

PV

# Proportional Valves



*Danfoss*

# Proportional Valves

## Application Notes

### Basic Operation: Solenoid Valves

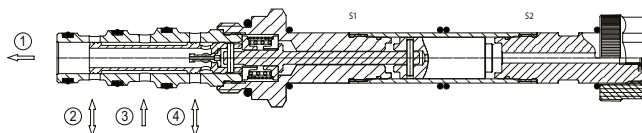
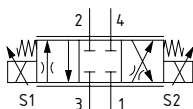
A proportional valve, or electro-proportional valve, controls pressure or flow in response to a change in current applied to the coil used to activate the valve.

There are 4 basic functions provided by proportional valves:

- **Directional control** - 2, 3, 4 and 5 ported valves where the oil can be diverted or directed within the circuit to control the motion of an actuator. They can include load sense ports to signal a pump or a compensator to react when the system demands it.
- **Flow control** - 2 and 3 ported valves function as an infinitely adjustable orifice. They are available as non-compensated or with an integrated compensator to provide restrictive (2 port) or priority (3 port) flow control functions in a single cartridge.
- **Pressure relieving** - Relief valves where the pressure setting is adjusted proportionally with the electrical input signal. They are available as pilot valves or as pilot operated valves in a single cartridge in both normally closed and normally open configurations.
- **Pressure reducing** - Valves where the downstream pressure is controlled proportionally with the electrical input signal. They are available with or without reverse relief functionality.

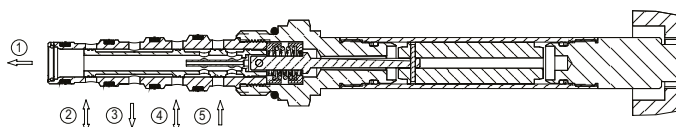
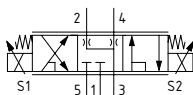
### 4-Way, 3-Position Proportional Directional Control Valves

4-way, 3-position proportional directional valves control the direction of the flow within a system, opening proportionally based on the electrical input signal. They are available with all ports closed and motor spool center positions, where the outlet ports 2 and 4 are connected to tank, port 1.



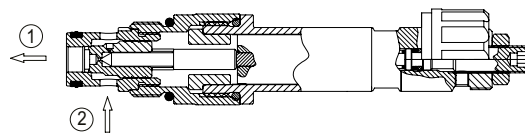
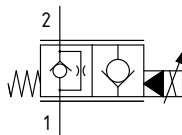
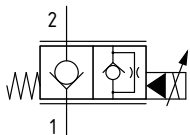
### 5-Way, 3-Position Proportional Directional Control Valves

5-way, 3-position proportional directional valves control the direction of the flow within a system, opening proportionally based on the electrical input signal. They offer load sense at port 1, which sends a signal to a pump or compensator to react when flow is required. In the center position (de-energized), the outlet ports 2 and 4 are connected to tank port 3 and the load sense port 1 is blocked. These are also available with an integral check valve on the load sense port.



### Proportional Poppet Type Flow Control Valves (Non-Compensated)

Proportional poppet type flow control valves are non-compensated, 2-position, 2-way normally open or closed valves. They provide an infinitely variable orifice with a load holding function when in the closed position. The outlet flow depends on the pressure differential across the valve and the opening area between the poppet and the seat. For optimal performance, these should be applied with a compensator to control the pressure differential across valve.

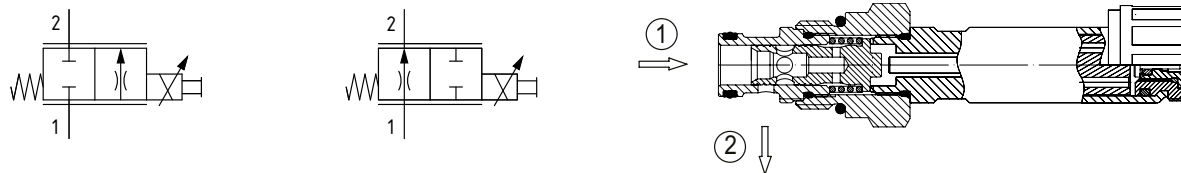


# Proportional Valves

## Application Notes

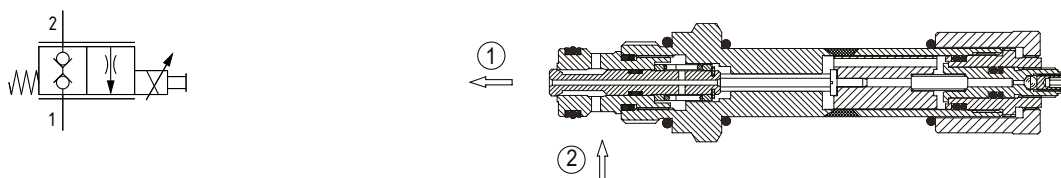
### Proportional Spool Type Flow Control Valves (Non-Compensated)

Proportional spool type flow control valves are non-compensated, 2-position, 2-way normally open or closed valves. They provide an infinitely variable orifice and the outlet flow depends on the pressure differential across the valve and the opening created by the spool and the cross holes in the sleeve. For optimal performance, these should be applied with a compensator to control the pressure differential across valve.



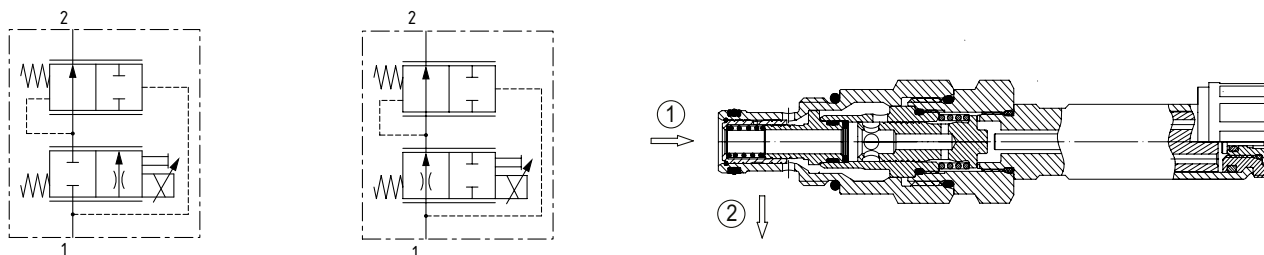
### Proportional Double Blocking Poppet Type Flow Control Valves (Non-Compensated)

Double blocking proportional poppet type flow control valves are 2-position, 2-ported normally closed bi-directional valves. These provide an infinitely variable orifice when opened and a load holding function when in the closed position. The outlet flow depends on the pressure differential across the valve and the opening area between the poppet and the seat. These valves are ideal for load lowering applications on boom or scissor lifts.



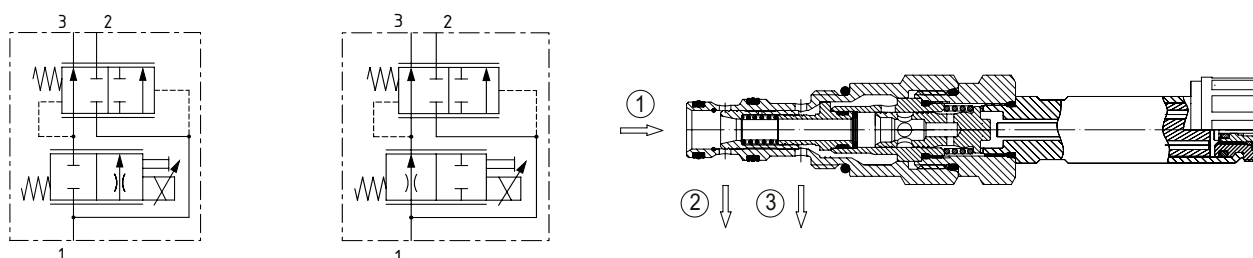
### Proportional Pressure Compensated Restrictive Type Flow Control Valves

These are 2-way electro proportionally adjusted restrictive-type flow regulators, which are available in normally open or normally closed configurations. The valve consists of an infinitely variable control orifice in conjunction with a compensating spool. They provide controlled flow that can be varied with input current, which remains constant regardless of the pressure difference between the inlet and the outlet pressure.



### Proportional Pressure Compensated Restrictive Type Flow Control Valves

These are 3 ported electro proportionally adjusted Priority type flow regulators, which are available in normally open or normally closed configurations. The valve consists of an infinitely variable control orifice that operates in conjunction with a compensating spool. They provide priority, controlled flow that can be varied with input current, while the excess flow passes through the bypass port. The priority flow remains constant regardless of changes in pressure across the valve or the bypass pressure being higher or lower than the priority pressure.

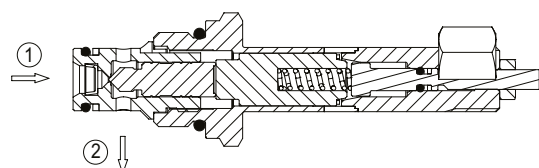
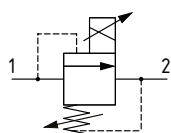


# Proportional Valves

## Application Notes

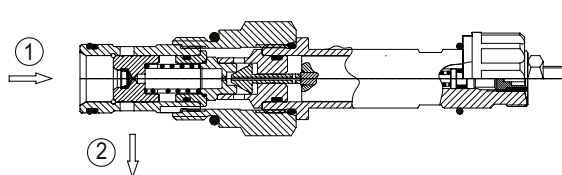
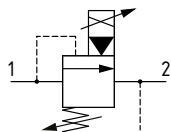
### Proportional Direct Acting Pressure Relief Valves

These are low flow, electro proportionally adjusted pressure relief valves that are available in normally open or closed configurations. They are typically used in conjunction with higher flow valves, such as logic elements, to create a high flow relief. Normally open valves will relieve at minimum pressure when de-energized, and the pressure setting will increase as the input current is increased. Normally closed valves will relieve at a pre-set value when de-energized, and the pressure setting will decrease as the input current is increased. These are ideal for applications such as cooling fan drives, where the fan needs to be at full speed if there is a power failure or a problem with a coil.



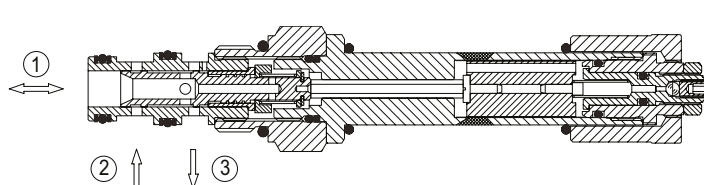
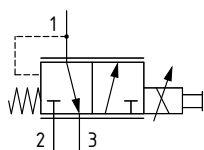
### Proportional Pilot Operated Pressure Relief Valves

These are pilot operated, electro proportionally adjusted pressure relief valves that are available in normally open or closed configurations. Normally open valves will relieve at minimum pressure when de-energized, and the pressure setting will increase as the input current is increased. Normally closed valves will relieve at a pre-set value when de-energized, and the pressure setting will decrease as the input current is increased. These are ideal for applications such as cooling fan drives, where the fan needs to be at full speed if there is a power failure or a problem with a coil.



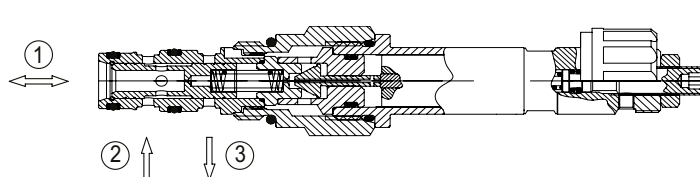
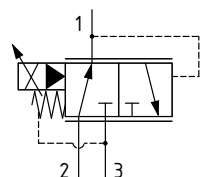
### Proportional Direct Acting Pressure Reducing / Relieving Valves

These are 2-way electro proportionally adjusted restrictive-type flow regulators, which are available in normally open or normally closed configurations. The valve consists of an infinitely variable control orifice in conjunction with a compensating spool. They provide controlled flow that can be varied with input current, which remains constant regardless of the pressure difference between the inlet and the outlet pressure.



### Proportional Pilot Operated Pressure Reducing / Relieving Valves

These are pilot operated, electro proportionally adjusted, pressure reducing valves with a reverse relief function. When the outlet pressure reaches the pressure setting, the valve restricts flow from the inlet (port 2). If, through external influence, the regulated pressure (port 1) should rise, the valve will relieve the excess flow to tank (port 3). These valves are available with the max setting at max current or inverse with the max setting at zero current. The proportional adjustment of these valves by an electrical signal allows for remote control of the outlet pressure in line with smooth operation of any actuator.



# Proportional Valves

## Application Notes

### Application Recommendations

- All Danfoss cartridge proportional valves are analog-type valves that control flow or pressure related to an electrical input.
- These valves should be controlled using current, as the force or movement created within the valve is proportional to the current. If voltage control is applied, a temperature increase in the coil will reduce the current as the resistance increases, directly impacting the output of the valve.
- In general, a current based controller supply using PWM (Pulse Width Modulation) of 100-200Hz is recommended to reduce hysteresis and improve control. Refer to each product page for specific recommendations.
- Many of the valves can be used with a separate mainstage or compensator element. This increases the maximum flow to which you can apply these valves.

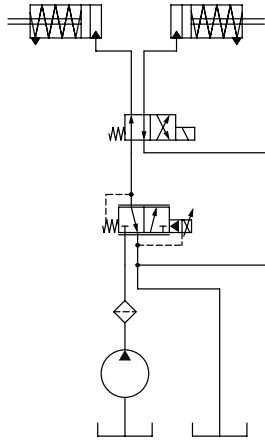
### TERMS AND DEFINITIONS

- **Compensator** is a hydraulic component that maintains a constant pressure drop across a fixed or variable orifice.
- **Current** is the flow of electricity through a conductor or coil, normally measured in amp (A) Steady-state current flow in an electrical circuit can be calculated by Ohm's Law, as well as voltage and resistance.  
Ohm's Law  $I=V/R$
- **Current Control** is a feature of almost all valve drivers. The output of analogue proportional valves is a direct function of current. If a valve is controlled with voltage, higher solenoid temperatures, which increase solenoid resistance, will result in lower valve output. To compensate for this, most valve drivers are designed with current feedback circuitry. This means that as solenoid temperature rises or as supply voltage losses change, the current and corresponding valve output are Current maintained.
- **Deadband** is the range from zero to the minimum current which causes the valve Input to respond.
- **Digital Proportional Valves** are extremely fast responding valves that are controlled by a precise on-off signal to produce an average output that is a function of duty cycle.
- **Dither** is a "ripple" signal sent to a solenoid to reduce hysteresis. Dither can be a sine, square, or saw-tooth wave superimposed on a PWM signal or it can be a wave on top of a DC signal.
- **Duty Cycle** is the % of time the valve is on divided by total time.
- **Hysteresis** is the difference in output for a given input, depending on whether the input is increasing or decreasing. It is normally expressed as a % of the maximum rated output. For example, if a 160 l/min 42 US gal/min proportional flow control valve provides 80 l/min 21 US gal/min with 1 amp-increasing and 88 l/min 23 US gal/min at 1 amp-decreasing, the hysteresis is:  
 $(88.80)/160=5\%$
- **I min** is the minimum current required for valve response (see deadband).
- **I max** is the current required for maximum valve output.
- **PWM** is an acronym for Pulse-Width-Modulation. Most valve drivers use a current controlled PWM which produces an average output that is a function of duty cycle in order to reduce valve hysteresis and to allow current control without excessive heat generation. A typical PWM output is a square wave from 80-500 Hz.
- **Ramping** is the application of current to a solenoid with a linear or non-linear ramp, rather than an instantaneous step. Ramping current on and off to a proportional valve provides actuators with soft-starts and soft-stops. Ramps can generally be set or pre-programmed into valve drivers
- **Resistance** is a component's opposition to the flow of electrical current, usually measured in ohms ( $\Omega$ ). Resistance depends on the conductivity of the material, as well as size, shape, and temperature. Solenoid resistance can vary greatly with temperature; to compensate for this, current-controlled drivers are generally always used with proportional valves.
- **Threshold** is the minimum current required for valve response; see deadband.
- **Valve Driver** is a generic term for any device that sends a signal to a proportional valve. A valve driver may range from a simple electronic circuit attached to a knob or lever up to a microcontroller with custom software and multiple inputs and outputs.
- **Voltage** is the potential for current to flow in an electric circuit, usually measured in volts (V).

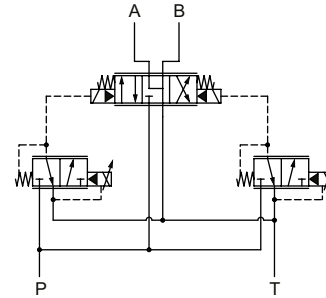
# Proportional Valves

## Application Notes

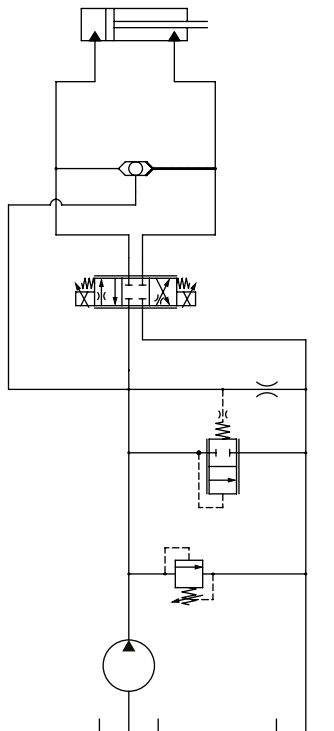
### Typical Applications



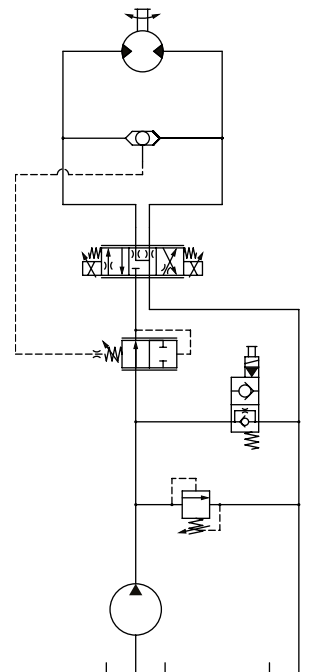
▲ Proportional Dual Clutch Circuit



▲ Proportional Pilot Control



▲ Pressure compensated.  
Cylinder control



▲ Pressure compensated.  
Motor control

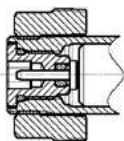
# Proportional Valves

## Manual Override Options

Note: Manual overrides are intended for emergency use only, not for continuous duty operation.

### "Omit/PN" - Push Pin

#### 10, 12, and 16 series



#### Product Availability

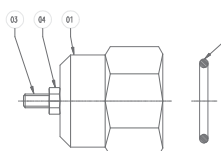
PSV10-NC	PSVP10-NOR	PFC10-R0	PFC10-P0
PSV12-NC	PSVP12-NOR	PFC12-R0	PFC12-P0
PSV16-NC	PSVP16-NOR	PFC16-R0	PFC16-P0
PSV10-N0	PFC10-RC	PFC10-PC	
PSV12-N0	PFC12-RC	PFC12-PC	
PSV16-N0	PFC16-RC	PFC16-PC	

#### OPERATION

1. Push the pin toward the valve using a hex key to actuate override
2. Remove the hex key to return to neutral position

### "EN" - Screw Type

#### 04 and 06 series



#### Product Availability

XMD 04	XMP 06	XRP 06
--------	--------	--------

#### OPERATION

1. Screw the screw clockwise to actuate override
2. Unscrew the screw counterclockwise to return to neutral position

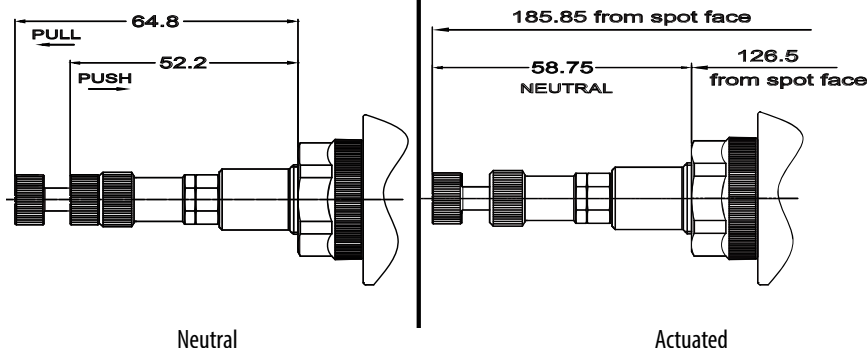
### "PAP" - Push and Pull

#### 08 series

#### 10 series

#### Product Availability

PSV10-34-02	PSV10-34-05
-------------	-------------



#### OPERATION

1. Push the knob toward the valve to actuate the override in one direction.
2. Pull the knob away from the valve to actuate the override in the opposite direction.
3. In either direction, release the knob to return the override to the neutral position.

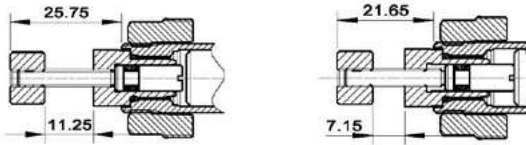
# Proportional Valves

## Manual Override Options

Note: Manual overrides are intended for emergency use only, not for continuous duty operation.

### "SPS" - Screw Type

#### 10, 12, 16 series



Neutral

Actuated

#### OPERATION

1. Screw the knob clockwise to actuate override
2. Unscrew the knob counterclockwise to return to neutral position

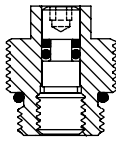
#### Product Availability

PSV10-NC	PSVP10-NOR	PFC10-RO	PFC10-PO
PSV12-NC	PSVP12-NOR	PFC12-RO	PFC12-PO
PSV16-NC	PSVP16-NOR	PFC16-RO	PFC16-PO
PSV10-NO	PFC10-RC	PFC10-PC	
PSV12-NO	PFC12-RC	PFC12-PC	
PSV16-NO	PFC16-RC	PFC16-PC	

### "S" - Screw Type

#### 10, 12, and 16 series

S - Screw type



Neutral 3 mm hex

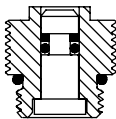
#### Product Availability

EPV10	EPV16	EFV2-12-C
EFV2-12-O	PPAR1-10	

### "M" - Pin Type

#### 10 and 16 series

M - Pin type



Neutral

#### Product Availability

EPV10	EPV16
-------	-------

\*Only available for system pressures less than 210 bar [3000 psi]

### "M" - Push and Pull

#### Product Availability

ESVL9-10-E	ESVL9-10-F
ESVL9-10-E-C	ESVL9-10-F-C

### "6" - Screw Type

#### Product Availability

PFR21H	PFR24A
PPD22A	

### "M" - Knob Type

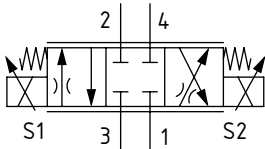
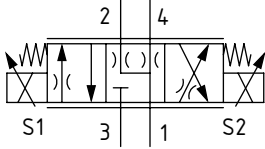
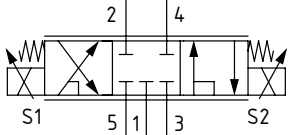
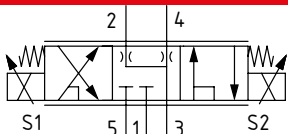
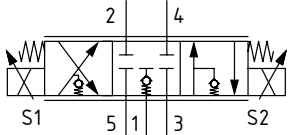
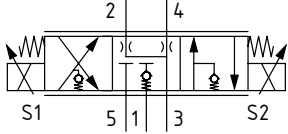
#### Product Availability

ESV1-8-C	ESV1-10-C	ESV1-12-C
ESV1-8-O	ESV1-10-O	ESV1-12-O



# Proportional Valves

## Quick Reference

Proportional Directional Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<a href="#">PSV10-34-02</a>	<b>SDC10-4</b>	Proportional Directional Valve, 4-way, 3-position, Spool Type, Non-Compensated	22 l/min [5.8 US gpm]	250 bar [3600 psi]	<b>15</b>
	<a href="#">PSV12-34-02</a>	<b>CP12-4</b>	Proportional Directional Valve, 4-way, 3-position, Spool Type, Non-Compensated	50 l/min [13 US gpm]	250 bar [3600 psi]	<b>16</b>
Proportional Directional Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<a href="#">PSV08-34-05</a>	<b>SDC08-4</b>	Proportional Directional Valve, 4-way, 3-position, Spool Type, Non-Compensated	12 l/min [3.2 US gpm]	240 bar [3500 psi]	<b>17</b>
	<a href="#">PSV10-34-05</a>	<b>SDC10-4</b>	Proportional Directional Valve, 4-way, 3-position, Spool Type, Non-Compensated	22 l/min [5.8 US gpm]	250 bar [3600 psi]	<b>18</b>
	<a href="#">PSV12-34-05</a>	<b>CP12-4</b>	Proportional Directional Valve, 4-way, 3-position, Spool Type, Non-Compensated	60 l/min [16 US gpm]	250 bar [3600 psi]	<b>19</b>
Proportional Directional Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<a href="#">ESVL9-10-E</a>	<b>SDC10-5</b>	Proportional Directional Valve, 5-way, 3-position, Spool Type, Non-Compensated	23 l/min [6 US gpm]	250 bar [3600 psi]	<b>20</b>
Proportional Directional Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<a href="#">ESVL9-10-F</a>	<b>SDC10-5</b>	Proportional Directional Valve, 5-way, 3-position, Spool Type, Non-Compensated	23 l/min [6 US gpm]	250 bar [3600 psi]	<b>21</b>
Proportional Directional Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<a href="#">ESVL9-10-E-C</a>	<b>SDC10-5</b>	Proportional Directional Valve, 5-way, 3-position, Spool Type, Non-Compensated, Load Sense Check	23 l/min [6 US gpm]	250 bar [3600 psi]	<b>22</b>
Proportional Directional Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<a href="#">ESVL9-10-F-C</a>	<b>SDC10-5</b>	Proportional Directional Valve, 5-way, 3-position, Spool Type, Non-Compensated, Load Sense Check	23 l/min [6 US gpm]	250 bar [3600 psi]	<b>23</b>

\*Flow ratings are for reference only. Refer to individual product page for performance information.

# Proportional Valves

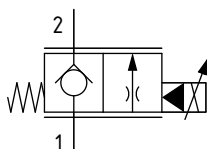
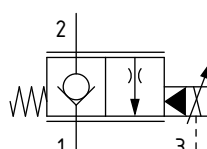
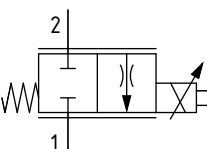
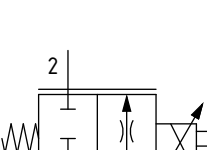
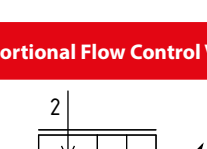
## Quick Reference

Proportional Flow Control Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<a href="#">ESV1-8-C</a>	<b>SDC08-2</b>	Proportional Flow Control Valve, Poppet Type, Normally Closed, Pilot Operated, Non-Compensated	32 l/min [8.4 US gpm]	210 bar [3000 psi]	<b>24</b>
	<a href="#">ESV1-10-C</a>	<b>SDC10-2</b>	Proportional Flow Control Valve, Poppet Type, Normally Closed, Pilot Operated, Non-Compensated	70 l/min [18.5 US gpm]	210 bar [3000 psi]	<b>25</b>
	<a href="#">PSVP10-NCR</a>	<b>SDC10-2</b>	Proportional Flow Control Valve, Poppet Type, Normally Closed, Pilot Operated, Non-Compensated	100 l/min [26 US gpm]	260 bar [3800 psi]	<b>26</b>
	<a href="#">ESV1-12-C</a>	<b>C-12-2</b>	Proportional Flow Control Valve, Poppet Type, Normally Closed, Pilot Operated, Non-Compensated	103 l/min [27.3 US gpm]	210 bar [3000 psi]	<b>27</b>
	<a href="#">PSVP12-NCR</a>	<b>SDC12-2</b>	Proportional Flow Control Valve, Poppet Type, Normally Closed, Pilot Operated, Non-Compensated	120 l/min [32 US gpm]	260 bar [3800 psi]	<b>28</b>
	<a href="#">PSVP16-NCR</a>	<b>SDC16-2</b>	Proportional Flow Control Valve, Poppet Type, Normally Closed, Pilot Operated, Non-Compensated	176 l/min [46 US gpm]	260 bar [3800 psi]	<b>29</b>
Proportional Flow Control Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<a href="#">ESV1-8-O</a>	<b>SDC08-2</b>	Proportional Flow Control Valve, Poppet Type, Normally Open, Pilot Operated, Non-Compensated	32 l/min 8.4 US gpm]	210 bar [3000 psi]	<b>30</b>
	<a href="#">ESV1-10-O</a>	<b>SDC10-2</b>	Proportional Flow Control Valve, Poppet Type, Normally Open, Pilot Operated, Non-Compensated	70 l/min [18.5 US gpm]	210 bar [3000 psi]	<b>31</b>
	<a href="#">PSVP10-NOR</a>	<b>SDC10-2</b>	Proportional Flow Control Valve, Poppet Type, Normally Open, Pilot Operated, Non-Compensated	100 l/min [26 US gpm]	260 bar [3800 psi]	<b>32</b>
	<a href="#">ESV1-12-O</a>	<b>C-12-2</b>	Proportional Flow Control Valve, Poppet Type, Normally Open, Pilot Operated, Non-Compensated	103 l/min [27.3 US gpm]	210 bar [3000 psi]	<b>33</b>
	<a href="#">PSVP12-NOR</a>	<b>SDC12-2</b>	Proportional Flow Control Valve, Poppet Type, Normally Open, Pilot Operated, Non-Compensated	120 l/min [32 US gpm]	260 bar [3800 psi]	<b>34</b>
	<a href="#">PSVP16-NOR</a>	<b>SDC16-2</b>	Proportional Flow Control Valve, Poppet Type, Normally Open, Pilot Operated, Non-Compensated	165 l/min [44 US gpm]	260 bar [3800 psi]	<b>35</b>
Proportional Flow Control Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<a href="#">EPV10</a>	<b>SDC10-2</b>	Proportional Flow Control Valve, Poppet Type, Normally Closed, Uni-Directional, Pressure Compensated	30 l/min [8 US gpm]	350 bar [5000 psi]	<b>36</b>

\*Flow ratings are for reference only. Refer to individual product page for performance information.

# Proportional Valves

## Quick Reference

Proportional Flow Control Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<b>EPV16-A</b>	<b>C-16-3SU</b>	Proportional Flow Control Valve, Poppet Type, Normally Closed, Pilot Operated, Pressure Compensated	160 l/min [42 US gpm]	280 bar [4000 psi]	<b>38</b>
	<b>EPV16-B</b>	<b>C-16-3SU</b>	Proportional Flow Control Valve, Poppet Type, Normally Closed, Pilot Operated, Pressure Compensated	160 l/min [42 US gpm]	280 bar [4000 psi]	<b>40</b>
	<b>CP518-PNC</b>	<b>SDC08-2</b>	Proportional Flow Control Valve, Spool Type, Normally Closed, Direct Acting, Non-Compensated	12 l/min [3.2 US gpm]	210 bar [3000 psi]	<b>42</b>
	<b>PSV10-NC</b>	<b>SDC10-2</b>	Proportional Flow Control Valve, Spool Type, Normally Closed, Direct Acting, Non-Compensated	40 l/min [10.6 US gpm]	260 bar [3800 psi]	<b>43</b>
	<b>PSV12-NC</b>	<b>SDC12-2</b>	Proportional Flow Control Valve, Spool Type, Normally Closed, Direct Acting, Non-Compensated	80 l/min [21 US gpm]	260 bar [3800 psi]	<b>44</b>
	<b>PSV16-NC</b>	<b>SDC16-2</b>	Proportional Flow Control Valve, Spool Type, Normally Closed, Direct Acting, Non-Compensated	100 l/min [26 US gpm]	260 bar [3800 psi]	<b>45</b>
	<b>CP518-PNO</b>	<b>SDC08-2</b>	Proportional Flow Control Valve, Spool Type, Normally Open, Direct Acting, Non-Compensated	11.5 l/min [3 US gpm]	210 bar [3000 psi]	<b>46</b>
	<b>PSV10-NO</b>	<b>SDC10-2</b>	Proportional Flow Control Valve, Spool Type, Normally Open, Direct Acting, Non-Compensated	45 l/min [12 US gpm]	260 bar [3800 psi]	<b>47</b>
	<b>PSV12-NO</b>	<b>SDC12-2</b>	Proportional Flow Control Valve, Spool Type, Normally Open, Direct Acting, Non-Compensated	100 l/min [26 US gpm]	260 bar [3800 psi]	<b>48</b>
	<b>PSV16-NO</b>	<b>SDC16-2</b>	Proportional Flow Control Valve, Spool Type, Normally Open, Direct Acting, Non-Compensated	110 l/min [29 US gpm]	260 bar [3800 psi]	<b>49</b>

\*Flow ratings are for reference only. Refer to individual product page for performance information.

# Proportional Valves

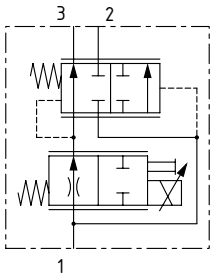
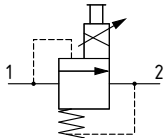
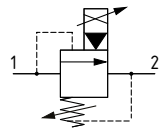
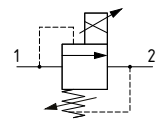
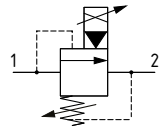
## Quick Reference

Proportional Flow Control Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<b>PFR24A</b>	<b>A6701</b>	Proportional Flow Control Valve, Spool Type, Normally Closed, Direct Acting, Pressure Compensated	28 l/min [7.4 US gpm]	210 bar [3000 psi]	<b>50</b>
Proportional Flow Control Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<b>PFR21H</b>	<b>A6701</b>	Proportional Flow Control Valve, Poppet Type, Normally Closed, Direct Acting, Partially Compensated	20 l/min [5.3 US gpm]	210 bar [3000 psi]	<b>51</b>
Proportional Flow Control Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<b>PFC10-RC</b>	<b>SDC10-2</b>	Proportional Flow Control Valve, Normally Closed, Restrictive Type, Pressure Compensated	30 l/min [8 US gpm]	260 bar [3800 psi]	<b>52</b>
	<b>PFC12-RC</b>	<b>SDC12-2</b>	Proportional Flow Control Valve, Normally Closed, Restrictive Type, Pressure Compensated	65 l/min [17 US gpm]	260 bar [3800 psi]	<b>53</b>
	<b>PFC16-RC</b>	<b>SDC16-2</b>	Proportional Flow Control Valve, Normally Closed, Restrictive Type, Pressure Compensated	90 l/min [24 US gpm]	260 bar [3800 psi]	<b>54</b>
Proportional Flow Control Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<b>PFC10-RO</b>	<b>SDC10-2</b>	Proportional Flow Control Valve, Normally Open, Restrictive Type, Pressure Compensated	30 l/min [8 US gpm]	260 bar [3800 psi]	<b>55</b>
	<b>PFC12-RO</b>	<b>SDC12-2</b>	Proportional Flow Control Valve, Normally Open, Restrictive Type, Pressure Compensated	60 l/min [16 US gpm]	260 bar [3800 psi]	<b>56</b>
	<b>PFC16-RO</b>	<b>SDC16-2</b>	Proportional Flow Control Valve, Normally Open, Restrictive Type, Pressure Compensated	85 l/min [22.5 US gpm]	260 bar [3800 psi]	<b>57</b>
Proportional Flow Control Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<b>PFC10-PC</b>	<b>SDC10-3</b>	Proportional Flow Control Valve, Normally Closed, Priority Type, Pressure Compensated	40 l/min [10.6 US gpm]	260 bar [3800 psi]	<b>58</b>
	<b>PFC12-PC</b>	<b>SDC12-3</b>	Proportional Flow Control Valve, Normally Closed, Priority Type, Pressure Compensated	65 l/min [17 US gpm]	260 bar [3800 psi]	<b>59</b>
	<b>EFV2-12-C</b>	<b>C-12-3</b>	Proportional Flow Control Valve, Normally Closed, Priority Type, Pressure Compensated	57 l/min [15 US gpm]	210 bar [3000 psi]	<b>60</b>
	<b>PFC16-PC</b>	<b>SDC16-3</b>	Proportional Flow Control Valve, Normally Closed, Priority Type, Pressure Compensated	85 l/min [22.5 US gpm]	260 bar [3800 psi]	<b>62</b>

\*Flow ratings are for reference only. Refer to individual product page for performance information.

# Proportional Valves

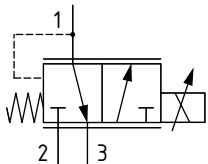
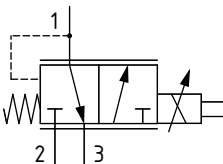
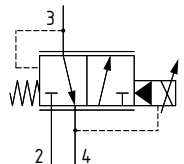
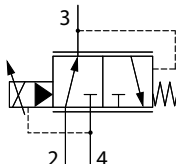
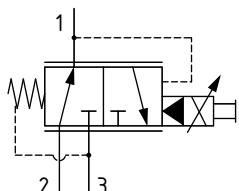
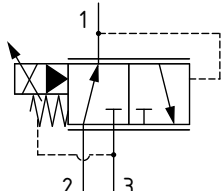
## Quick Reference

Proportional Flow Control Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<b>PFC10-PO</b>	<b>SDC10-3</b>	Proportional Flow Control Valve, Normally Open, Priority Type, Pressure Compensated	35 l/min [9.2 US gpm]	260 bar [3800 psi]	<b>63</b>
	<b>PFC12-PO</b>	<b>SDC12-3</b>	Proportional Flow Control Valve, Normally Open, Priority Type, Pressure Compensated	70 l/min [18.5 US gpm]	260 bar [3800 psi]	<b>64</b>
	<b>EFV2-12-O</b>	<b>C-12-3</b>	Proportional Flow Control Valve, Normally Open, Priority Type, Pressure Compensated	53 l/min [14 US gpm]	210 bar [3000 psi]	<b>65</b>
	<b>PFC16-PO</b>	<b>SDC16-3</b>	Proportional Flow Control Valve, Normally Open, Priority Type, Pressure Compensated	90 l/min [24 US gpm]	260 bar [3800 psi]	<b>67</b>
Proportional Relief Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<b>XMD 04</b>	<b>NCS 04/2</b>	Proportional Relief Valve, Poppet Type, Direct Acting, Normally Open	5 l/min [1.3 US gpm]	250 bar [3600 psi]	<b>68</b>
	<b>XMP 06</b>	<b>NCS 06/2</b>	Proportional Relief Valve, Spool Type, Pilot Operated, Normally Open	50 l/min [13 US gpm]	250 bar [3600 psi]	<b>69</b>
	<b>PAR1-10</b>	<b>SDC10-2</b>	Proportional Relief Valve, Spool Type, Pilot Operated, Normally Open	57 l/min [15 US gpm]	240 bar [3500 psi]	<b>70</b>
	<b>PAR1-16</b>	<b>SDC16-2</b>	Proportional Relief Valve, Spool Type, Pilot Operated, Normally Open	132 l/min [35 US gpm]	210 bar [3000 psi]	<b>71</b>
Proportional Relief Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<b>PRV08-DAC</b>	<b>SDC08-2</b>	Proportional Relief Valve, Poppet Type, Direct Acting, Normally Closed	3.8 l/min [1 US gpm]	215 bar [3100 psi]	<b>72</b>
	<b>HPRV08-DAC</b>	<b>SDC08-2</b>	Proportional Relief Valve, Poppet Type, Direct Acting, Normally Closed	1.9 l/min [0.5 US gpm]	350 bar [5000 psi]	<b>73</b>
Proportional Relief Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<b>PRV10-POC</b>	<b>SDC10-2</b>	Proportional Relief Valve, Spool Type, Pilot Operated, Normally Closed	76 l/min [20 US gpm]	250 bar [3600 psi]	<b>74</b>
	<b>PRV12-POC</b>	<b>SDC12-2</b>	Proportional Relief Valve, Spool Type, Pilot Operated, Normally Closed	180 l/min [47 US gpm]	250 bar [3600 psi]	<b>75</b>

\*Flow ratings are for reference only. Refer to individual product page for performance information.

# Proportional Valves

## Quick Reference

Proportional Pressure Reducing Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<b>EPRV2-8</b>	<b>SDC08-3</b>	Proportional Pressure Reducing, Relieving, Direct Acting, Normally Open to Drain	7.6 l/min [2 US gpm]	35 bar [500 psi]	<b>76</b>
Proportional Pressure Reducing Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<b>PPD22A</b>	<b>A3531</b>	Proportional Pressure Reducing, Relieving, Direct Acting, Normally Open to Drain	20 l/min [5.3 US gpm]	210 bar [3000 psi]	<b>77</b>
Proportional Pressure Reducing Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<b>PPR09-POD</b>	<b>SDC10-4</b>	Proportional Pressure Reducing, Relieving, Pilot Operated, Normally Open to Drain	25 l/min [6.6 US gpm]	50 bar [725 psi]	<b>78</b>
	<b>PPR09-POR</b>	<b>SDC10</b>	Proportional Pressure Reducing, Relieving, Pilot Operated	25 l/min [6.6 US gpm]	50 bar [725 psi]	<b>79</b>
Proportional Pressure Reducing Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<b>XRP 06</b>	<b>NCS 06/3</b>	Proportional Pressure Reducing, Relieving, Pilot Operated	25 l/min [6.6 US gpm]	315 bar [4600 psi]	<b>80</b>
	<b>PPAR1-10</b>	<b>SDC10-3</b>	Proportional Pressure Reducing, Relieving, Pilot Operated	30 l/min [8 US gpm]	210 bar [3000 psi]	<b>81</b>
Proportional Pressure Reducing Valves	Model No.	Cavity	Description	Flow*	Pressure	Page
	<b>PPR10-PAC</b>	<b>SDC10-3</b>	Proportional Pressure Reducing, Relieving, Pilot Operated	38 l/min [10 US gpm]	250 bar [3600 psi]	<b>82</b>

\*Flow ratings are for reference only. Refer to individual product page for performance information.