3500 psi); See page 8.010.1. Ductile iron and steel bodies available; dimensions may differ; consult factory.

Standard Coil: Weight: 0.32 kg. (0.7 lbs.); Unitized thermostatic encapsulated, Class H high temperature magnet wire; See page 3.200.1.

E-Coil: Weight: 0.41 kg. (0.9 lbs.); Fully encapsulated with rugged external metal shell; Rated up to IP69K with integral connectors; Note: See page 3.400.1 for all E-Coil retrofit applications.

DIMENSIONS

Patent Pending

TO ORDER

TS12-36

- Maximum Reducing Pressure

| 207 bar (3000 psi) | A |
| 172 bar (2500 psi) | B |
| 138 bar (2000 psi) | C |

| Option(s)   | | |
|-------------| | |
| None (Blank)| | |
| Bleed Screw | S |

Porting

Cartridge Only 0
SAE 8 8T
SAE 10 10T
SAE 12 12T
1/2 in. BSP* 4B
3/4 in. BSP* 6B

*BSP Body; U.K. Mfr. Only

Seals

N Buna N (Std.)
V Fluorocarbon

Termination Std. Coil

DS Dual Spades
DG DIN 43650
DL Leadwires (2)
DL/W Leads w/Weatherpak® Connectors
DR Deutsch DT04-2P

Termination E-Coil

ER Deutsch DT04-2P (IP69K Rated)
EY Metri-Pack® 150 (IP69K Rated)

Coils with internal diode are available. Consult factory.

Voltage

0 Less Coil* 12 VDC
12 12 VDC
24 24 VDC

* Includes Coil nut.
DESCRIPTION
A drop-in, flange-mounted, cartridge-style, pilot-operated, spool-type reducing/relieving valve, which can be infinitely adjusted across a prescribed range using a variable electric input. Pressure output is proportional to DC current input. This valve is intended for use as a pressure control device in demanding applications.

OPERATION
Without applied current, the TS98-T34 allows bidirectional flow from ➂ to ➃ while blocking ➁. When the coil is energized, ➂ is connected to ➁, and pressure at ➂ is controlled proportional to the amount of current applied to the coil. If pressure at ➂ exceeds the setting induced by the coil, pressure is relieved to ➃.

Back pressure on port ➃ becomes additive to the pressure setting at a 1:1 ratio.

Note: This product may be customized for special OEM performance characteristics. Consult factory.

FEATURES
• Economical drop-in style.
• Integral waterproof coil standard.
• 12 or 24 VDC coils.
• Several push-on termination options.

RATINGS
Maximum Inlet Pressure and Regulated Pressure: 30 bar (435 psi)
Maximum Control Current: To achieve 20 bar (290 psi) regulated pressure:
- 0.85 amps for 12 VDC coil; 0.43 amps for 24 VDC coil
Note: Regulated pressures up to 29.3 bar (425 psi) can be attained with increased current values and 30 bar (435 psi) inlet pressure.
Deadband: 0.150 amps @ 12 VDC; 0.075 amps @ 24 VDC
Hysteresis: 5% PWM for 20 bar (290 psi) control pressure
Reducing/Relieving Pressure Range from Zero to Maximum Control Current: 0–20.7 bar (0–300 psi)
Rated Flow: Port ➂ to ➃ with coil de-energized: 30 lpm (8 gpm)
Maximum Pilot Flow: 0.79 lpm (0.21 gpm) with 20.7 bar (300 psi) inlet
Flow Path: Free Flow: ➂ to ➃ coil de-energized; Reduced: ➁ to ➂ coil energized;
    Relieving: ➂ to ➃ coil energized; Port ➀ is not plumbed externally
Oil Temperature: -40 to 120°C (-40 to 248°F)
Ambient Air Temperature: -40 to 120°C (-40 to 248°F)
Filtration: See page 9.010.1
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
Installation Recommendation: When possible, the valve should be mounted below the reservoir oil level. This will maintain oil in the armature preventing trapped air instability. If this is not feasible, mount the valve horizontally for best results.
Cavity: Special; Consult factory; Cavity Tool: Special; Consult factory
Seal Kit: SK90-3V; See page 8.650.1

Recommended Controllers (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig. with 12V or 24V Coil</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000141</td>
<td>4000182</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000143</td>
<td>4000186</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

Note: Regulated pressures up to 29.3 bar (425 psi) can be attained with increased current values and 30 bar (435 psi) inlet pressure.
Valve w/Internally Piloted Spool

PERFORMANCE (continued)

Reducing/Relieving Pressure vs. Flow Characteristic
Regulated Pressure Range: 0–20 bar (0–290 psi) with 20.7 bar (300 psi) Input Pressure at ② for Various Control Currents (ΔP Shown for Cartridge & Body)

<table>
<thead>
<tr>
<th>PRESSURE (psi)</th>
<th>FLOW (gpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>97</td>
</tr>
<tr>
<td>50</td>
<td>86</td>
</tr>
<tr>
<td>100</td>
<td>5</td>
</tr>
<tr>
<td>150</td>
<td>4</td>
</tr>
<tr>
<td>200</td>
<td>32</td>
</tr>
<tr>
<td>250</td>
<td>1</td>
</tr>
<tr>
<td>300</td>
<td>10</td>
</tr>
<tr>
<td>350</td>
<td>15</td>
</tr>
<tr>
<td>400</td>
<td>20</td>
</tr>
<tr>
<td>450</td>
<td>25</td>
</tr>
<tr>
<td>500</td>
<td>30</td>
</tr>
<tr>
<td>550</td>
<td>35</td>
</tr>
<tr>
<td>600</td>
<td>40</td>
</tr>
<tr>
<td>650</td>
<td>45</td>
</tr>
<tr>
<td>700</td>
<td>50</td>
</tr>
<tr>
<td>750</td>
<td>55</td>
</tr>
<tr>
<td>800</td>
<td>60</td>
</tr>
<tr>
<td>850</td>
<td>65</td>
</tr>
<tr>
<td>900</td>
<td>70</td>
</tr>
<tr>
<td>950</td>
<td>75</td>
</tr>
<tr>
<td>1000</td>
<td>80</td>
</tr>
<tr>
<td>1050</td>
<td>85</td>
</tr>
<tr>
<td>1100</td>
<td>90</td>
</tr>
<tr>
<td>1150</td>
<td>95</td>
</tr>
<tr>
<td>1200</td>
<td>100</td>
</tr>
</tbody>
</table>

DIMENSIONS

- MOUNTING SCREW TORQUE: 2 to 3 ft-lbs (3 to 4 Nm)

MATERIALS

Cartridge including Coil: Weight: 0.23 kg. (0.50 lbs.); Steel with hardened work surfaces. Zinc-Nickel plated exposed surfaces; HNBR O-rings standard. Coil is encapsulated, class H high-temperature magnetwire, with zinc-nickel plated shell.

Special Ported Body: Consult factory.

TO ORDER

<table>
<thead>
<tr>
<th>TS98-T34</th>
<th>Option</th>
<th>Porting</th>
<th>Seals</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None (Blank)</td>
<td>Cartridge Only</td>
<td>Hydrogenated Nitrile (HNBR)</td>
<td>12 VDC (0.70 amps max.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24 VDC (0.35 amps max.)</td>
</tr>
</tbody>
</table>

Consult factory for other voltages.
**DESCRIPTION**
A screw-in, cartridge-style, direct acting, spool-type reducing/relieving valve, which can be infinitely adjusted across a prescribed range using a variable electric input. Pressure output is proportional to DC current input. This valve is intended for use as a pressure control device in demanding applications.

**OPERATION**
The EHPR08-33 allows free flow from $\text{➀}$ to $\text{➂}$ when no current is applied to the coil. When the coil is energized, $\text{➁}$ is connected to $\text{➀}$. Increasing current applied to the coil will increase the control (reduced) pressure proportionally. If pressure at $\text{➀}$ exceeds the setting induced by the coil, pressure from $\text{➀}$ is relieved to $\text{➂}$.

Note: Back pressure on port $\text{➂}$ becomes additive to the pressure setting at a 1:1 ratio.

**FEATURES**
- 12 and 24 volt coils standard.
- Optional manual override.
- Industry common cavity.
- Waterproofed coils standard.

**RATINGS**
- Maximum Port Pressure: 207 bar (3000 psi)
- Maximum Control Current: 1.2 amps for 12 VDC coil; 0.6 amps for 24 VDC coil; For other voltages, consult factory
- Dither Frequency Required: 200 Hz
- Typical Frequency Response: See Section 10
- Hysteresis: Less than 3%
- Reducing/Relieving Pressure Range from Zero to Maximum Control Current: 0–26 bar (0–375 psi)
- Rated Flow: 4.0 lpm (1.05 gpm), $\Delta P=6$ bar (87 psi), Cartridge only, $\text{➀}$ to $\text{➂}$ coil de-energized
- Step Response: $T_{\text{ON}} <30$ ms; $T_{\text{OFF}} <12$ ms
- Flow Path: Free Flow: $\text{➀}$ to $\text{➂}$ coil de-energized; Reduced: $\text{➁}$ to $\text{➀}$ coil energized; Relieving: $\text{➀}$ to $\text{➂}$ coil energized
- Temperature: -40 to 120°C (-40 to 250°F), with standard Buna N seals
- Ambient Air Temperature: -40 to 80°C (-40 to 176°F)
- Filtration: See page 9.010.1
- Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
- Installation: No restrictions; See page 9.020.1
- Cavity: VC08-3; See page 9.108.1; Cavity Tool: CT08-3XX; See page 8.600.1
- Seal Kit: SK08-3X-00; See page 8.650.1

**PERFORMANCE**
Pressure Drop vs. Flow Characteristic
For Flow $\text{➀}$ to $\text{➂}$ with Coil De-energized

**SPECIAL CHARACTERISTICS**

**Typical Relieving/Reducing Pressure vs. Flow Characteristic**
Typical Relieving Pressure at Various %’s of Maximum Control Current
Pressure Range “K” (26 bar/375 psi); Cartridge in Body
**PERFORMANCE (continued)**

**Typical Frequency Response Curves**

Input Current and Regulated Pressure

**Typical Step Response Curve**

Inlet: 35 bar (500 psi), 4 lpm (1 gpm)

Regulated: Blocked

Input Signal: Sinusoidal

**DIMENSIONS**

**Recommended Controllers** (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig. w/12V or 24V Coil</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000161</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000165</td>
<td>4000141</td>
<td>4000182</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000169</td>
<td>4000143</td>
<td>4000186</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

**MATERIALS**

**Cartridge:** Weight: 0.25 kg. (0.55 lbs.);
Steel with hardened work surfaces.
Zinc-plated exposed surfaces. Buna N O-rings.

**Standard Ported Body:** Weight: 0.16 kg. (0.35 lbs.);
Anodized high-strength 6061 T6 aluminum alloy,
rated to 240 bar (3500 psi); See page 8.008.1. Steel and ductile iron bodies available; dimensions may differ; consult factory.

**EHPR Series Coil:** Weight: 0.11 kg. (0.25 lbs.);
Unitized, thermoplastic encapsulated, Class H high temperature magnetwire; See page 3.200.1.

**TO ORDER**

**EHPR08-33**

<table>
<thead>
<tr>
<th>Option</th>
<th>None (Blank)</th>
<th>Manual Override</th>
<th>M</th>
</tr>
</thead>
</table>

**Porting**

<table>
<thead>
<tr>
<th>Cartridge Only</th>
<th>SAE 6</th>
<th>SAE 8</th>
<th>3/8 in. BSP*</th>
<th>1/2 in. BSP*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6T</td>
<td>8T</td>
<td>3B</td>
<td>4B</td>
</tr>
</tbody>
</table>

**Seals**

<table>
<thead>
<tr>
<th>Buna N (Std.)</th>
<th>Fluorocarbon</th>
</tr>
</thead>
</table>

**Terminations**

DS Dual Spades
DG DIN 43650
DL Leadwires (2)
DL/W Leads w/Weatherpak® Connectors
ER Deutsch DT04-2P

**Voltage**

0 Less Coil
10 *10 VDC (1.5 amps max.)
12 12 VDC (1.2 amps max.)
20 *20 VDC (0.75 amps max.)
24 24 VDC (0.6 amps max.)

*For use where there is a voltage drop across the controller. Consult factory for other voltages.
**DESCRIPTION**

A direct-acting, spool-type, drop-in-style, flange-mounted, pressure reducing/relieving valve, which can be infinitely adjusted across a prescribed range using a variable electric input. Pressure output is proportional to DC current input. The Ecoil is an integral part of the valve assembly, and cannot be replaced or field-serviced.

**OPERATION**

The EHPR98-T33 allows free flow from ➊ to ➋ when no current is applied to the coil. When the coil is energized, ➋ is connected to ➊. Increasing current applied to the coil will increase the control (reduced) pressure proportionally. If pressure at ➊ exceeds the setting induced by the coil, pressure from ➊ is relieved to ➋.

Note: Back pressure on port ➋ becomes additive to the pressure setting at a 1:1 ratio.

**FEATURES**

- Economical drop-in style.
- Integral waterproof coil standard.
- 10, 12, 20 or 24 VDC coils.
- Several push-on termination options.

**RATINGS**

- Maximum Inlet Pressure: 241 bar (3500 psi)
- Common Port Burst Pressure: One cycle at 158 bar (2300 psi) on all ports simultaneously pressurized
- Tank Port Pressure: 34.5 bar (500 psi) maximum for 100,000 cycles
- Maximum Control Current: 1.38 amps for 10 VDC coil; 1.30 amps for 12 VDC coil; 0.69 amps for 20 VDC coil; 0.65 amps for 24 VDC coil;
- Hysteresis: Less than 3% with 200 Hz PWM
- Rated Flow: 3.8 lpm (1.0 gpm), cartridge only, ➊ to ➋ coil de-energized
- Step Response: T<sub>ON</sub> <30 ms; T<sub>OFF</sub> <12 ms
- Temperature: -40 to 120°C (-40 to 250°F), with standard Buna N seals
- Ambient Air Temperature: -40 to 80°C (-40 to 176°F)
- Filtration: See page 9.010.1
- Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
- Installation: Flange Mount
- Mounting Screws: M4 x 0.7 x 10 Long; Part No. 4001015
- Cavity and Cavity Tool: VC-T009; See page 9.108.1
- Seal Kit: SK98-T39X-000; See page 8.650.1

**PERFORMANCE**

- Pressure Drop vs. Flow
  - Body and Line: ➊ to ➋ ——; ➋ to ➊ ——
  - Pressure Drop Chart
  - Flow vs. Pressure Chart

- Reducing Pressure vs. Current
  - Inlet: 241 bar/3500 psi; 200 Hz PWM
  - Reducing Pressure Chart

- Typical Relieving/Reducing Pressure vs. Flow Characteristic
  - Typical Relieving Pressure at Various %s of Maximum Control Current
  - Inlet: 241 bar/3500 psi; 100 Hz PWM (Both Directions)

**SYMBOLS**

USASI/ISO:

- Diagram of valve symbols

**DESCRIPTION**

A direct-acting, spool-type, drop-in-style, flange-mounted, pressure reducing/relieving valve, which can be infinitely adjusted across a prescribed range using a variable electric input. Pressure output is proportional to DC current input. The Ecoil is an integral part of the valve assembly, and cannot be replaced or field-serviced.

**OPERATION**

The EHPR98-T33 allows free flow from ➊ to ➋ when no current is applied to the coil. When the coil is energized, ➋ is connected to ➊. Increasing current applied to the coil will increase the control (reduced) pressure proportionally. If pressure at ➊ exceeds the setting induced by the coil, pressure from ➊ is relieved to ➋.

Note: Back pressure on port ➋ becomes additive to the pressure setting at a 1:1 ratio.

**FEATURES**

- Economical drop-in style.
- Integral waterproof coil standard.
- 10, 12, 20 or 24 VDC coils.
- Several push-on termination options.

**RATINGS**

- Maximum Inlet Pressure: 241 bar (3500 psi)
- Common Port Burst Pressure: One cycle at 158 bar (2300 psi) on all ports simultaneously pressurized
- Tank Port Pressure: 34.5 bar (500 psi) maximum for 100,000 cycles
- Maximum Control Current: 1.38 amps for 10 VDC coil; 1.30 amps for 12 VDC coil; 0.69 amps for 20 VDC coil; 0.65 amps for 24 VDC coil;
- Hysteresis: Less than 3% with 200 Hz PWM
- Rated Flow: 3.8 lpm (1.0 gpm), cartridge only, ➊ to ➋ coil de-energized
- Step Response: T<sub>ON</sub> <30 ms; T<sub>OFF</sub> <12 ms
- Temperature: -40 to 120°C (-40 to 250°F), with standard Buna N seals
- Ambient Air Temperature: -40 to 80°C (-40 to 176°F)
- Filtration: See page 9.010.1
- Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 ssu)
- Installation: Flange Mount
- Mounting Screws: M4 x 0.7 x 10 Long; Part No. 4001015
- Cavity and Cavity Tool: VC-T009; See page 9.108.1
- Seal Kit: SK98-T39X-000; See page 8.650.1

**PERFORMANCE**

- Pressure Drop vs. Flow
  - Body and Line: ➊ to ➋ ——; ➋ to ➊ ——
  - Pressure Drop Chart
  - Flow vs. Pressure Chart

- Reducing Pressure vs. Current
  - Inlet: 241 bar/3500 psi; 200 Hz PWM
  - Reducing Pressure Chart

- Typical Relieving/Reducing Pressure vs. Flow Characteristic
  - Typical Relieving Pressure at Various %s of Maximum Control Current
  - Inlet: 241 bar/3500 psi; 100 Hz PWM (Both Directions)
**PERFORMANCE** (continued)

**Typical Frequency Response Curves**
Inlet: 241 bar/3500 psi; Regulated Port Blocked
Signals: 40% ±10%; 50% ±25%; 70% ±20%

**MATERIALS**
Cartridge including Coil: Weight: 0.20 kg. (0.44 lbs.); Steel with hardened work surfaces. Zinc-Nickel plated exposed surfaces; HNBR O-rings standard. Coil is encapsulated, class H high-temperature magnetwire, with zinc-nickel plated shell.

**Ported Body:** Consult Factory

**TO ORDER**

**Option**
None (Blank) S

**Porting**
Consult Factory

**Seals**
Hydrogenated Nitrile (HNBR)

**Voltage**
10 10 VDC
12 12 VDC
20 20 VDC
24 24 VDC

**Termination**
ER Deutsch DT04-2P
EJ Amp Junior Timer

**DIMENSIONS**

**Mounting Screw Torque:**
0.9–1.1 ft-lbs (1.2–1.5 Nm)

**Recommended Controllers** (See Section 3)

<table>
<thead>
<tr>
<th>Input Sig. w/12V or 24V Coil</th>
<th>DIN Coil Mount</th>
<th>PCB Board</th>
<th>Metal Box</th>
<th>DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>4000161</td>
<td>4000194</td>
<td>4000174</td>
<td>4000136</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>4000165</td>
<td>4000141</td>
<td>4000182</td>
<td>4000137</td>
</tr>
<tr>
<td>4-20 mA</td>
<td>4000169</td>
<td>4000143</td>
<td>4000186</td>
<td>4000139</td>
</tr>
<tr>
<td>PWM</td>
<td>—</td>
<td>4000144</td>
<td>4000133</td>
<td>4000140</td>
</tr>
</tbody>
</table>

**OTHER**
Other voltages and coils with internal diode are available. Consult factory.
**DESCRIPTION**

A direct-acting, spool-type, drop-in-style, flange-mounted, pressure reducing/relieving valve, which can be infinitely adjusted across a prescribed range using a variable electric input. Pressure output is proportional to DC current input. The Ecoil is an integral part of the valve assembly, and cannot be replaced or field-serviced.

**OPERATION**

The **EHPR98-T35** allows free flow from ➊ to ➋ when no current is applied to the coil. When the coil is energized, ➋ is connected to ➊. Increasing current applied to the coil will increase the control (reduced) pressure proportionally. If pressure at ➊ exceeds the setting induced by the coil, pressure from ➊ is relieved to ➋.

Note: Back pressure on port ➋ becomes additive to the pressure setting at a 1:1 ratio.

**FEATURES**

- Economical drop-in style.
- Integral waterproof coil standard.
- 1000-hour salt spray protection.
- 10, 12, 20 or 24 VDC coils.

**RATINGS**

**Maximum Inlet Pressure:** 103 bar (1500 psi); If higher inlet pressure is required (103 bar/1500 psi to 241 bar/3500 psi) select the “A” option in the model code.

**Maximum Tank Pressure:** 34.5 bar (500 psi); with Manual Override Option: 17.2 bar (250 psi)

**Control Pressure at Maximum Control Current:** 20.7 bar (300 psi)

**Maximum Control Current:** 1.38 amps for 10 VDC coil; 1.30 amps for 12 VDC coil; 0.69 amps for 20 VDC coil; 0.65 amps for 24 VDC coil

**Resistance:** 4.2Ω (10V); 5.1Ω (12V); 17.0Ω (20V); 19.3Ω (24V)

**Inductance:** 80 mH (12V);

**Hysteresis:** Less than 4% with 100 Hz PWM

**Flow Rating:** 5.7 lpm (1.5 gpm)

**Maximum Internal Leakage:**

De-energized: 75 ml/minute (4.58 cu. in./minute) at 25 bar (365 psi); 200 ml/minute (12.2 cu. in. minute) at 241 bar (3500 psi).

Energized at I-Max.: 125 ml/minute (7.63 cu. in./minute) at 25 bar (365 psi); 400 ml/minute (24.4 cu. in. minute) at 241 bar (3500 psi).

**Temperature:** -40 to 120°C (-40 to 250°F), with standard Buna N seals

**Ambient Air Temperature:** -40 to 80°C (-40 to 176°F)

**Environmental Rating:** IP69K

**Filtration:** See page 9.010.1

**Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 sus); See Temperature and Oil Viscosity, page 9.060.1

**Installation:** Flange Mount

**Mounting Screws:** M4 x 0.7 x 12 Long; Part No. 4001015 (not provided with valve)

**Cavity:** VC-T009; See page 9.111.1 **Cavity Tool:** CT-T009R0-x-G; See page 8.600.1

**Seal Kit:** SKEHPR98-T3X; See page 8.650.1

**Typical Relieving/Reducing Pressure vs. Flow Characteristic**

Inlet: 25 bar/365 psi ——— ; Inlet: 241 bar/3500 psi - - - - -

100 Hz PWM (Both Directions); Note: Curves overlap on Relieving Pressure (LH) side of graph

**ELECTRO-PROPORTIONAL VALVES—PRESSURE CONTROLS**

**EHPR98-T35 Proportional Reducing/Relieving**
**Drop-In-Style Valve**

**EHPR98-T35**

**PERFORMANCE** (continued)

Typical Frequency Response Curves
Inlet: 25 bar/365 psi; DC Current; Regulated Port Blocked
Signals: 40% ±10%; 50% ±25%; 70% ±20%; 80% ±10%

Note: For additional Frequency Response or Step Response information, consult factory.

**DIMENSIONS**

**MATERIALS**

Cartridge including Coil:
Weight: 0.20 kg. (0.44 lbs.)
Steel with hardened work surfaces. Zinc-Nickel plated exposed surfaces. HNBR O-rings standard. Coil is encapsulated, class H high-temperature magnetwire, with zinc-nickel plated shell.

Ported Test Body:
Consult Factory

Mounting Screws:
Must be ordered separately:
Part No. 4001015

**TO ORDER**

**EHPR98-T35**

Inlet Pressure
0 to 103 bar (0 to 1500 psi) (Blank)
103 to 241 bar (1500 to 3500 psi) A

Option
None (Blank) M
Manual Override

Screen Option
None (Blank) S
142µ on Inlet Port 2

Porting
Cartridge Only 0

Diode
None Z
Zener Diode, Bidirectional

Voltage
10 10 VDC
12 12 VDC
20 20 VDC
24 24 VDC

Termination
ER Deutsch DT04-2P
EJ Amp Junior Timer

Seals
N Hydrogenated Nitrile (HNBR)
V Fluorocarbon
**DESCRIPTION**

A direct-acting, spool-type, drop-in-style, flange-mounted, pressure reducing/relieving valve, which can be infinitely adjusted across a prescribed range using a variable electric input. Pressure output is proportional to DC current input. The Ecoil is an integral part of the valve assembly, and cannot be replaced or field-serviced.

**OPERATION**

The EHPR98-T38 allows free flow from ➀ to ➂ when no current is applied to the coil. When the coil is energized, ➁ is connected to ➀. Increasing current applied to the coil will increase the control (reduced) pressure proportionally. If pressure at ➀ exceeds the setting induced by the coil, pressure from ➀ is relieved to ➂.

Note: Back pressure on port ➂ becomes additive to the pressure setting at a 1:1 ratio.

**FEATURES**

- Economical drop-in style.
- Integral waterproof coil standard.
- 10, 12, 20 or 24 VDC coils.

**RATINGS**

- **Maximum Inlet Pressure:** 241 bar (3500 psi)
- **Tank Port (➂) Pressure:** 34.5 bar (500 psi) maximum;
  17.2 bar (250 psi) maximum with manual override option.
- **Maximum Control Current:** 1.38 amps for 10 VDC coil; 1.30 amps for 12 VDC coil;
  0.69 amps for 20 VDC coil; 0.65 amps for 24 VDC coil;
- **Control Pressure at Maximum Control Current:** 30 bar (435 psi)
- **Resistance:** 4.3 ohm (10V); 5.2 ohm (12V); 17.5 ohm (20V); 20.9 ohm (24V)
- **Inductance:** 80 mH (12V)
- **Hysteresis:** at 150 Hz PWM: 5% of maximum control pressure
- **Flow Rating:** 18.9 lpm (5.0 gpm)
- **Maximum Internal Leakage:** De-energized: 50 ml/min. (3 cu. in./min.) at 34.5 bar (500 psi);
  Energized at I-max: 100 ml/min. (6 cu. in./min.) at 34.5 bar (500 psi)
- **Temperature:** -40 to 120°C (-40 to 250°F), with standard Buna N seals
- **Ambient Air Temperature:** -40 to 80°C (-40 to 176°F)
- **Environmental Rating:** IP69K
- **Filtration:** See page 9.010.1
- **Fluids:** Mineral-based or synthetics with lubricating properties at viscosities of
  7.4 to 420 cSt (50 to 2000 sus); See Temperature and Oil Viscosity, page 9.060.1
- **Mounting Screws:** M4 x 0.7 x 12 Long; Part No. 4001015 (not provided with valve)
- **Cavity:** VC-T011; See page 9.111.1
- **Cavity Tool:** CT-T011R0-x-G; See page 8.600.1
- **Seal Kit:** SK-T011; See page 8.650.1

**Flow vs. Pressure Characteristics**

- **Reducing Pressure vs. Current**
  Inlet: 34.5 bar/500 psi; 150 Hz PWM; 12V Coil
- **Relieving Pressure vs. Current**
  Inlet: 34.5 bar/500 psi; 150 Hz PWM; 12V Coil

**Electro-Proportional Valves—Pressure Controls**

HYDRAFORCE.com

2.973.1
**Drop-In-Style Valve**

**EHPR98-T38**

**PERFORMANCE** (continued)

**Typical Frequency Response Curves**
- Inlet: 34.5 bar/500 psi; DC Current; Regulated Port Blocked
  - For 241 bar/3500 psi inlet frequency response curves, consult factory.

**Signals:** 40% ±10% ———; 50% ±25% ———; 70% ±20% ———; 80% ±10% ———

![Typical Frequency Response Curve](image)

**Typical Step Response Curve**
- Inlet 34.5 bar/500 psi; DC Current; Regulated Port Blocked

![Typical Step Response Curve](image)

**DIMENSIONS**

![Dimension Diagram](image)

**Note:** To operate manual override, rotate screw clockwise until desired pressure is achieved.

**MATERIALS**

**Cartridge including Coil:**
- Weight: 0.32 kg. (0.70 lbs.) Steel with hardened work surfaces. Zinc-Nickel plated exposed surfaces. HNBR O-rings standard. Coil is encapsulated, class H high-temperature magnetwire, with zinc-nickel plated shell.

**Ported Test Body:** Consult Factory

**Mounting Screws:** Must be ordered separately: Part No. 4001015

**Recommended Electronic Controllers:**
- See page 2.001.1 or our Electronics catalog.

**TO ORDER**

<table>
<thead>
<tr>
<th>Option</th>
<th>Voltage</th>
<th>Diode</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>10 VDC</td>
<td>(Blank)</td>
</tr>
<tr>
<td>Manual Override</td>
<td>12 VDC</td>
<td>Z Zener Diode, Bidirectional</td>
</tr>
<tr>
<td>Cartridge Only</td>
<td>20 VDC</td>
<td>(Blank) EJ Deutsch DT04-2P Amp Junior Timer</td>
</tr>
<tr>
<td></td>
<td>24 VDC</td>
<td>V Fluorocarbon</td>
</tr>
</tbody>
</table>

**Seals**
- Hydrogenated Nitrile (HNBR) N
- Fluorocarbon V

**Termination**
- Other voltages are available. Consult factory.
HSP16-20  HyPerformance™ Poppet, 2-Way, N.C.

DESCRIPTION
A proportional solenoid-operated, 2-way, poppet-type, normally closed, screw-in hydraulic cartridge valve for low-leakage blocking and load-holding in high pressure applications requiring low internal leakage.

OPERATION
When de-energized, the HSP16-20 acts as a check valve, allowing flow from ➀ to ➁, and blocking flow from ➁ to ➀. When energized, the ➁ to ➀ flow path opens. Flow is proportional to current applied to the coil.

Note: If low voltage is expected on the machine, 12 or 24 volt systems will require the use of 10 volt or 20 volt coils respectively. See “SP Valves and Coil Operating Parameters,” page 2.002.1.

FEATURES
• Industry-common cavity.
• Efficient wet-armature construction.
• Continuous-duty rated coils.
• Waterproof E-Coils rated up to IP69K.
• 1000-hour salt-spray rated solenoid tubes.
• All HyPerformance products are tested to NFPA specification T2.6.1, and are tested at a verification level of 90% and an assurance of 99%.

RATINGS
Operating Pressure: 350 bar (5075 psi); 10% Cycle Life: 420 bar (6090 psi)
Fatigue Rating: 2 million cycles at 420 bar
Burst Pressure: 1380 bar (20,000 psi)
Flow: Up to 265 lpm (70 gpm); see performance curves.
Hysteresis: From 3.8 to 11.3 lpm (1 to 3 gpm); Less than 7.6 lpm (2 gpm); From 11.3 to 113.4 lpm (3 to 30 gpm); Less than 15.1 lpm (4 gpm);
Maximum Control Current: 1.2 amps
Max. Internal Leakage: 7 drops per minute at 345 bar (5000 psi) inlet
Temperature: -54° to 107°C (-65° to 225°F) with Urethane seals
Fluids: Mineral-based or synthetics with lubricating properties at viscosities of 7.4 to 420 cSt (50 to 2000 sus); See Temperature and Oil Viscosity, page 9.060.1
Filtration: See page 9.010.1; Installation: No Restrictions. See page 9.020.1
Cavity: HVC16-2; See page 9.116.1; Cavity Tool: HCT16-2XX; See page 8.600.1
Seal Kit: SK16-2U-O; See page 8.650.1; Coil Nut: Part No. 4553800

PERFORMANCE

FLOW vs. CURRENT at Various Inlet Pressures with 12 VDC Coil — 32 cSt/150 sus oil at 40°C

TYPICAL PRESSURE RESPONSE

Recommended Electronic Controllers:
See page 2.001.1 or our Electronics catalog.
HSP16-20

DIMENSIONS

COIL MUST BE INSTALLED WITH LETTERING UP

TORQUE: 5 – 7 ft-lb.  6.8 – 9.5 Nm

ACROSS FLATS

TORQUE: 195 – 205 ft-lb.  265 – 278 Nm

ORIFICE DISC CANNOT BE USED WITH THIS PRODUCT due to HyPerformance™ Cavity.

MATERIALS

Cartridge: Weight: 0.32 kg.  (0.71 lbs.); Steel with hardened work surfaces. Zinc-plated exposed surfaces. Urethane O-rings with no back-up standard.

Ported Body: Ductile iron recommended for pressures above 207 bar (3000 psi). Consult Factory.

E-Coil: Weight: 0.41 kg. (0.9 lbs.); Fully encapsulated with rugged external metal shell. Rated up to IP69K with integral connectors. See page 3.400.1.

TO ORDER

HSP16-20

Option

None (Blank)

Porting

Cartridge Only

Seals

PPDI Urethane Recommended for pressures above 241 bar (3500 psi).

Voltage

0 Less Coil**
10 10 VDC (0- or E-Coil)
12 12 VDC (0- or E-Coil)
20 20 VDC (E-Coil)
24 24 VDC (0- or E-Coil)

**Includes E-Coil Nut.

Coil Termination

Deutsch DT04-2P ER (IP69K)
Metri-Pak 150 EY (IP69K)
Dual Lead Wires EL (IP69K)
Amp Jr. Timer EJ (IP67)
DIN 43650 EG (IP65)

For Coils with Zener Diode, add “/Z” to option code. For example: “ER/Z”. Not available on all models. See coil option info. on page 3.400.1