Hydraulic Cartridge Systems

Product Selection Guide

aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding

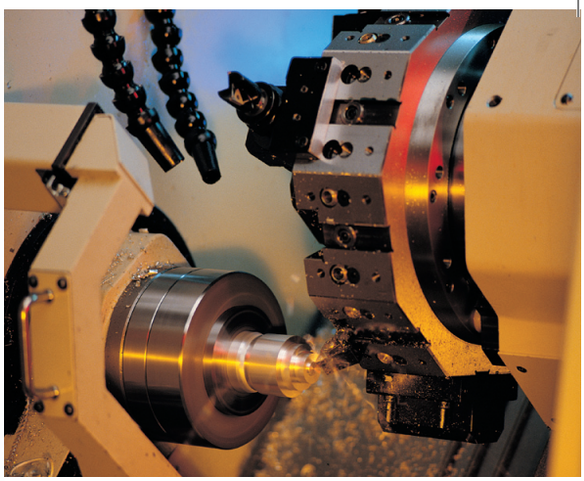
Parker

ENGINEERING YOUR SUCCESS.

Presenting...

We would like to take this opportunity to welcome you to the new Hydraulic Cartridge Systems Division. This new Product Selection Guide represents our published product offering. This Guide is intended to replace all previous Hydraulic Cartridge Systems (HCS) catalogs. You will find many changes to this catalog in content and format. Here are a few highlights of what you will find:

- **Complete Product Offering Including:**
  - **Check Valves**
  - **Shuttle Valves**
  - **Load/Motor Controls**
  - **Flow Controls**
  - **Pressure Controls**
  - **Logic Elements**
  - **Directional Controls**
  - **Manual Valves**
  - **Solenoid Valves**
  - **Proportional Valves**



We at the Hydraulic Cartridge Systems Division hope you find this Guide useful and want to thank you for turning to Parker Hannifin for your integrated hydraulic needs.

Check Valves — CV Check Valves

Shuttle Valves — SH Shuttle Valves

Load and Motor Control Valves — LM Load/Motor Controls

Flow Control Valves — FC Flow Controls

Pressure Control Valves — PC Pressure Controls

Logic Element Valves — LE Logic Elements

Directional Control Valves — DC Directional Controls

Manual Valves — MV Manual Valves

Solenoid Valves — SV Solenoid Valves

Proportional Valves — PV Proportional Valves

Coils and Electronics — CE Coils & Electronics

Bodies and Cavities — BC Bodies & Cavities

Technical Data — TD Technical Data

Contents

Check Valves

SERIES	CAVITY	DESCRIPTION	FLOW LPM/GPM	PRESSURE BAR/PSI
STANDARD CHECKS				
D1A060	2U	Check Valve Insert, Ball Type	145/38	420/6000
D1B125	2C	Check Valve Insert, Ball Type	500/132	420/6000
D0WB2	CAV0W-2	Cartridge Check, Ball Type	3.5/0.9	420/6000
D02B2	C08-2	Cartridge Check, Ball Type	45/12	420/6000
CVH081P	C08-2	Cartridge Check, Poppet Type	38/10	350/5000
CVH103P	C10-2	Cartridge Check, Poppet Type	60/16	350/5000
D04B2	C10-2	Cartridge Check, Ball Type	160/42	420/6000
CVH121P	C12-2	Cartridge Check, Poppet Type	121/32	350/5000
D06B2P	C16-2	Cartridge Check, Poppet Type	280/74	420/6000
CVH161P	C16-2	Cartridge Check, Poppet Type	226/60	350/5000
CVH201P	C20-2	Cartridge Check, Poppet Type	303/80	350/5000
CVH104P	C10-2	Cartridge Check, Poppet Type 2 to 1 Flow Path	19/5	350/5000
D06C2	C16-2	Cartridge Check, Poppet Type 2 to 1 Flow Path	500/132	420/6000
PILOT OPERATED CHECKS				
CP084P	C08-3	Single P.O. Check, Pilot on Port 1	19/5	207/3000
CPH104P	C10-3	Single P.O. Check, Pilot on Port 1	30/8	350/5000
CPH124P	C12-3	Single P.O. Check, Pilot on Port 1	75/20	350/5000
PP02SP		Single P.O. Check Package, Steel Body	40/11	420/6000*
PP04SP		Single P.O. Check Package, Steel Body	135/36	420/6000*
PP06SP		Single P.O. Check Package, Steel Body	340/90	420/6000*
D4A020	53-1	Single P.O. Check, Pilot on Port 3	30/8	420/6000
D4A040	68-1	Single P.O. Check, Pilot on Port 3	60/16	420/6000
D2K1	T11A	Single P.O. Check, Pilot on Port 3	70/19	350/5000
D3B125	3C	Single P.O. Check, Pilot on Port 3	150/40	420/6000
CPC101P	C10-3	Pilot to Close Check, Pilot on Port 3	20/5	420/6000
DUAL PILOT OPERATED CHECKS				
CPD084P	C08-4	Dual P.O. Check Cartridge	19/5	207/3000
PP02DP		Dual P.O. Check Package, Steel Body	40/11	420/6000*
PP04DP		Dual P.O. Check Package, Steel Body	135/36	420/6000*
PP06DP		Dual P.O. Check Package, Steel Body	340/90	420/6000*
CHECK WITH RELIEF				
D04F2	C10-2	Check With Thermal Relief, Relieving Port 2 to 1	130/40	420/6000

**Rated to 207 Bar/3000 PSI with Aluminum Body.*

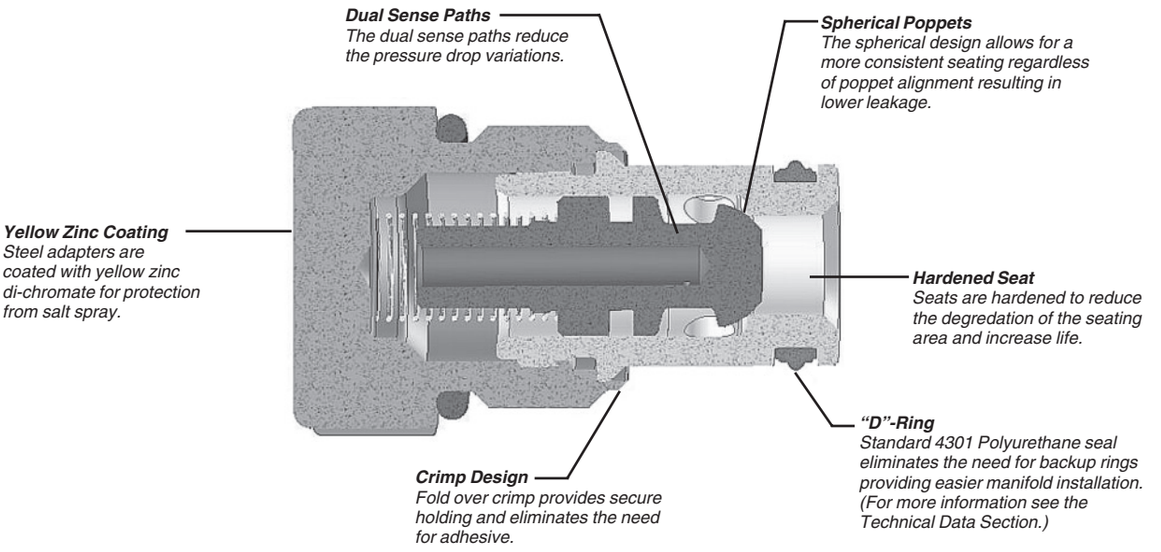
INTRODUCTION:

This technical tips section is designed to help familiarize you with the Parker line of Check Valves. In this section we present the products that are new to this catalog as well as some design features of our checks valves. In addition, we present common options available to help you in selecting products for your application.
Finally we give a brief synopsis of the operation and applications of the various product offered in this section.

NEW PRODUCTS:

There are several new additions and product improvements to our Check Valve product line.

Here are just some of the general design features and advantages to the "Winner's Circle" check valve.



COMMON OPTIONS:

Since check valves and shuttles are fairly simple components, there are very few options. Here are the standard options you will find.

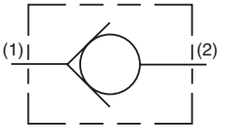
Seals: The Winner's Circle products feature a standard 4301 Polyurethane "D"-Ring. The "D"-Ring eliminates the need for backup rings. The majority of the products are available in Nitrile or Fluorocarbon Seals. You should match the seal compatibility to the temperature and fluid being used in your application.

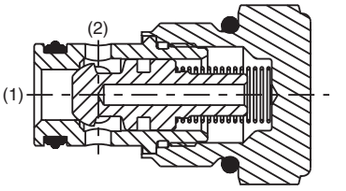
Crack Pressure: Parker offers a number of standard crack pressure options for each valve. Check the model code pages for these options. The crack pressure is defined as the minimum amount of pressure that is needed to unseat the poppet. In pilot operated check applications, you may want to go with a slightly higher cracking pressure to keep the piston weight, friction, and drag from accidently unseating the poppet.

Pilot Piston Seal: On the pilot piston style pilot operated check valves, Parker offers the option to place a seal on the piston to reduce the leakage across the piston. ***Note:*** Sealing the pilot piston does not decrease the leakage across the poppet. In other words, if you are trying to reduce the leakage from the actuator port, sealing the piston will not help. While most applications do not require a seal on the piston, it can be advantageous in applications with very small pump flows where the lost fluid would have a high impact on actuator speed.

PRODUCT TYPES / APPLICATIONS

Check Valve - Poppet Type

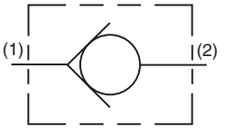


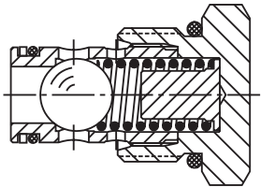


Check valves are poppet style elements that allow free flow in one direction while preventing flow in the reverse direction. They can be used to isolate portions of a hydraulic circuit or to provide a free flow path around a restrictive valve.

OPERATION - Pressure on the inlet (port 1) of the check valve creates a force against the poppet, pushing it off its seat and permitting free flow to port 2. Reverse flow through the check is blocked by the poppet.

Check Valve - Ball Type

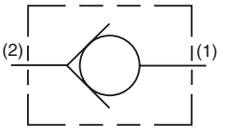


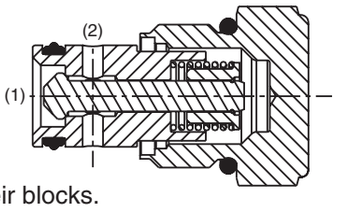


Ball type check valves are check valves that use a hardened steel ball to seal against the valve seat as opposed to a poppet. They are simple in their design and provide low leakage over the life of the system.

OPERATION - Pressure on the inlet (port 1) of the check valve creates a force on the steel ball pushing it off of it's seat and permitting free flow to port 2. Reverse flow through the check is blocked by the steel ball on the seat.

Side to Nose Check Valve

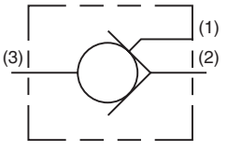




Side to nose check valves are a special type of check valve where the free flow path is from the side of the cartridge valve to the nose. They functionally are the same as the standard check valve. Side to nose check valves are occasionally used by manifold designers to simply the flow path design of their blocks.

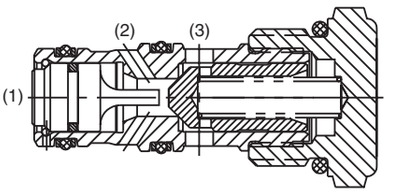
OPERATION - Pressure on the inlet (port 2) of the check valve creates a force against the poppet, pushing it off its seat and permitting free flow to port 1. Reverse flow through the check is blocked by the poppet.

Pilot Operated Check Valve

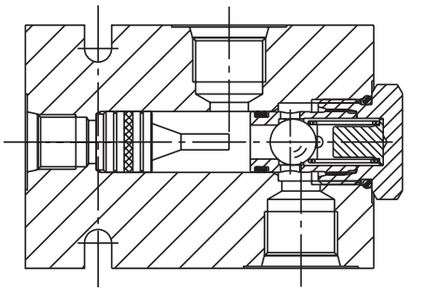


Pilot operated check valves (also referred to as P.O. check valves), are check valves which can be opened by an external pilot pressure. Thus, P.O. checks, block flow in one direction, like standard check valves, but can be released once an adequate pilot pressure is applied. Free flow is allowed in the reverse direction. P.O. checks are often used to positively lock a dual acting cylinder. There are two types of pilot operated check valves; threaded cartridge style and pilot piston style. These valves work best when used in conjunction with a control valve that vents the valve ports to tank when centered.

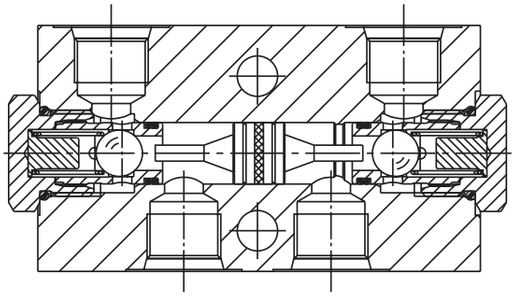
Cartridge Style P.O. Check Valve



Single Pilot Piston Style P.O. Check Valve

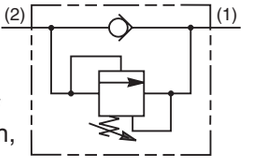


Dual Pilot Piston Style P.O. Check Valve

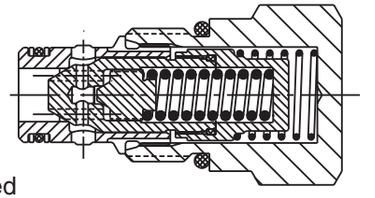


OPERATION - In the absence of adequate pilot pressure, the poppet remains seated preventing flow from the actuator port (port 3) to the valve port (port 2). Once adequate pilot pressure is applied at the pilot port (port 1), the internal pilot piston unseats the check poppet permitting flow from port 3 to port 2. The amount of pressure needed at port 1 to unseat the check valve is determined by the pilot ratio of the pilot piston to the poppet seat diameter. If you have a pilot operated check valve with a 3:1 ratio pilot piston, then you would need a pilot pressure at port 1 that is 1/3 of the pressure being checked at port 3 plus the spring. For example, if you had 3000 psi on port 3 and a 5 psi spring and a 3:1 pilot ratio, it would take 1002 psi [(3000 psi + 5 psi) / 3)] to release the check valve.
Free flow is permitted from the valve port (port 2) to the cylinder port (port 3).

Check Valve With Thermal Relief



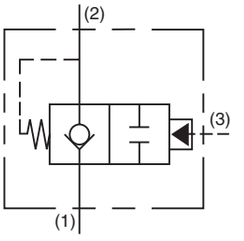
The check valve with thermal relief performs the same function as a standard check valve. It allows free flow in one direction. In the opposite direction, it performs as a normal check valve preventing flow, while also venting excess pressure caused by the thermal expansion of fluid. This type of valve can be used with an external pilot piston to provide a pilot operated valve that will vent trapped pressure due to thermal expansion. These valves work best when used in conjunction with a control valve that vents the valve ports to tank when centered.

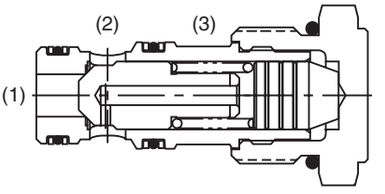


OPERATION - The check valve is a guided poppet design. As the pressure on the inlet exceeds the spring rate, the poppet is pushed off of its seat allowing flow to pass. Once the pressure on the inlet side drops below the spring force, the spring then pushes the poppet back on its seat blocking flow from the outlet to the inlet of the check valve. If the pressure on the outlet side of the check valve (when it is in a load holding function) rises (through thermal expansion), the direct acting relief will vent the excess pressure caused by the thermal expansion to the inlet side of the check.

Pilot to Close Check

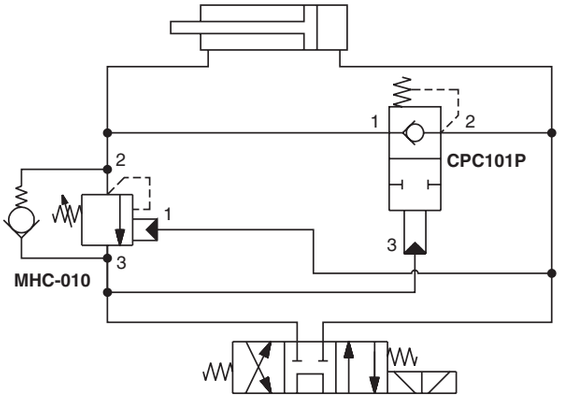
Pilot to close check valves are unique 2 way valves that act as a check valve, allowing free flow in one direction and blocking flow from the opposite direction. When an external pilot pressure is applied, flow is blocked from both directions.





These products are ideal for regeneration circuits. See sample diagram shown.

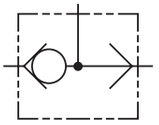
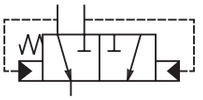
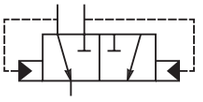
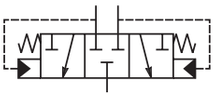
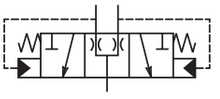
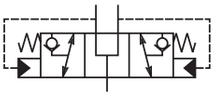
OPERATION - In the absence of adequate pilot pressure, the valve functions as a simple check valve, allowing free flow from port 1 to port 2. When adequate pilot pressure at port 3 is applied, the pilot piston holds the poppet closed, blocking flow in both directions.



Notes

Contents

Shuttle Valves

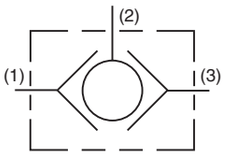
	SERIES	CAVITY	DESCRIPTION	FLOW LPM/GPM	PRESSURE BAR/PSI
	KSWA3	SW-3	Ball Insert Type	9.5/2.5	420/6000
	K2A005	3Z	Poppet Insert Type	38/10	350/5000
	CS041B	C04-3	Cartridge Shuttle	3.8/1.0	207/3000
	K02A3	C08-3	Cartridge Shuttle	50/13	420/6000
	CSH101B	C10-3	Cartridge Shuttle	38/10	350/5000
	ASH-04		In-Line Shuttle,-4 Male JIC	11/3	207/3000
	ASH-06		In-Line Shuttle,-6T	22/6	207/3000
	K04B3	C10-3	Spool Type Shuttle	90/24	420/6000
	K04D3	C10-3	Spool Type Shuttle	90/24	420/6000
	K04C3	C10-4	Spool Type, Spring Centered, All Ports Closed	100/26	420/6000
	K3A125	3J	Spool Type, Spring Centered, All Ports Closed	175/46	350/5000
	K04F3	C10-4	Spool Type, Spring Centered, All Ports Open	100/26	420/6000
	K04G3	C10-4	Spool Type Shuttle, Inverse	50/13	350/5000

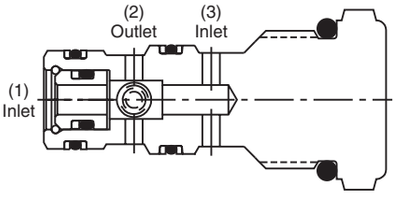
INTRODUCTION:

Shuttle valves accept flow from two different sources and divert the highest pressure to a single outlet port. Shuttle valves are commonly used in Load Sensing circuits as well as Brake circuits. Parker offers many different types of shuttles, including ball type, poppet type, spool type. There are a number of configurations available such as cartridge type, insert type, and an in-line version.

Ball Type - Cartridge Style

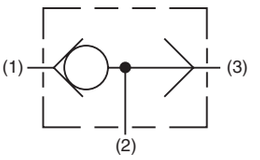
The valve consists of a steel ball that can seal against one of two adjacent seats, providing a path from the highest pressure signal to another function. When one inlet port is pressurized, the ball or poppet is forced against the opposite seat, blocking that inlet and providing a flow path to the outlet port.

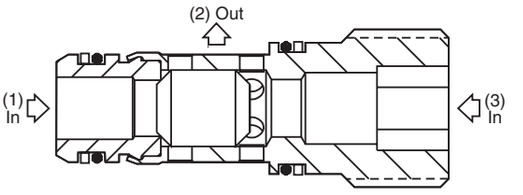




Poppet Type - Insert Style

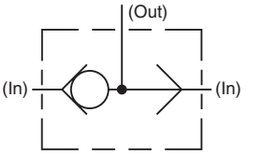
This shuttle performs the same function, but allows for higher flow rates due to poppet design.

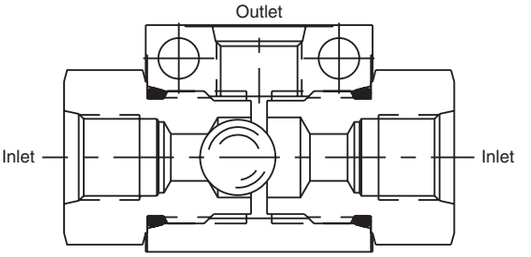




In-Line Type

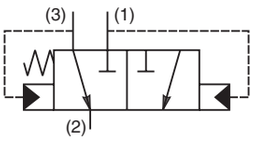
This shuttle variant performs the same function in a self-contained body. It can be mounted anywhere on the machine.

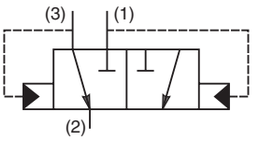


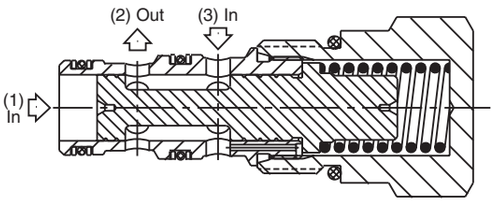


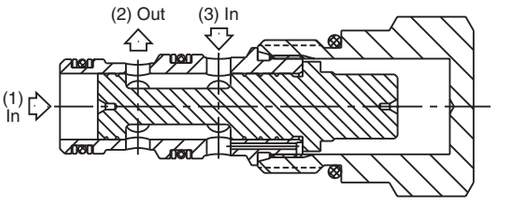
Spool Type - Centered or Spring Offset

The spool type shuttle allows for higher flow rates. These are 2 position valves.

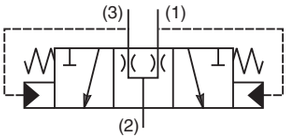


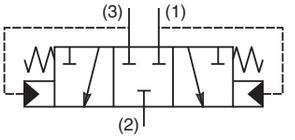


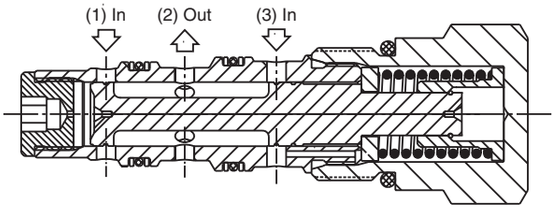


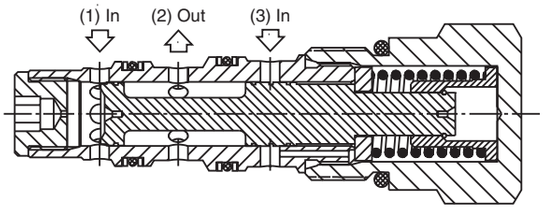


3 Way 2 Position Spool type shuttles are designed to direct flow in such a way as to allow higher pressure signals to open the lower pressure port and connect it to the common outlet port. These spring centered valves will shift when pressure at either end of the spool exceed the spring setting. These are typically used in transmission hot oil shuttle circuits.

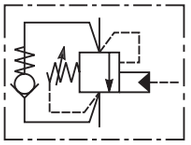
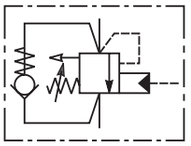
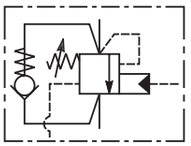








Notes

SERIES	CAVITY	DESCRIPTION	FLOW LPM/GPM	PRESSURE BAR/PSI
STANDARD PILOT ASSISTED				
				
CB101	C10-3	Load Control Cartridge Valve	45/12	380/5500
MHC-010-S***	CDD-1010	Load Control Cartridge Valve	37/10	350/5000
MHC-022-S***	CDD-1036	Load Control Cartridge Valve	94/25	350/5000
E2*020	53-1	Load Control Cartridge Valve	20/5.3	420/6000
E2*040	68-1	Load Control Cartridge Valve	60/16	350/5000
E2*1	T11-A	Load Control Cartridge Valve	60/16	350/5000
E2*1S	T11-A	Load Control Cartridge Valve	60/16	350/5000
E2*1R	T11-A	Load Control Cartridge Valve	60/16	350/5000
E2*060	3C	Load Control Cartridge Valve	120/32	350/5000
E2*125	3M	Load Control Cartridge Valve	200/53	350/5000
E2*300	3K Flange		350/90	350/5000
INDEPENDENT OF BACK-PRESSURE, VENTED TO ATMOSPHERE				
				
E6B020	53-1	Load Control Cartridge Valve, 4.5:1 Ratio	20/5.3	350/5000
E6K020	53-1	Load Control Cartridge Valve, 15:1 Ratio	20/5.3	350/5000
E6*1	T11-A	Load Control Cartridge Valve	60/16	350/5000
E6B040	3C	Load Control Cartridge Valve, 3:1 Ratio	60/16	350/5000
E6A060*409	3C	Load Control Cartridge Valve, 3:1 Ratio	180/48	350/5000
E6B060*409	3C	Load Control Cartridge Valve, 3:1 Ratio	180/48	350/5000
MHC-010-V***	CDD-1010	Load Control Cartridge Valve	37/10	350/5000
MHC-022-V***	CDD-1036	Load Control Cartridge Valve	94/25	350/5000
INDEPENDENT OF BACK-PRESSURE, VENTED TO DRAIN ON PORT 4				
				
E9*1	T21A	Load Control Cartridge Valve	60/16	350/5000

Introduction

Counterbalance valves are one of the most misunderstood products in the hydraulic industry. Many people tend to complicate the task of selecting a counterbalance valve and as such avoid opportunities. The goal of this Technical Tips Section is to hopefully eliminate some of this confusion and help you chose the correct valve for your application. It is only a guide! It is not meant to be your only method of input, nor is it meant to replace good hydraulic common sense and reasoning.

Application

DO I NEED A COUNTERBALANCE VALVE?

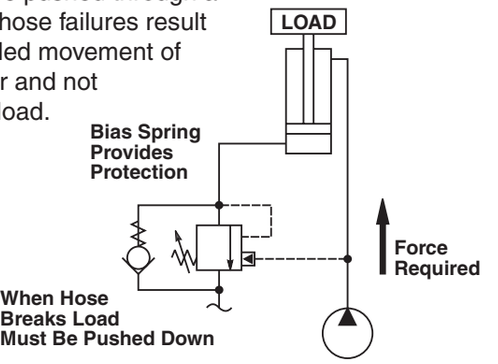
A counterbalance is generally used for one or more of the following purposes:

Control an Overrunning Load – It restricts the flow from an actuator, thus forcing the load to be pushed through the restriction and providing control of the potential runaway load. This also helps in the prevention of cavitation.

Control in Critical Metering Applications – The outward restriction also helps to gain control of systems with varying loads and speeds.

Holding a Load – Much like a pilot operated check valve, a load is held in one direction until the appropriate pilot pressure is available unseat the check and pass fluid.

Help Protect Against Hose Failures – Since the fluid must be pushed through a restriction, hose failures result in a controlled movement of the actuator and not a runaway load.



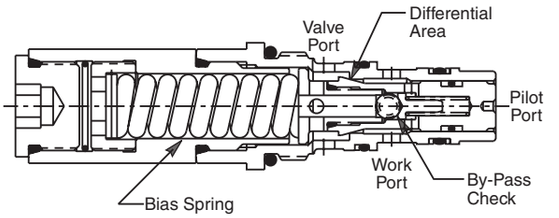
***NOTE:** Counterbalance Valves are only needed if the application calls for varying loads or varying speeds. If the load and speed are fixed, flow control valves and pilot operated check valves may be substituted at generally a lower cost.*

Operation

An understanding of the general operation of a counterbalance valve is required before proceeding further into valve selection.

The counterbalance valve is a pressure control device and functions as follows: Pressure is developed at the Work Port of the holding valve when the actuator is pressurized. This pressure acts on the differential area, and the force generated is counteracted by the bias spring. When there is sufficient pressure present to overcome the spring setting, the poppet begins to shift, allowing fluid to pass through the valve port to tank via the control valve.

To assist in the shifting of the poppet, an external pressure source (generally the opposite side of the actuator) is connected to the pilot port of the counterbalance valve. This pressure is applied to the pilot area and assists the differential area in opening the valve. The pilot assist reduces load pressure required to open the valve, and allows for a reduction in the horsepower required to move the load. If the load attempts to “run away” (move faster than the pump can supply flow), the pilot signal will diminish and the piston will begin to close restricting flow to tank and thus controlling the load. The counterbalance piston will maintain a position that maintains a positive pilot signal and will control the descent of the load.



An added feature of the counterbalance valve is its built-in thermal relief characteristic. A temperature rise can cause thermal expansion of the hydraulic fluid trapped between the actuator and the counterbalance valve’s poppet. As the pressure increases and reaches the bias spring setting, the poppet unseats and a few drops of oil are allowed to escape through the valve port of the counterbalance valve. This relieves the thermal expansion of oil, allowing the counterbalance valve to continue holding the load in the same position.

When the flow is reversed to the actuator, then pressure unseats the built-in bypass check portion of the counterbalance valve allowing flow to pass from the valve port to the work port. When no pressure is applied to either port of the counterbalance valve, the load is held in place.

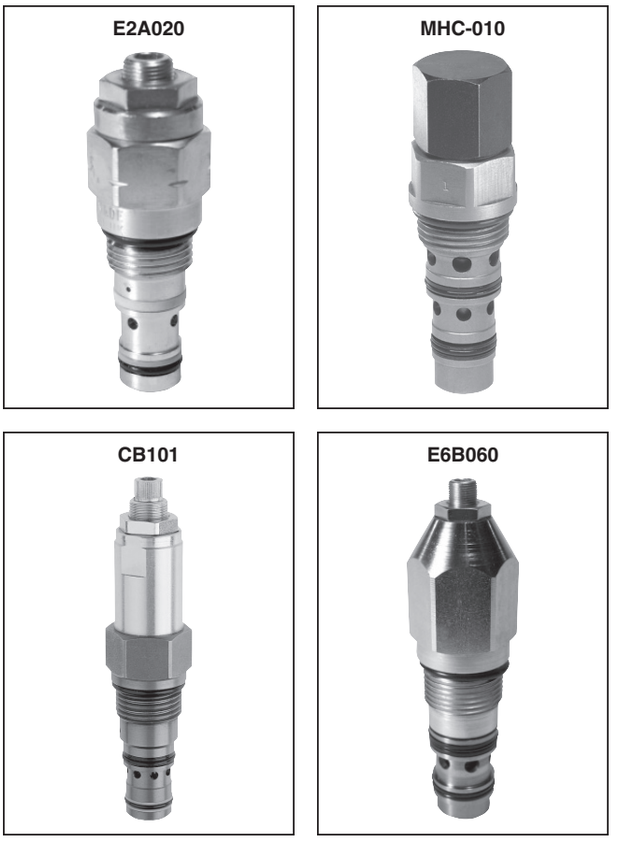
Valve Series

Parker offers the four series of products outlined below:

MHC – The MHC series is a threaded cartridge style counterbalance valve. This series is ideal for incorporating into an integrated manifold or for installation directly into the port of the actuator. There are various flow rates and pilot ratios available for the MHC Series.

CB101 – The CB101 is also a threaded cartridge style counterbalance valve. It also is ideal for incorporating into an integrated manifold or for installation directly into the port of the actuator. The CB101 has an industry common cavity (C10-3) and is available in three pilot ratios.

E2 Series – The E2 Series valves are threaded cartridge style counterbalance valves. They are available in standard and Vented configurations. In the Vented configurations, the valves maintain their settings regardless of system backpressure. There are various flow rates and pilot ratios available.



Selecting Options

Below is a brief description of the options available on the ordering information pages and a brief explanation of when each would be used.

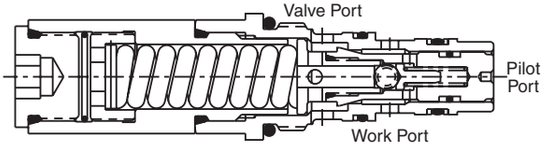
Flow Selection – Generally the counterbalance valve is sized according to the actual flow the valve will see and not the system flow. Note that the ordering information callout is the nominal flow rate and not the maximum. In other words, refer to the pressure drop curves when sizing the valves. For example: A MHC-010 can flow 25 GPM, but is rated as a 10 GPM valve. It is possible to oversize a counterbalance valve! If the counterbalance is oversized, the annulus between the poppet and the seat is too large, thus the poppet opens too far causing instability. Remember you are gaining control by causing a restriction. If you oversize the counterbalance valve, the restriction is reduced and so is the control.

Vented versus Non-Vented – With a standard counterbalance valve, the bias spring is internally vented to tank. This means any pressure on the tank line is sensed in the bias spring chamber and additive to the setting. Thus, the pressure at the work port now must be greater than the bias spring plus the tank pressure before the counterbalance poppet will shift allowing flow.

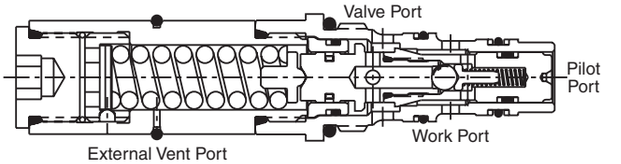
A vented style counterbalance valve relieves the bias spring chamber to atmosphere. Thus, the spring chamber is in no way related to the tank chamber of the counterbalance valve. So, if the pressure on the tank line is high, or if the pressure setting is critical, then a vented style counterbalance valve would be required.

Parker's counterbalance valves are externally vented. This means no extra porting or manifold costs are incurred when a vented counterbalance is needed.

MHC-010-S*S* Non-Vented Counterbalance Adjustable

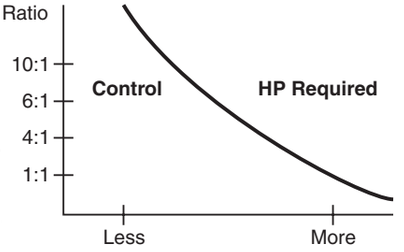


MHC-010-V*S* Vented Counterbalance Adjustable



Selection Options (Continued)

Pilot Ratio – The pilot ratio is the ratio of the pilot area versus the differential area poppet. Thus, the higher the pilot ratio, the less pressure that is needed to assist the load pressure in unseating the poppet. This means there is less restriction to the overrunning load, resulting in less horsepower required and more control of the load. So higher pilot ratio equates to less restriction to the overrunning load, less control and less horsepower required. Lower ratio equates to more restriction to the overrunning load, more control and more horsepower required. The pilot ratio decision is one of Horsepower versus Control. For reference the most popular ratio is 6:1.



Sample Ratios:

10:1
Primary function is load holding or hose break protection
Loads moving at fast speeds and positioning is not critical

7:1, 6:1 and 5:1
Most popular starting ratio

4:1 and 3:1
Positioning is critical such as a pick and place application
Instability with 6:1 ratio

1:1
Motor control application

ADJUSTMENT TYPE

Parker offers counterbalance valves with adjustable and non-adjustable pressure settings. The non-adjustable or shimmed version is recommended for most applications as it prevents tampering or improper adjustment by uneducated end users.

SELECTING SETTINGS

There are three basic settings to consider before finalizing a counterbalance valve for your application.

Holding Setting – The holding setting is sometimes referred to as the counterbalance setting. It is the maximum load setting you expect the counterbalance to hold. Note that the counterbalance valve should be set for the absolute maximum hold pressure required. Also note that counterbalance valves are restrictive type devices and as such are not ideal for low pressure applications, such as those below 750 psi. The holding setting is the setting you choose when selecting a counterbalance valve.

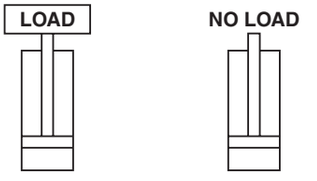
Thermal Setting – Counterbalance valves have a built-in thermal relief valve that compensates for the expansion of oil, due to temperature, by bleeding off excess pressure. In other words, the thermal setting is the pressure that the counterbalance will unload at if no pressure is present at the pilot port. Obviously, this setting should be above the holding setting. The Parker **MHC** counterbalance valves are automatically set 1000 psi above the holding setting of the valve. ***You do not specify this setting, only the holding setting.*** For the **CB101** Series, you do specify the Thermal/Crack setting in the model code. The holding setting (maximum load induced pressure) is 70% of that specified setting. Example: Hold at 3000 psi, crack at 4285 psi. For the **E2** Series, you specify the Thermal/Crack setting in the model code. The crack setting (maximum load induced pressure) should be 1.3 times the hold. Example: Hold at 3000 psi, crack at 3900 psi.

Pilot Area – The pilot pressure required to lower the cylinder when fully loaded and unloaded can also be determined before applying the valve. The pilot pressure can be determined by the below equation:

$$P_P = (T_S - L) / R_P$$

P_P = Pilot Pressure
T_S = Thermal Setting
L = Induced Load
R_P = Pilot Ratio

Example:
The maximum load is 3000 psi. A 6:1 Pilot Ratio was chosen and the thermal relief setting is the standard 1000 psi over load setting. What is the pilot pressure required to retract the cylinder if it is fully loaded? What pilot pressure is required to retract the cylinder if there is no load?



FULLY LOADED:

P_P = (4000 psi – 3000 psi) / 6
P_P = 1000 psi / 6
P_P = 167 psi

Thus, any time the pilot line sees at least 167 psi, the cylinder could lower the load.

UNLOADED:

P_P = (4000 psi – 0 psi) / 6
P_P = 4000 psi / 6
P_P = 667 psi

Thus, at least 667 psi will be needed to lower the cylinder when it is unloaded.

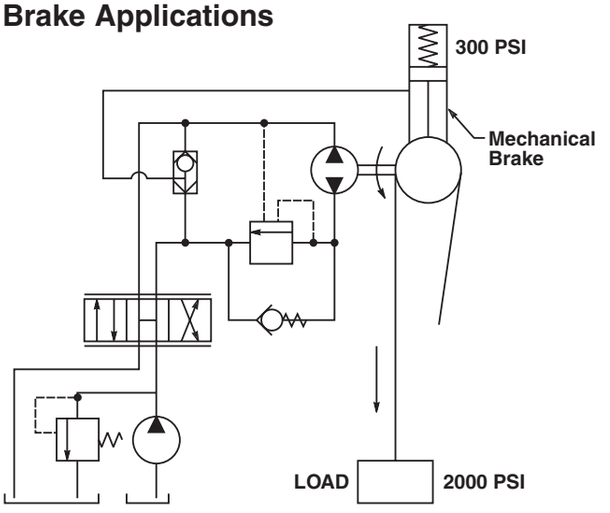
Motor Controls

Counterbalance valves are used in motor circuits to stop overrunning loads and prevent cavitation. Since hydraulic motors leak internally, the counterbalance valve by itself cannot be used to hold the load. So, a mechanical brake is used to hold the load on the motor in place, as shown below. Some typical applications include winches, swing drives, conveyor control and traction drives. For applications in closed loop motor circuits, vented spring cavities are required.

Operation

Free flow to the motor is allowed through the internal check valve. In the controlled flow direction, the oil passes across a metering poppet. The position of the metering poppet is determined by an external pilot signal from the other side of the motor. In an open loop motor circuit, this pilot signal will be a 1:1 ratio. The reason an equal ratio pilot signal is utilized is to provide positive control as well as to release mechanical brakes (when used in a braking circuit). In applications where the motor will see overrunning loads in both directions (such as a traction drive circuit), a dual MMB or two single MMB valves must be used.

Brake Applications



When the directional control valve is shifted, hydraulic pressure (usually 300 psi) releases the mechanical brake and allows the load to be moved. The counterbalance valve needs to provide adequate back pressure to open the brake, then immediately counterbalance the load. Ideally, the brake will be disengaged before the motor begins to rotate. If this sequence is not achieved, the motor will try to rotate against the applied brake reducing the life of the brake. This would be the equivalent of trying to drive with your emergency brake applied. Remember that hydraulic motors are equal area devices. So, in an effort to avoid the movement of the motor prior to the release of the brake, an equal area ratio counterbalance is used. To demonstrate let's look again at the above example with a 10:1 Ratio Counterbalance valve installed and a maximum thermal setting of 3000 psi.

10:1 Example

NO LOAD

$P_P = (T_S - L) / R_P$
$P_P = (3000 \text{ psi} - 0 \text{ psi}) / 10$
$P_P = 3000 \text{ psi} / 10$
$P_P = 300 \text{ psi}$

2000 PSI LOAD

$P_P = (T_S - L) / R_P$
$P_P = (3000 \text{ psi} - 2000 \text{ psi}) / 10$
$P_P = 1000 \text{ psi} / 10$
$P_P = 100 \text{ psi}$

Thus, when there is no load on the motor, the counterbalance opens at 300 psi, or just as the brake is being released. When there is a 2000 psi load on the motor, the counterbalance will start to open with a pilot pressure of 100 psi. The brake requires 300 psi, so the motor can start to rotate before the brake is released, causing wear on the brake. To offset this problem, you could increase the maximum thermal setting to 5000 psi, but this is very inefficient.

1:1 (Equal Area) Example

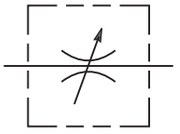
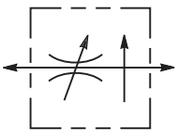
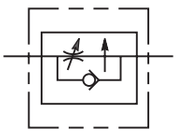
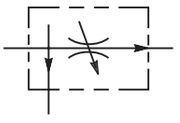
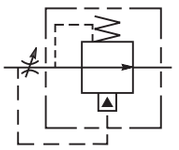
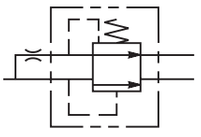
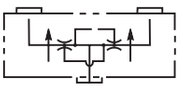
Equal area counterbalance valves are used primarily in brake applications to avoid the wear problem described above. With an Equal Area counterbalance valve, there is no thermal relief valve, and there is no differential area to work on. In other words, the counterbalance valve only opens when the pilot pressure is greater than the valve setting. The applied load has nothing to do with the pilot pressure required. Thus you will want to choose a pressure setting for the equal area counterbalance valve that is just slightly above the brake release pressure (usually 350 psi).

In our example, the valve would be set at 350 psi. This would allow the brake to release before the counterbalance allows the load to move. Since the equal counterbalance valve always opens at 350 psi pilot pressure and is not dependent on the load, it is the best valve for brake applications.

Large Pressure Spike Application – Keep in mind that equal area counterbalance valves do not have a built-in thermal relief valve. As such, if there are large pressure spikes caused by the stopping of heavy loads, then a ratioed counterbalance, such as a 10:1 should be used. In most cases these are non-brake type applications.

Contents

Flow Control Valves

	SERIES	CAVITY	DESCRIPTION	FLOW LPM/GPM	PRESSURE BAR/PSI
	**NEEDLE VALVES**				
	J02A2	C08-2	Needle Valve, Cartridge Type	45/12	420/6000
	NVH081	C08-2	Needle Valve, Cartridge Type	38/10	380/5500
	NVH101	C10-2	Needle Valve, Cartridge Type	60/16	380/5500
	J06A2	C16-2	Needle Valve, Cartridge Type	225/60	420/6000
	J02B2	C08-2	Needle Valve with Reverse Check, 2 to 1 Free Flow	30/8	420/6000
	FV101	C10-3	Needle Valve with Reverse Check, 1 to 2 Free Flow	45/12	210/3000
	FV102	C10-2	Needle Valve with Reverse Check, 1 to 2 Free Flow	23/6	210/3000
	**PRESSURE COMPENSATED FLOW CONTROLS**				
	J02E2	C08-2	Restrictive Flow Control, Adjustable	20/5.3	420/6000
	FR101	C10-2	Restrictive Flow Control, Tuneable	26/7	245/3500
	J04E2	C10-2	Restrictive Flow Control, Adjustable	40/10	420/6000
	J04C2	C10-2	Restrictive Flow Control, Adjustable	40/10	420/6000
	FA101	C10-2	Restrictive Flow Control, Reverse Check, Adjustable	21/5.5	210/3000
	FC101	C10-2	Restrictive Flow Control, Reverse Check, Tuneable	56/15	210/3000
	**PRESSURE COMPENSATED PRIORITY FLOW CONTROLS**				
	J02D3	C08-3	Priority Type, with Bypass	15/4	420/6000
	FP101	C10-3	Priority Type, with Bypass	56/15	245/3500
	J04D3	C10-3	Priority Type, with Bypass	45/12	420/6000
	J1A125	3A	Priority Type, with Bypass	90/24	350/5000
	**PRESSURE COMPENSATORS**				
	FCR101	C10-3	Restrictive Type, Press. Compensators	38/10	245/3500
	FCR161	C16-3	Restrictive Type, Press. Compensators	150/40	245/3500
	**PRIORITY PRESSURE COMPENSATORS**				
	FCP101	C10-4	Priority Type, with Bypass	56/15	245/3500
	FCPH121	C12-4	Priority Type, with Bypass	95/25	380/5500
	**FLOW DIVIDERS/COMBINERS**				
	FDC101	C10-4	Flow Divider/Combiner	45/12	245/3500
	L04A3	C10-4	Flow Divider/Combiner	60/16	420/6000
	L06A3	C16-4	Flow Divider/Combiner	180/47	420/6000
	L1A300	91-1	Flow Divider/Combiner	320/85	350/5000

INTRODUCTION

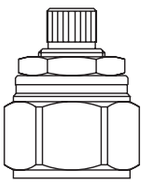
This technical tips section is designed to help familiarize you with the Parker line of Flow Control Valves. In this section we present common options available as well as a brief synopsis of the operation and applications of the various product offered in this section. The intent of this section is to help you in selecting the best products for your application.

COMMON OPTIONS

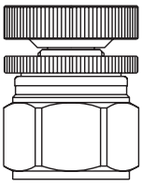
As you will see, Parker offers a variety of Flow Control products. As such, some of the options mentioned below may not be available on all valve models. Consult the model coding and dimensions of each valve for specifics. Here are some of the common options available.

Adjustment Types: Parker offers four primary types of adjustments for most of the flow control products. Samples of these types are shown below. Please note all options may not be available for all valves. Consult the individual catalog pages for more details.

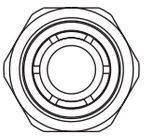
Screw Adjustment - Valve can be adjusted with an allen wrench. Lock nut included to maintain desired setting after adjustment. This is the most common adjustment option available on most Parker products.

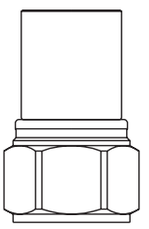


Knob Adjustment - An aluminum knob is added to the standard screw adjustment. A lock knob is provided to help maintain the desired setting after adjustment. Parker offers knob conversion kits for most flow control valves. For kit numbers consult the individual valve pages.

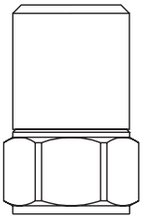


Fixed Style - In most cases, the Fixed Style product is a screw adjustable product with a steel collet threaded over the adjustment. These valves are preset at the factory. Should the valve need to adjusted, the star washer and aluminum plate can be removed from the top of the assembly exposing the adjustment.





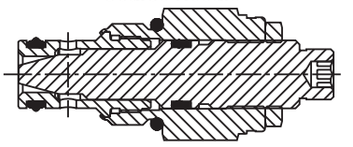
Tamper Resistant - The tamper resistant option is a screw adjustable valve with a steel cap installed to conceal the adjustment. The cap is designed so the internal edges clamp into the groove of the valve adapter. Once the cap is installed, it cannot be removed without damaging the cap and the valve. When a valve is ordered with the tamper resistant option, it will be preset at the factory, and the cap will be included in a separate plastic bag to allow for fine tuning at the customer site. Parker offers tamper resistant cap conversion kits for most flow control valves. For kit numbers consult the individual valve pages.



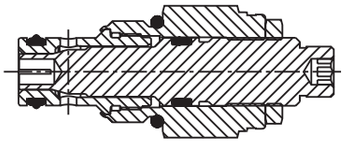
Seals: The Winner's Circle products feature a standard 4301 Polyurethane "D"-Ring. The "D"-Ring eliminates the need for backup rings.The majority of the products are available in Nitrile or Fluorocarbon Seals. You should match the seal compatibility to the temperature and fluid being used in your application.

Fine Meter Options: Fine meter needles are offered on some needle valve series. When this option is specified, the standard needle is replaced by a slotted needle. The slotted needle restricts substantially more flow giving you finer control in the small flow ranges. Obviously, the maximum flow capacity of the needle valve is decreased with the fine meter option.

Coarse Needle



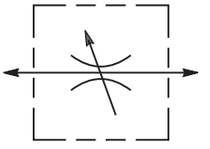
Fine Needle

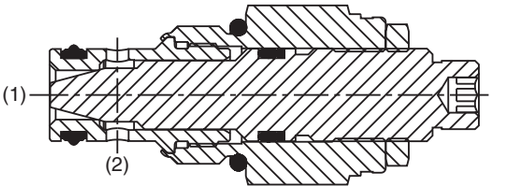


PRODUCT TYPES / APPLICATIONS

Needle Valve

Needle valves provide uncompensated adjustable flow control of a desired function. They are ideal for applications where general control of hydraulic flow is needed, like in a bleed off circuit. When used with a compensator spool, a pressure compensated system can be obtained.

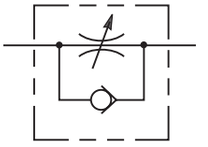


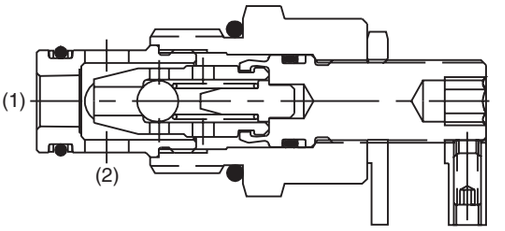


OPERATION - The valve acts as a fixed orifice in a hydraulic circuit. The effective size of the orifice increases as the tapered needle is opened. Shutoff is provided when fully closed. While a needle valve will meter flow regardless of the flow path, flow from port 2 to 1 is preferred. When you flow in the reverse direction (1 to 2), pressure forces work on the nose of the needle in an effort to drive it off of its seat. As such, all leakage conditions found in the catalog are based on flow from side to nose (port 2 to port 1). In addition, the adjustment will be harder to turn due to the added force.

Needle with a Reverse Check

Needle valves with reverse check functions are sometimes also referred to as flow control valves. As the name implies, these valves provide uncompensated adjustable speed control in one direction and allow free flow in the opposite direction. When used with a compensator spool, a pressure compensated system can be obtained.

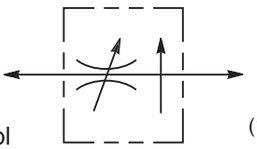


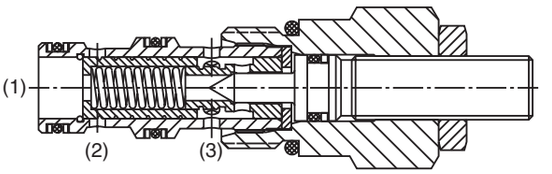


OPERATION - With flow entering the side of the cartridge (port 2), the needle acts as a fixed orifice. The effective size of this orifice is increased as the needle is opened controlling the output flow to port 1. With flow entering the nose (port 1), the check ball inside the needle is unseated allowing free flow to port 2.

P.C. Flow Regulator

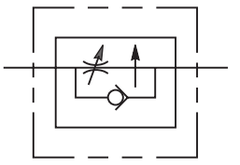
Pressure compensated flow regulators maintain a regulated flow regardless of changes in load or inlet pressure. They are commonly used to accurately control an actuator function. They can be used in meter-in or meter-out applications.

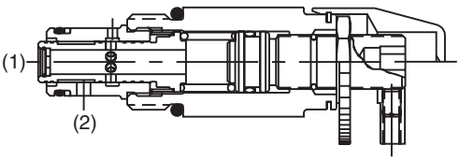




OPERATION - The valve consists of a control orifice within a normally open, spring biased compensator spool. Flow through the control orifice produces a pressure drop across the compensator spool. When inlet flow exceeds the flow setting of the valve, the force produced by the pressure differential across the spool exceeds the spring force and shifts the compensator spool to throttle or restrict flow; thus maintaining consistent flow through the valve. In the reverse direction, flow is metered, but not pressure compensated.

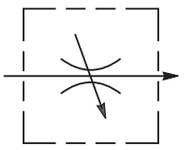
P.C. Flow Control

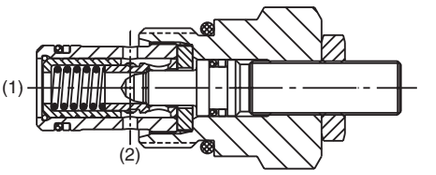




Pressure compensated flow controls are pressure compensated regulators with a reverse flow check valve. They provide constant regulated flow in the one direction regardless of changes in load pressure. Flow in the reverse direction is non-regulated, free flow. They can be used in meter-in or meter-out applications.

Adjustable Flow Controls

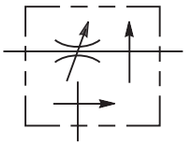


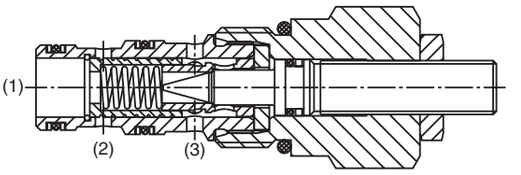


Most adjustable pressure compensated flow controls have a limited adjustment range. You will see in our catalog that we use the term “tuneable” for the FR101 and FC101 valves. This means they are only adjustable within a pre-set range. The FA101, J02E2, J04E2 and J04C2 are fully adjustable. Keep this adjustment capability in mind when you select a flow control.

OPERATION - When flow enters the nose (port 1) of the cartridge, it passes through a control orifice. This control orifice creates a pressure differential across the regulating spool. As the inlet flow increases, the pressure differential across the regulating spool increases, allowing the regulating spool to overcome its spring force and begin to shift. As it shifts, it throttles to maintain a constant flow. When used in conjunction with a fixed displacement pump, a relief valve between pump and valve is needed. Full flow is allowed in the reverse direction (port 2 to 1).

Priority Style P.C. Flow Regulator



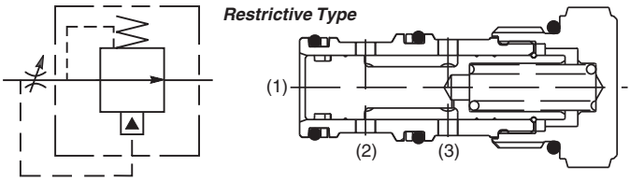


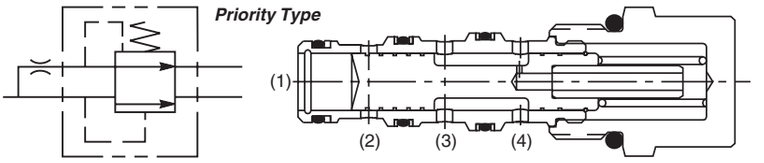
Priority style pressure compensator regulators maintain constant priority flow to one leg of the circuit regardless of changes in load or inlet pressure. Once this priority flow requirement is satisfied, the excess flow is diverted and can be used in another leg of the circuit. These valves are usually used in meter-in applications.

OPERATION - The valve consists of a control orifice within a spring biased compensator spool. The priority port is normally open while the bypass port is normally closed. As flow enters the inlet of the cartridge and passes through the control orifice, a pressure differential is created across the compensator spool. When the inlet flow exceeds the setting of the valve, the force produced by this pressure differential exceeds the spring force and shifts the compensator spool; opening up the bypass port, and bypassing the excess flow. If load pressure at the bypass port is greater than the load pressure at the priority port, the compensator spool will further shift restricting the priority flow to that of the valve setting. ***Caution:*** If the priority line is blocked so that no flow can pass through the control orifice, the compensator spool will shift, blocking the bypass port and allowing inlet pressure to go to full system relief pressure. These valves do not provide a pressure relieving function, so it is common to place an external relief valve downstream of port 3 to prevent a no flow condition.

Compensator Valves

Compensator valves are used to provide pressure compensated control across an external fixed or adjustable orifice. Parker offers both the restrictive type of compensator and a priority style.



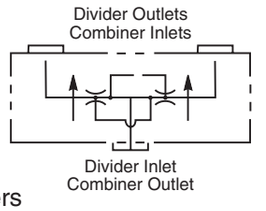


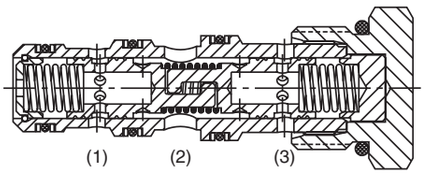
OPERATION - ***Restrictive Type:*** Inlet flow (upstream of the orifice) is split with one portion going to the compensator port inlet (port 1), the other portion passes through the orifice to the supply port (port 3). As pressure drop across the orifice reaches the selected compensator pressure drop, the higher pressure (pre-orifice) at port 1 starts to shift the compensator spool into throttling position. The valve works to maintain a constant pressure drop across the orifice.

Priority Type: Flow through the external orifice into the supply port (port 4) produces a pressure drop across the compensator spool. When the inlet pressure exceeds the initial setting of the valve, the force produced by the pressure differential across the spool exceeds the spring force and shifts the compensator spool to throttle or restrict the flow, thus maintaining constant flow through the priority port (port 3). The excess flow is bypassed to port 2. Regulated port flow must be maintained for bypass flow to continue.

Flow Divider / Combiner

Flow divider / combiner valves are used to proportion the flow from a single source into two actuators. In the reverse mode, the valve takes the flow from the two sources and combines it into one flow. When attempting to synchronize two cylinders with a flow/divider combiner valve, please consider that the flow accuracy is +10%. A crossover relief can be used to help re-synchronize the cylinders by bottoming them out after several cycles.

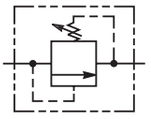
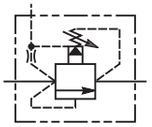
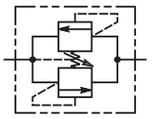
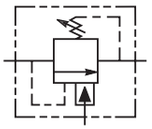
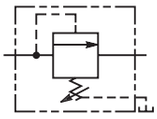
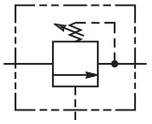


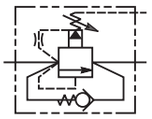
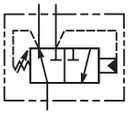
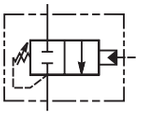
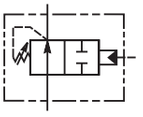
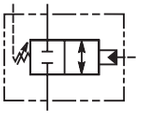
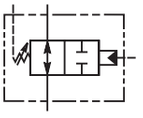
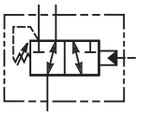
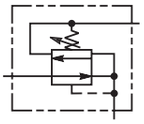
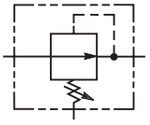
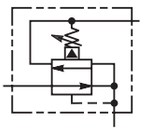


OPERATION - When flow enters the divider inlet port, it will pass through orifices in each of the interconnected spools. The flow passing through the orifices creates a pressure drop which pulls the two spools away from each other. The flow then passes to the two divider outlet ports. The division of flow (i.e. 50-50, 60-40, 66-33, etc.) is determined by the orifice sizes in the two spools.When flow is being combined, it enters the valve through two combiner inlets. The pressure drop across the orifices pulls the two spools together. The combined flow then passes through the combiner outlet.

Contents

Pressure Control Valves

	SERIES	CAVITY	DESCRIPTION	FLOW LPM/GPM	PRESSURE BAR/PSI
RELIEF VALVES	**DIRECT ACTING**				
	RDH042	C04-2	Direct Acting Relief, Poppet Type	3.8/1	350/5000
	A02A2	C08-2	Direct Acting Relief, Ball Type	6/1.6	420/6000
	A02B2	C08-2	Direct Acting Relief, Poppet Type	8/30	420/6000
	RD102	C10-2	Direct Acting Relief, Poppet Type	38/10	250/3600
	A04B2	C10-2	Direct Acting Relief, Poppet Type	100/26	420/6000
	A04B2*CE	C10-2	Direct Acting Relief, Poppet Type*		
	A04C2	C10-2	Direct Acting Relief, Spool Type	200/53	100/1450
					**CE marked, PED Compliant*
	DIFFERENTIAL AREA				
	RDH083	C08-2	Direct Acting Differential Area Relief	53/14	350/5000
	RDH103	C10-2	Direct Acting Differential Area Relief	75/20	350/5000
	RD163	C16-2	Direct Acting Differential Area Relief	151/40	210/3000
	PILOT OPERATED				
	RAH081	C08-2	Pilot Operated Spool Type	75.8/20	350/5000
	RAH101	C10-2	Pilot Operated Spool Type	113/30	350/5000
	RAH161	C16-2	Pilot Operated Spool Type	303/80	380/5500
	A06G2	C16-2	Pilot Operated Spool Type	400/106	420/6000
	RAH201	C20-2	Pilot Operated Spool Type	379/100	350/5000
	A04K2	C10-2	Pilot Operated Spool Type Kick Down	160/42	420/6000
	**VENTABLE**				
	RAH101V	C10-3	Pilot Operated Vented Relief	68/18	380/5500
	A04H3	C10-3S	Pilot Operated Vented Relief	190/50	420/6000
	A06H3	C16-3S	Pilot Operated Vented Relief	400/106	420/6000
	**CROSS-OVER**				
	A04J2	C10-2	Direct Acting Cross-over Relief	120/32	350/5000
	A04J2*CE	C10-2	Direct Acting Cross-over Relief*	120/32	350/5000
					**CE marked, PED Compliant*
	**UNLOADING**				
	RU101	C10-3	Direct Acting Unloading	3.75/1	210/3000
	M04A4J	C10-4	Direct Acting Piloting Unloading	2/0.53	420/6000
	PILOT OPERATED WITH REVERSE CHECK				
	A06P2	C16-2	Pilot Operated Poppet Type	400/106	420/6000
SEQUENCE VALVES	**PILOT OPERATED**				
	SVH081	C08-3	Pilot Operated, Int. Pilot, Ext. Drain	45/12	350/5000
	SVH101	C10-3	Pilot Operated, Int. Pilot, Ext. Drain	56.3/15	350/5000
	SVH161	C16-3	Pilot Operated, Int. Pilot, Ext. Drain	151.6/40	350/5000
	SVH102	C10-3	Pilot Operated, Ext. Pilot, Int. Drain	56.3/15	350/5000
	SVH162	C16-3	Pilot Operated, Ext. Pilot, Int. Drain	151.6/40	350/5000

	SERIES	CAVITY	DESCRIPTION	FLOW LPM/GPM	PRESSURE BAR/PSI
SEQUENCE VALVES	**Pilot Operated (Continued)**				
	B04D3	C10-3S	Pilot Operated, Reverse Check, Ext. Drain	120/32	420/6000
	B04C3	C10-3S	Pilot Operated, Kick Down	160/42	420/6000
	DIRECT ACTING				
	B02E3F	C08-3	Direct Acting, 2P-3W, Int. Pilot, Int. Drain	30/8	420/6000
	B04E3	C10-3	Direct Acting, 2P-3W, Int. Pilot, Int. Drain	50/13	420/6000
	B04F3	C10-3	Direct Acting, 2P-2W, NC, Ext. Pilot, Int. Drain	34/9	420/6000
	B04G3	C10-3	Direct Acting, 2P-2W, NO, Ext. Pilot, Int. Drain	40/10.6	420/6000
	B04H4	C10-4	Direct Acting, 2P-2W, NC, Ext. Pilot, Ext. Drain	47/12	420/6000
	B04J4	C10-4	Direct Acting, 2P-2W, NO, Ext. Pilot, Ext. Drain	47/12	420/6000
	B04K4	C10-4	Direct Acting, 2P-3W, NO, Ext. Pilot, Int. Drain	42/11	420/6000
REDUCING VALVES	**DIRECT ACTING**				
	C02A3	C08-3	Direct Acting Reducing/Relieving	20/5	420/6000
	PR103	C10-3	Direct Acting Reducing/Relieving	56/13	210/3000
	PILOT OPERATED				
	PRH082	C08-3	Pilot Operated Reducing	30/8	350/5000
	PRH102	C10-3	Pilot Operated Reducing	56.3/15	350/5000
	PRH122	C12-3	Pilot Operated Reducing	113.7/30	350/5000
	PRH162	C16-3	Pilot Operated Reducing	150/40	350/5000
	PRH081	C08-3	Pilot Operated Reducing/Relieving	30/8	350/5000
	PRH101	C10-3	Pilot Operated Reducing/Relieving	56.3/15	350/5000
	PRH121	C12-3	Pilot Operated Reducing/Relieving	113.7/30	350/5000
	PRH161	C16-3	Pilot Operated Reducing/Relieving	150/40	350/5000

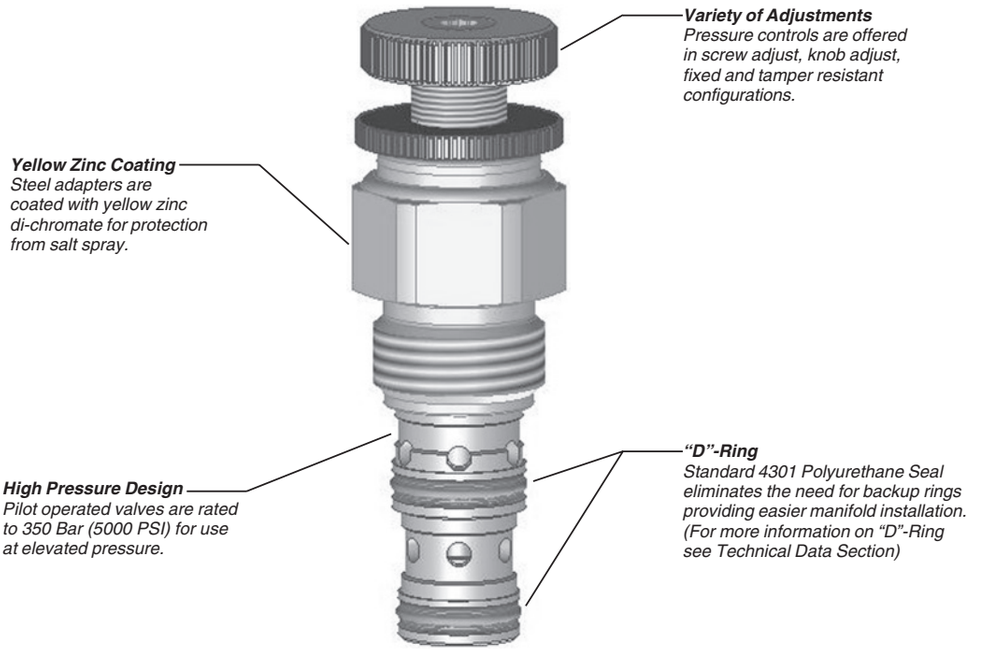
INTRODUCTION

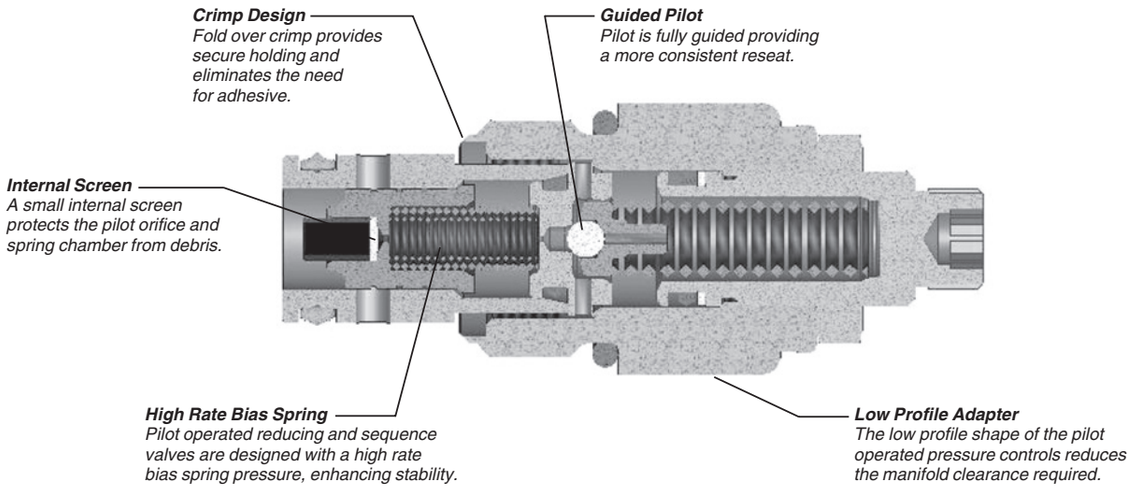
This technical tips section is designed to help familiarize you with the Parker line of Pressure Controls. In this section we highlight new products to this catalog as well as some design features of our pressure control line. In addition we present common options available to help you in selecting products for your application. Finally we give a brief synopsis of the operation and applications of the various product offered in this section.

NEW PRODUCTS

There are several new additions and product improvements to our Pressure Controls product line.

Here are just some of the design features and advantages to the "Winner's Circle" product line.



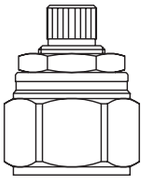


COMMON OPTIONS

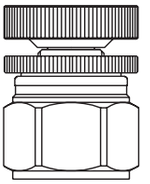
As you will see, Parker offers a variety of Pressure Control products. As such, some of the options mentioned below may not be available on all valves. Consult the model coding and dimensions for each valve for specifics. Here are some of the common options available.

Adjustment Types: Parker offers four primary types of adjustments for most of the pressure control products. Samples of these types are shown below. Please note all options may not be available for all valves. Consult the individual catalog pages for more details.

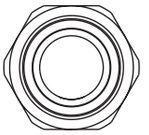
Screw Adjustment - Valve can be adjusted with an allen wrench. Lock nut included to maintain desired setting after adjustment. This is the most common adjustment option available on most Parker products.

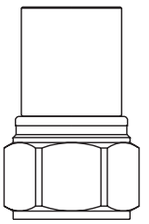


Knob Adjustment - An aluminum knob is added to the standard screw adjustment. A lock knob is provided to help maintain the desired setting after adjustment. Parker offers knob conversion kits for most pressure control valves. For kit numbers consult individual valve pages.

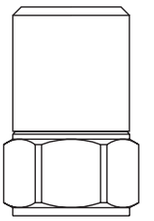


Fixed Style - In most cases, the Fixed Style product is a screw adjustable product with a steel collet threaded over the screw adjustment. These valves are preset at the factory.





Tamper Resistant - The tamper resistant option is a screw adjustable valve with a steel cap installed to conceal the adjustment. The cap is designed so that the internal edges clamp into the groove of the valve adapter. Once the cap is installed, it cannot be removed without damaging the cap and the valve. When a valve is ordered with the tamper resistant option, it will be preset at the factory, and the cap will be included in a separate plastic bag to allow for fine tuning at the customer site. Parker offers tamper resistant cap conversion kits for most pressure control valves. For kit numbers consult individual valve pages.

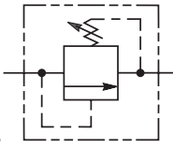


Seals: The Winner's Circle products feature a standard 4301 Polyurethane "D"-Ring. The "D"-Ring eliminates the need for backup rings. The majority of the products are available in Nitrile or Fluorocarbon Seals. You should match the seal compatibility to the temperature and fluid being used in your application.

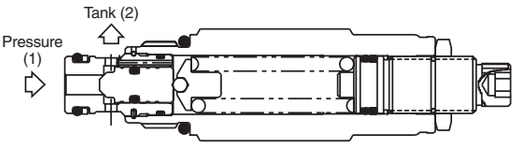
Pressure Range: Parker offers a range of spring settings for the Pressure Control product line. You want to choose the setting that best meets the operating range. The model callout is equivalent to the maximum setting (in psi) of the spring divided by 100 (i.e. 50 = 5000 psi).

PRODUCT TYPES / APPLICATIONS

Direct Acting Relief Valves

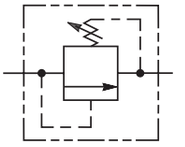


Direct acting relief valves are designed for fast response in intermittent duty applications. They are often used as an economical solution to clip pressure spikes. The poppet design allows for low leakage.

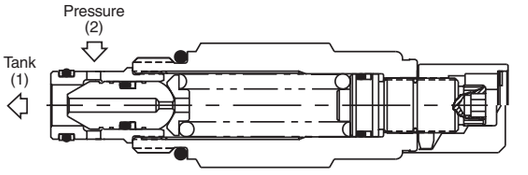


OPERATION - The valve poppet is held against the seat by the spring force. Inlet pressure on the nose (port 1) of the poppet acts against the spring force to unseat the poppet at the valve setting and allow flow to pass to tank. Since the pressure is working directly on the spring, this valve is very fast responding. It is not the best choice for system pressure regulation as it is slightly noisier than pilot operated relief valves and has higher pressure rise. *Note:* Any backpressure on port 2 would be additive to the spring setting.

Differential Area Relief Valves

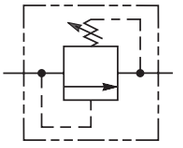


Differential area relief valves also are also best suited for intermittent applications where fast response is critical. These valves are often used as cross-over relief valves to chop pressure spikes. Due to their design, they generally can handle a larger flow rate and have a lower pressure rise than the standard directing acting relief. The poppet design allows for low leakage.

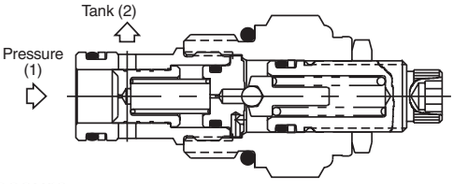


OPERATION - Pressure on the inlet (port 2) of the valve acts on the differential area of the poppet (difference between the O.D. of the poppet and the seat diameter) to produce a force which is opposed by the spring force. When pressure reaches the valve setting, the poppet is pushed off its seat, permitting flow to tank. *Note:* Any backpressure on port 1 would be additive to the spring setting.

Pilot Operated Relief



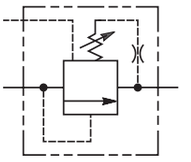
Pilot operated relief valves are designed for continuous duty applications. Due to their stability and low pressure rise, the pilot operated relief is the best option for setting the pressure of a hydraulic system.

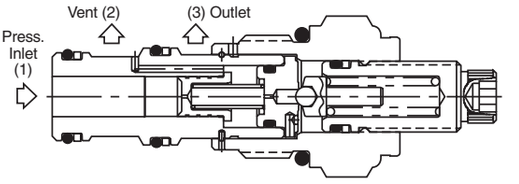


OPERATION - When inlet pressure at the nose (port 1) exceeds the valve setting, the pilot ball unseats. The pilot flow creates a pressure imbalance across the main spool causing the spool to move and allowing flow from inlet (port) 1 to tank (port 2.) *Note:* Any backpressure on port 2 would be additive to the spring setting.

Ventable Pilot Operated Relief

Ventable relief valves are a unique type of pilot operated relief. With this valve, you can control the pressure setting with the internal adjustment as well as via remote circuit. These valves are ideal in cirucits where multiple pressures are needed.

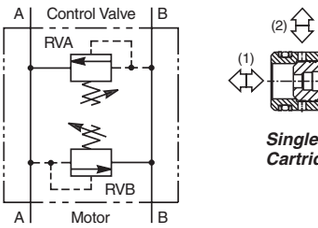


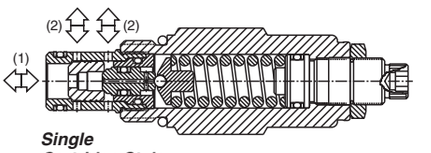


OPERATION - This valve can be controlled by the adjustment setting on the valve, or a remote circuit via the vent line. When the vent line is used, the smaller of the two pressure settings will determine the valve setting. In other words, if the pressure setting of the remote circuit is less than the adjusted setting, then the valve will relieve at the remote setting. If the pressure setting of the remote circuit is greater than the adjusted setting, then the valve will relieve at the adjusted setting. With the vent port (port 2) blocked, the valve operates like a standard pilot operated relief valve. Thus, a solenoid valve could be used on the vent port to select control between this valve another remote valve.

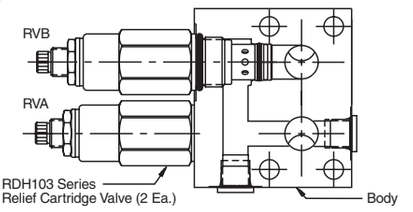
Dual Crossover Relief Valves

Dual crossover relief valves provide pressure surge protection for double acting hydraulic actuators. For best results, you always want to install the valve as close to the actuator as possible. The dual crossover feature can be achieved in two different methods. One way is to manifold two Differential Area Relief Valves into a single body. Parker offers three versions of this two cartridge arrangement. The advantage gained is higher flows can be pushed through this arrangement. The second method is to combine this dual function into a single cartridge. The single cartridge arrangement reduces cost considerably of the total package. In addition, a standard common cavity line body can be used instead of a special two body arrangement. The operation for the single cartridge style is shown below.





Single Cartridge Style

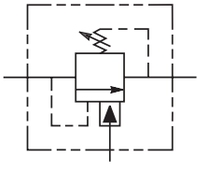


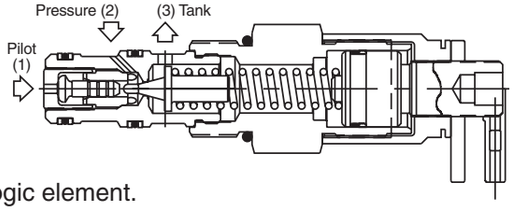
Two Cartridge Style

OPERATION - Pressure at port 1 acts on the spool to produce a force which is opposed by the spring setting. When pressure reaches the valve setting, the spool and poppet move relieving flow from port 1 to port 2. When port 2 is pressurized, the pressure acts on the differential area poppet to produce a force which is opposed by the spring force. When the pressure reaches the valve setting, the poppet is pushed off of its seat, relieving flow from port 2 to port 1. *Note:* Due to the construction and flow paths through the valve, the relief pressure settings may vary by approximately 300 psi from one direction to the other.

Differential Area Unloading Relief Valve

Unloading valves are differential area relief valves that can also be fully dumped or unloaded via a remote signal. They are best suited for low flow accumulator unloading circuits. They provide a fixed percentage between load and unload pressures. This pilot valve would generally be used in conjunction with a logic element.

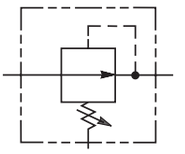


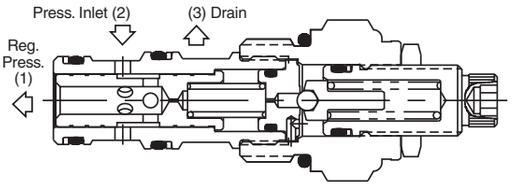


OPERATION - The fixed differential is provided by the pilot piston which has greater area than the dart seat. With its greater area, the piston is able to hold the dart off its seat, permitting flow from pressure to tank, until pressure on the pilot piston falls below the fixed percentage of the valve settings.

Pilot Operated Reducing Valve

Pilot operated pressure reducing valves can be used to reduce the pressure in a leg of the circuit lower than system pressure. Thus, they can be used to provide protection to downstream components from higher pressures.



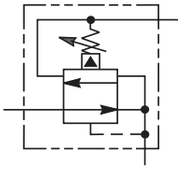


OPERATION - The pilot section controls the valve setting when reducing. As pressure at the regulated port exceeds the valve setting, the pilot ball is unseated. The pilot flow creates a pressure imbalance across the main spool causing the spool to throttle in order to maintain constant downstream pressure. The normally open design will allow flow to pass from inlet to reduced port with the only restriction being the pressure drop.

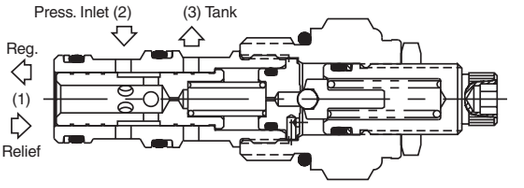
Pressure Reducing / Relieving Valves

Pressure reducing / relieving valves can be used to reduce the pressure in a leg of the circuit lower than system pressure. The valve also acts as a relief valve, relieving any shocks or surges that occur between the regulated port and the actuator. When the valve is in the relieving mode, the inlet port is blocked. Parker offers pressure reducing/relieving valves in both pilot operated and directing acting styles. The direct acting version is generally used in static applications where response is critical, or leakage is a concern.

Pilot Operated

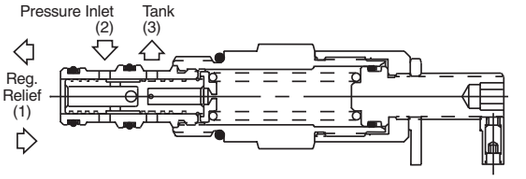


OPERATION - The pilot section controls the valve setting when reducing. As pressure at the regulated port exceeds the valve setting, the pilot ball is unseated. The pilot flow creates a pressure imbalance across the main spool causing the spool to throttle in order to maintain constant downstream pressure. A shock or surge at the regulated port shifts the spool, relieving flow to tank.



Direct Acting

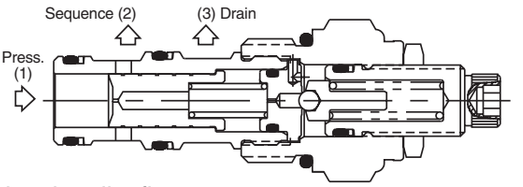
OPERATION - As pressure at the regulated port exceeds the valve setting, the valve throttles or closes in order to maintain constant downstream pressure. A shock or surge at the regulated port further shifts the spool, relieving flow to tank. This valve is not intended for rapidly changing flows which could lead to instability.



Pilot Operated Sequence Valves

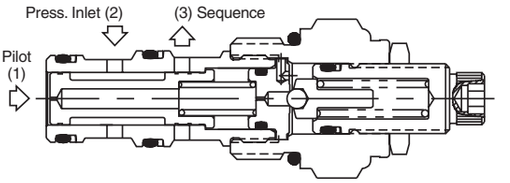
Sequence valves are used to control the sequence of operation of two or more hydraulic actuators. The sequence valve pressure is set higher than the first actuator operation pressure. Once the first actuator has completed its cycle, the sequence valve opens allowing the second actuator to move. Parker's line of pilot operated sequence valves include a series of internally piloted, externally drained valves and a series of externally piloted, internally vented valves. Parker also offers a line of direct acting sequence valves which are ideal for piloting logic elements in steady state applications.

P.O. Sequence (Internally Piloted, Externally Drained)



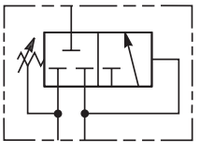
OPERATION - For this valve, the pilot pressure is sensed from the inlet of the valve (port 1). When the pilot pressure exceeds the valve setting, the pilot section opens creating a pressure imbalance across the main spool. This causes the spool to move allowing the flow to pass from the nose of the cartridge (port 1) to the actuator port (port 2). By externally draining the pilot flow directly to tank (port 3), the valve is insensitive to back pressure at the sequence port.

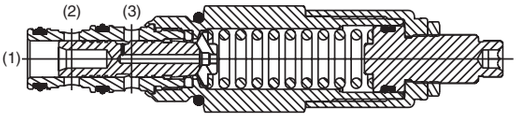
P.O. Sequence (Externally Piloted, Internally Vented)



OPERATION - For this valve, the pilot pressure is obtained from an external source and not from the pressure port. When the external pilot pressure (port 1) exceeds the valve setting, the pilot section opens creating a pressure imbalance across the main spool. This causes the spool to move allowing the flow to pass from the side of the cartridge (port 2) to the actuator port (port 3). Any pressure at port 3 is additive to the pressure setting. It is most common for port 3 to be connected to tank.

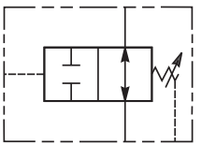
D.A. Sequence (Internally Piloted, Externally Drained)

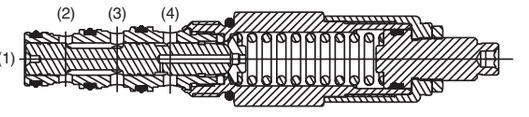




OPERATION - In the steady state condition, all three ports are blocked with the spring chamber drained to port 3. When the pressure at port 1 exceeds the valve setting, the spool moves allowing flow from the nose of the cartridge (port 1) to the actuator port (port 2). By externally draining the spring chamber directly to tank (port 3), the valve is insensitive to back pressure at the sequence port.

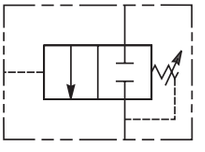
D.A. Sequence, N.O. (Externally Piloted, Externally Drained)

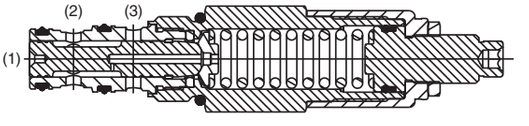




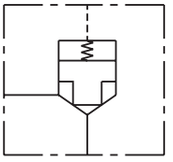
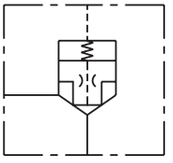
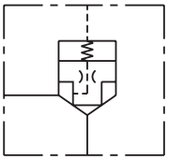
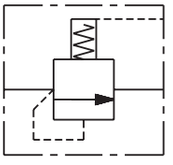
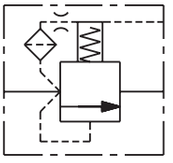
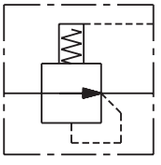
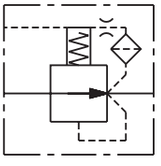
OPERATION - With no pressure at the pilot port (port 1), bi-directional flow is allowed between port 3 and port 2. When the pilot pressure at port 1 exceeds the valve setting the spool moves blocking both port 3 and port 2. By externally draining the spring chamber to tank (port 4), the valve is insensitive to back pressure at the sequencing ports.

D.A. Sequence, N.C. (Externally Piloted)





OPERATION - With no pressure at the pilot port (port 1), both port 3 and port 2 are blocked. When the pilot pressure at port 1 exceeds the valve setting, the spool moves opening a path and allowing flow from port 3 to port 2. This valve internally drains the spring chamber to tank via the sequencing port, thus any backpressure on port 2 would be additive to the spring setting.

	SERIES	CAVITY	DESCRIPTION	FLOW LPM/GPM	PRESSURE BAR/PSI
	**POPPET TYPE**				
	10SLC1-A	C10-3S	Normally Closed, Pilot to Close	57/15	240/3500
	16SLC1-A	C16-3S	Normally Closed, Pilot to Close	189/50	240/3500
	20SLC1-A	C20-3S	Normally Closed, Pilot to Close	303/80	240/3500
	16SLC1-B	C16-3S	Normally Closed, Vent to Open	189/50	240/3500
	16SLC1-C	C16-3S	Normally Closed, Vent to Open	189/50	240/3500
	**SPOOL TYPE**				
	10SLC2-A	C10-3S	Normally Closed, Pilot to Close	57/15	240/3500
	16SLC2-A	C16-3S	Normally Closed, Pilot to Close	189/50	240/3500
	20SLC2-A	C20-3S	Normally Closed, Pilot to Close	303/80	240/3500
	R04E3	C10-3S	Normally Closed, Pilot to Close	170/45	420/6000
	R06E3	C16-3S	Normally Closed, Pilot to Close	400/106	420/6000
	R08E3	C20-3S	Normally Closed, Pilot to Close	500/132	420/6000
	10SLC2-B	C10-3S	Normally Closed, Vent to Open	57/15	240/3500
	16SLC2-B	C16-3S	Normally Closed, Vent to Open	189/50	240/3500
	20SLC2-B	C20-3S	Normally Closed, Vent to Open	303/80	240/3500
	R04F3	C10-3S	Normally Closed, Vent to Open	170/45	420/6000
	R06F3	C16-3S	Normally Closed, Vent to Open	400/106	420/6000
	R08F3	C20-3S	Normally Closed, Vent to Open	500/132	420/6000
	10SLC3-A	C10-3S	Normally Open, Vent to Close	57/15	240/3500
	16SLC3-A	C16-3S	Normally Open, Vent to Close	189/50	240/3500
	R04H3	C10-3S	Normally Open, Vent to Close	57/15	420/6000
	R06H3	C16-3S	Normally Open, Vent to Close	160/42	420/6000
	10SLC3-B	C10-3S	Normally Open, Vent to Close	57/15	240/3500
	16SLC3-B	C16-3S	Normally Open, Vent to Close	189/50	240/3500
	R04G3	C10-3S	Normally Open, Vent to Close	57/15	420/6000
	R06G3	C16-3S	Normally Open, Vent to Close	160/42	420/6000

INTRODUCTION:

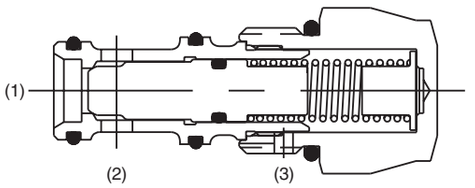
Parker's logic valves offer system designers a versatile range of screw-in elements that, when used in the proper combinations, can provide flexible design solutions for many common cartridge valve applications. They offer system designers the advantage of applying cartridge valve technology in applications where the flow and pressure conditions may exceed the limits of typical cartridge valves. Logic valves are essentially high flow poppet or spool elements that are controlled by small pilot devices. They can be used to control flow, pressure, or direction, and when applied in the proper arrangements, can perform multi-task control functions. Parker's logic valves offer system designers alternative products that can help reduce the size, cost, and complexity of integrated manifold systems.

NEW PRODUCTS:

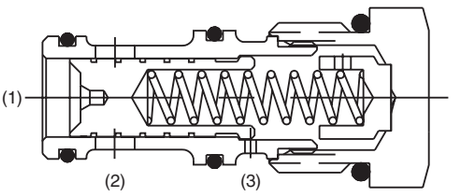
Parker Logic Valves are offered in two basic categories: Poppet and Spool.

Now Available in 6000 PSI

Poppet Type - Used for flow switching directional control applications.

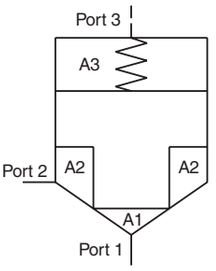


Spool Type - Used for pressure sensing in modulating applications to regulate flow and pressure.



PRODUCT TYPES / APPLICATIONS

POPPET TYPE



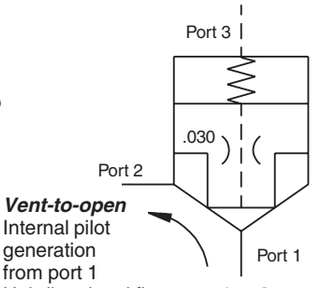
A1 + A2 = A3

Poppet type logic valves are 3 ported, 2-way on/off valves that switch flow between port 1 and port 2. The poppet's on/off action is operated by controlling pilot oil at port 3 of the valve. A small low flow solenoid or pilot valve is an ideal control for this purpose. Parker offers vent-to-open and pilot-to-close style poppet logic valves.

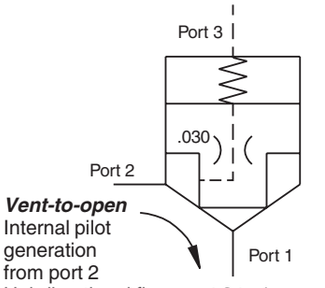
Note: *Poppet logic valves are an unbalanced 2:1 ratio poppet design. The opening and closing of the poppet is dependent on the force balances on the areas of the poppet at port 1, port 2, and port 3.*

Vent-to-open logic valves:

Vent-to-open logic valves are primarily used for uni-directional flow switching applications. The poppet in the vent-to-open logic valve is spring biased to the closed condition. The pilot oil source that operates the logic element is generated internally by direct pressure from either work port 1 or 2, depending on the option chosen. Venting the pilot oil at port 3 allows the valve to open and pass flow between port 1 and port 2 at the bias spring setting. Blocking the pilot at port 3 causes the valve to close. When closed, the 2:1 ratio poppet design provides a positive low leak seal. Because the pilot source is generated internally within the valve, vent-to-open logic valves are best suited for uni-directional applications.



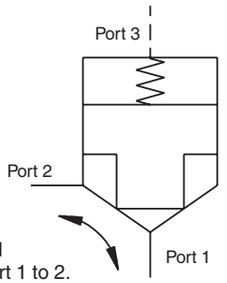
Vent-to-open
Internal pilot generation from port 1
Uni-directional flow, port 1 to 2.



Vent-to-open
Internal pilot generation from port 2
Uni-directional flow, port 2 to 1.

POPPET TYPE *Continued*

Pilot-to-close logic valve:
Pilot-to-close logic elements are primarily used for bi-directional flow switching applications. The poppet in the pilot-to-close logic valve is spring biased to the closed condition. With no pilot signal at port 3, the valve will open allowing flow in either direction between work ports 1 and 2 once pressure at one of the work ports reaches the biased spring setting. Appling a sufficient externally generated pilot force to port 3 of the valve closes the poppet creating a low leak seal between port 1 and port 2.



Pilot-to-close
External pilot required
Bi-directional flow, port 1 to 2.

2-way, 3-way, and 4-way Directional Control:
Poppet logic valves are typically used to perform high flow directional switching operations using small low power pilot valves to control the sequence of the directional operation.

- A single logic valve can be used to control 2-way, on/off switching.
- Multiple elements in a bridge arrangement can control 3-way or 4-way directional switching.
- Since each logic valve is individually controlled, the timing, sequence, and overlap of directional functions can be controlled very precisely.
- Uni-directional or bi-directional flow can be achieved, depending on the valve selected.
- Flows in excess of 80 gpm can be controlled through a single logic element, and more than one logic valve can be used in parallel to control flow in excess of the rated flow of a single element.
- Poppet construction provides a low leak directional control.

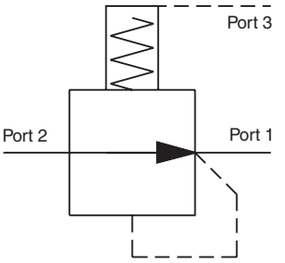
(See circuit examples on pages LE4-LE5)

SPOOL TYPE

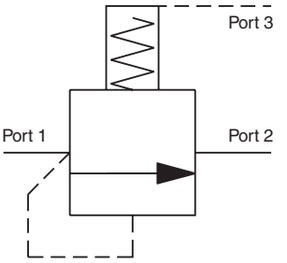
Spool type logic valves can also be used for directional switching, however, they are typically used in modulating applications to control flow or regulate pressure. Virtually any pressure or flow control function can be achieved with a spool type logic valve including; restrictive or priority flow control, pressure relief, pressure reducing, sequencing, and unloading.

The spools in this category of logic valves are balanced designs; the spool area at the work port (port 1) and the pilot port (port 3) are equal (1:1). The spool is held in a biased condition by a spring. Venting the pilot at port 3 creates an unbalanced condition causing the valve spool to modulate open or close, depending on the valve chosen. This spool design makes the valve vary stable because the forces acting to open and close the valve are in balance.

Flow Control / Compensators:
Parker offers two types of logic valves for flow control functions.
1) Normally open spools function as a restrictive type compensator.
2) Normally closed spools function as a priority or by-pass compensator.

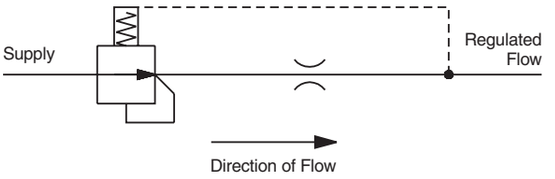


Normally open spool

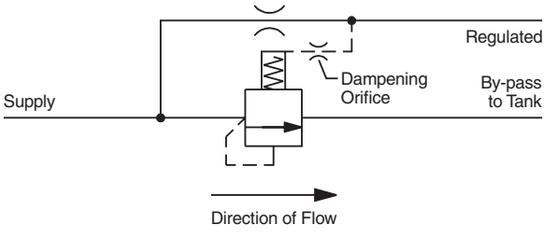


Normally closed spool

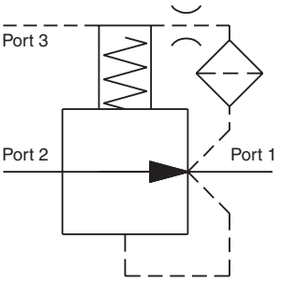
Restrictive Flow Regulator:
Normally open spool type logic elements can be used with an external orifice or valve as a compensator to regulate flow. Used as restrictive compensator, a normally open spool senses the upstream and downstream pressure across an orifice or valve. The spool modulates closed to maintain a constant pressure drop across the controlled device equal to the bias spring in the logic valve, thus maintaining a constant flow rate regardless of changes in upstream or downstream pressure.



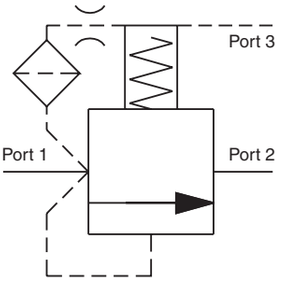
Priority / Bypass Flow Regulator:
A logic valve with a normally closed spool can be used as a priority or by-pass compensator. In this case, the spool modulates open to maintain a constant pressure drop across the controlled orifice or valve, thereby maintaining a constant priority flow regardless of upstream or downstream pressure changes. In a priority arrangement, any oil that doesn't saturate the controlled device is by-passed at load pressure plus the value of the bias spring in the logic valve.



Pressure Control:
Spool type logic valves can be used as the main stage spool in high flow pressure control applications with the logic valve handling the high flow, and a small pilot valve controlling the action of the logic valve spool. Normally open, and normally closed spool options are available enabling virtually all pressure control functions to be achieved. When used in pressure control applications, the logic valve spool modulates open or closed to maintain the pressure setting of the pilot valve communicated to port 3. Pressure control applications require a pilot connection between the control port (port 1 or 2), and the pilot port (port 3). In order to simplify the design, Parker offers spool type logic valves with internal piloting options that can help minimize the number of connections needed. When used in manifold systems, the internal piloting options help to simplify the manifold design by reducing the number of construction drillings in the block. Multiple functions such as relief, pump unloading, and pressure compensation can be performed with one logic valve by communicating multiple pilot devices to the same logic element.



Normally open spool
- Pressure Reducing



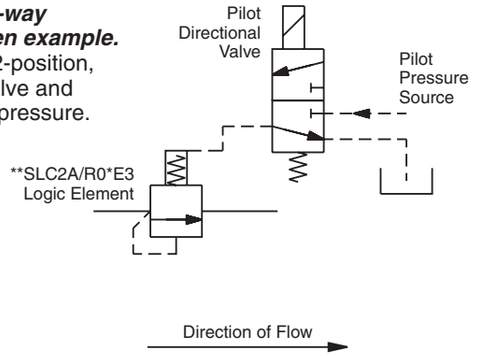
Normally closed spool
- Relief
- Sequence
- Unloading

(See circuit examples on page LE6)

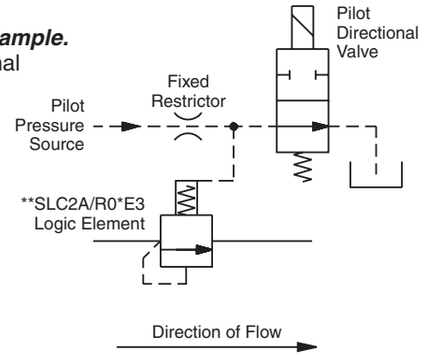
Application Note:
This section is as an application guide, and it is intended to illustrate the various ways that logic elements can be used to create a variety of hydraulic control functions. For additional help applying logic valves, contact your Parker Sales Engineer.

DIRECTIONAL CONTROL EXAMPLES

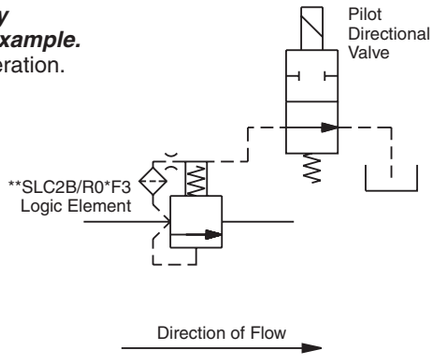
2-position, 2-way normally open example.
Switched by 2-position, 3-way pilot valve and external pilot pressure.



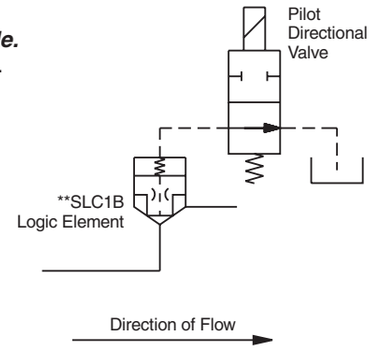
2-position, 2-way normally open example.
Switched by external pilot pressure and vented through 2-position, 2-way pilot valve.



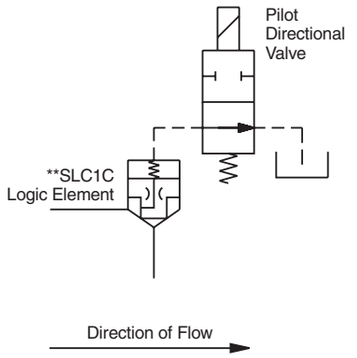
2-position, 2-way normally open example.
Internal pilot generation.



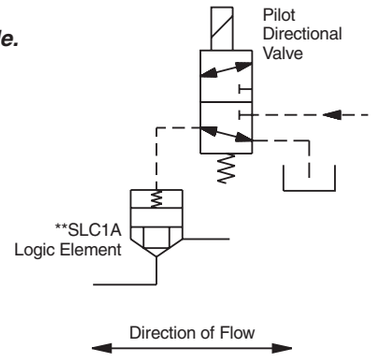
2-position, 2-way normally open example.
Internal pilot generation.



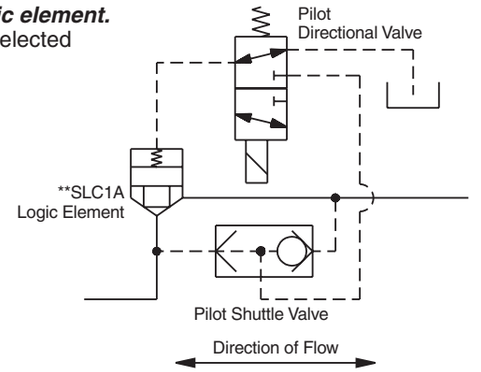
2-position, 2-way normally open example.
Internal pilot generation.



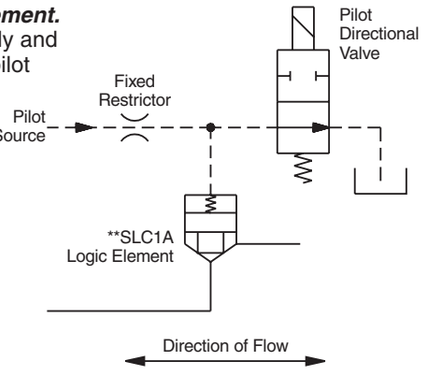
2-position, 2-way normally open example.
Switched by 2-position, 3-way pilot valve and external pilot.



*****SLC1A logic element.***
With shuttle-selected pilot supply.



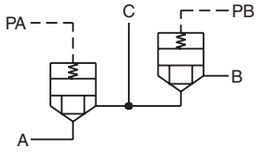
*****SLC1A logic element.***
External pilot supply and 2-position, 2-way pilot directional valve.



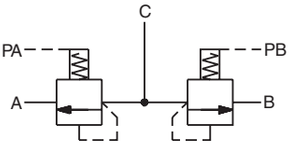
DIRECTIONAL CONTROL EXAMPLES

THREE-WAY BRIDGE CIRCUITS

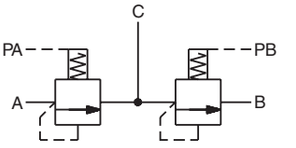
Circuit 1, with **SLC1A poppet logic element.



Circuit 2, with **SLC2A/R0*E3 spool logic element.



Circuit 3, with **SLC2A/R0*E3 spool logic element.



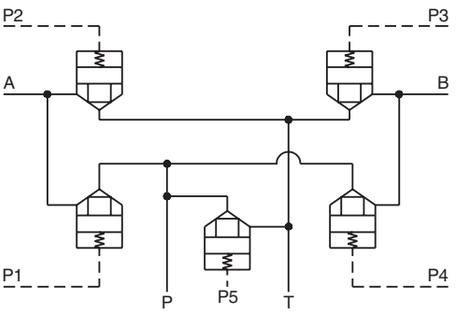
Required Flow Path	Pilot Pressure Applied To		Available From Circuit		
	PA	PB	1	2	3
	NO	NO	X	X	
	YES	NO	X	X	X

Required Flow Path	Pilot Pressure Applied To		Available From Circuit		
	PA	PB	1	2	3
	NO	YES	X	X	
	NO	YES	X		X

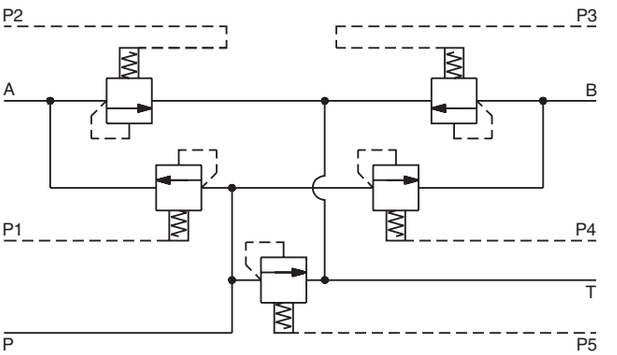
***NOTE:** Pilot pressure must exceed load pressure in order for valve to close.*

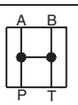
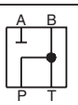
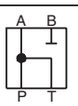
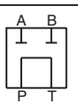
FOUR-WAY BRIDGE CIRCUITS

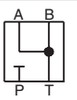
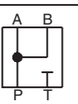
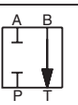
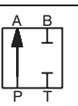
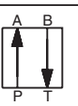
Circuit 1, with **SLC1A poppet logic elements.

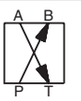
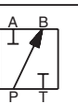
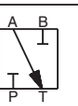


Circuit 2, with **SLC2A/R0*E3 spool logic elements.



Required Flow Path	Pilot Pressure Applied To				
	P1	P2	P3	P4	P5
	YES	YES	YES	YES	YES
	NO	NO	NO	NO	NO
	YES	YES	NO	NO	NO
	NO	NO	YES	YES	NO
	YES	YES	YES	YES	NO

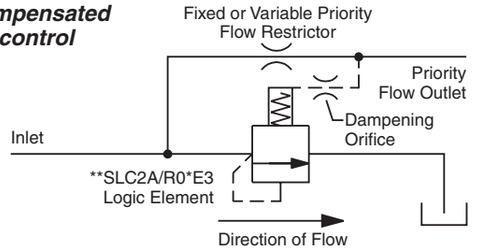
Required Flow Path	Pilot Pressure Applied To				
	P1	P2	P3	P4	P5
	YES	NO	NO	YES	YES
	NO	YES	YES	NO	YES
	YES	YES	NO	YES	YES
	NO	YES	YES	YES	YES
	NO	YES	NO	YES	YES

Required Flow Path	Pilot Pressure Applied To				
	P1	P2	P3	P4	P5
	YES	NO	YES	NO	YES
	YES	YES	YES	NO	YES
	YES	NO	YES	YES	YES

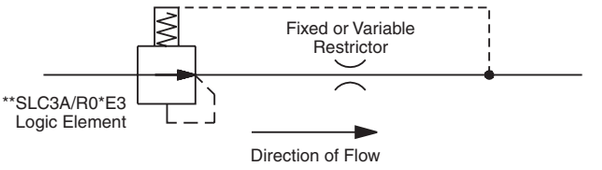
***NOTE:** Pilot pressure must exceed load pressure in order for valve to close.*

FLOW CONTROL EXAMPLES

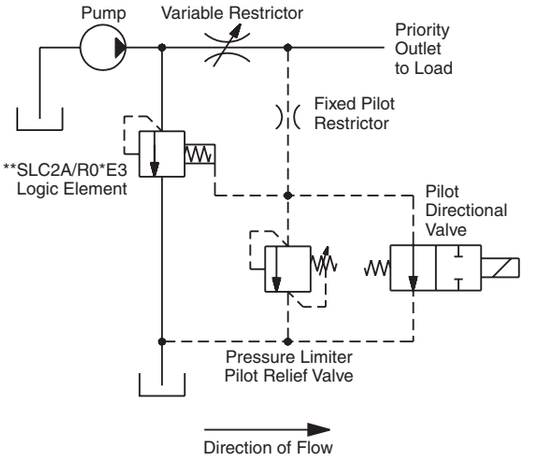
Pressure compensated priority flow control example.



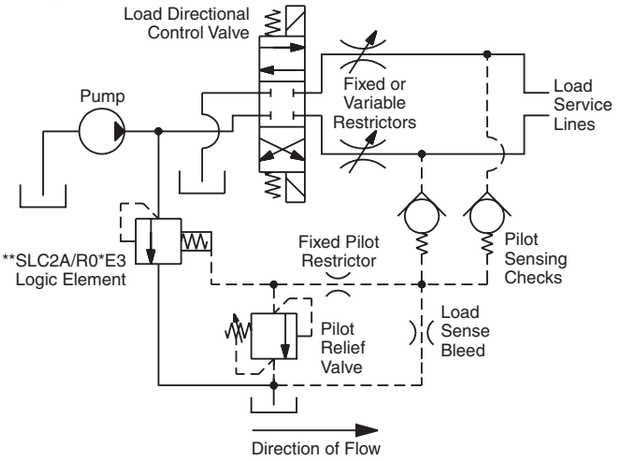
Pressure compensated restrictive flow control example.



Load sensing priority flow control example with pressure limiting and unloading.

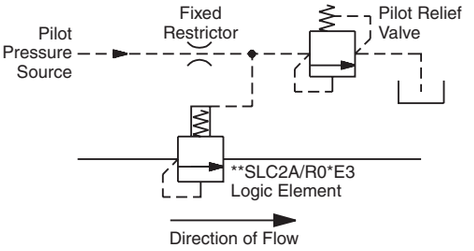


Load sensing priority flow control example with pressure limiter.

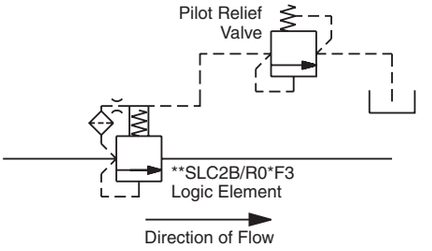


PRESSURE CONTROL EXAMPLES

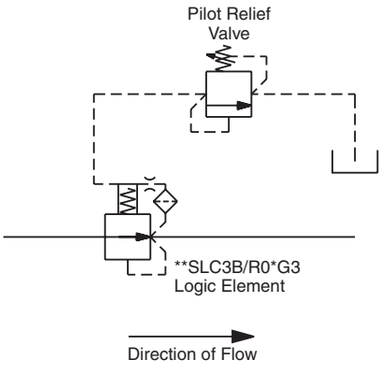
Pressure relief or sequence example with external pilot supply and pilot relief.



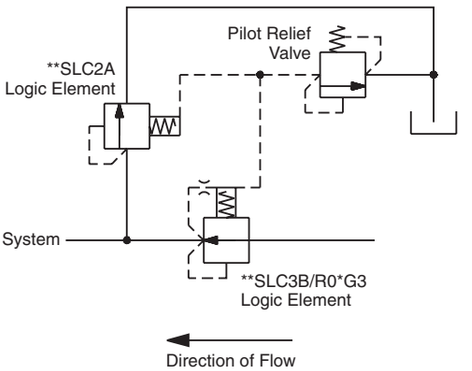
Pressure relief or sequence example with internal pilot supply and pilot relief.

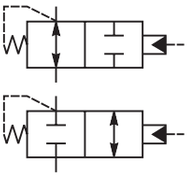
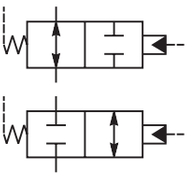
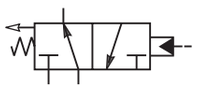
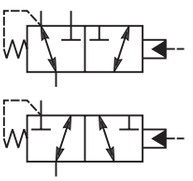
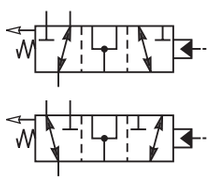
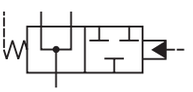
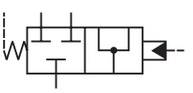


Pressure reducing example, non-relieving type.



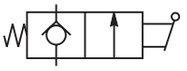
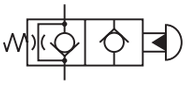
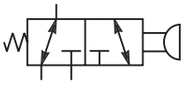
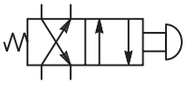
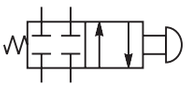
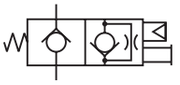
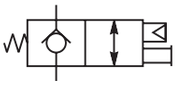
Pressure reducing-relieving example.



	SERIES	CAVITY	DESCRIPTION	FLOW LPM/GPM	PRESSURE BAR/PSI
	R04C3	C10-3	2 Way, Normally Open, Pilot to Close	80/21	420/6000
	R04D3	C10-3	2 Way, Normally Closed, Pilot to Open	100/26	420/6000
	R04A4	C10-4	2 Way, Normally Open, Pilot to Close, External Vent	80/21	420/6000
	R04B4	C10-4	2 Way, Normally Closed, Pilot to Open, External Vent	80/21	420/6000
	DH103	C10-4	3 Way, External Pilot, Normally Open, Vent to Atmosphere	38/10	240/3500
	N04A4	C10-4	3 Way, Internal Vent, External Pilot	90/24	420/6000
	N04B4	C10-4	3 Way, Internal Vent, External Pilot	90/24	420/6000
	N04G4	C10-4	3 Way, Vent to Atmosphere, External Pilot	85/22	420/6000
	N04H4	C10-4	3 Way, Vent to Atmosphere, External Pilot	85/22	420/6000
	N5A125	5A	3 Way, 2 Position, External Drain, Open Transition	160/42	420/6000
	N5A300	100-1	3 Way, 2 Position, External Drain, Open Transition	400/105	420/6000
	N5B125	5A	3 Way, 2 Position, External Drain, Closed Transition	160/42	420/6000
	N5B300	100-1	3 Way, 2 Position, External Drain, Closed Transition	400/105	420/6000
	N5C125	5A	3 Way, 2 Position, External Drain, Diverter Valve, Normally Open	160/42	420/6000
	N5C300	100-1	3 Way, 2 Position, External Drain, Diverter Valve, Normally Open	400/105	420/6000
	N5D125	5A	3 Way, 2 Position, External Drain, Diverter Valve, Normally Closed	160/42	420/6000
	N5D300	100-1	3 Way, 2 Position, External Drain, Diverter Valve, Normally Closed	400/105	420/6000

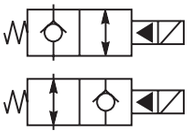
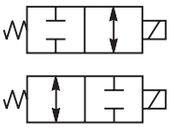
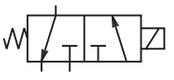
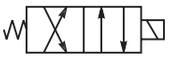
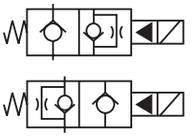
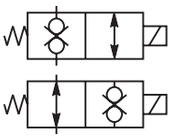
Contents

Manual Valves

	SERIES	CAVITY	DESCRIPTION	FLOW LPM/GPM	PRESSURE BAR/PSI
	DL081	C08-2	2 Position, 2 Way, N.C. Poppet, Pull to Open	30/8	210/3000
	DL101	C10-2	2 Position, 2 Way, N.C. Poppet, Pull to Open	49/13	210/3000
	GM0212	C08-2	2 Position, 2 Way, N.O. Poppet, Push to Close	45/12	350/5000
	GM0233	C08-3	2 Position, 3 Way, Spool Type, Pull to Shift	19/5	350/5000
	DM103	C10-3	3 Way, Rotary Spool	22/6	240/3500
	DM104	C10-4	4 Way, Rotary Spool	7/2	240/3500
	GM0240XS	C08-4	2 Position, 4 Way, Push to Shift	15/4	350/5000
	GM0240CS	C08-4	2 Position, 4 Way, Push to Shift	15/4	350/5000
	GM0251	C08-4	3 Position, 4 Way, Closed Center, Pull to Shift and Push to Shift	17/5	350/5000
	GM0253	C08-4	3 Position, 4 Way, Float Center, Pull to Shift and Push to Shift	17/5	350/5000
	GM0257	C08-4	3 Position, 4 Way, Tandem Center, Pull to Shift and Push to Shift	15/4	350/5000
	GM0259	C08-4	3 Position, 4 Way, Open Center, Pull to Shift and Push to Shift	15/4	350/5000
	GA0201	C08-2	2 Position, 2 Way, N.C. Poppet, Air Pilot or Pull to Open, Restricted Reverse Flow	45/12	210/3000
	GA0205	C08-2	2 Position, 2 Way, N.C. Poppet, Air Pilot or Pull to Open, Free Reverse Flow	45/12	210/3000

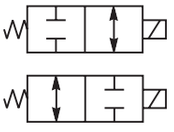
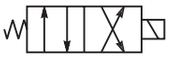
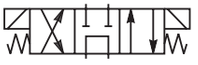
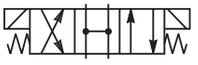
Contents

Solenoid Valves

	SERIES	CAVITY	DESCRIPTION	FLOW LPM/GPM	PRESSURE BAR/PSI
HIGH FLOW VALVE FAMILY			***See individual catalog pages for exact specifications.***		
	**2 WAY POPPET TYPE**				
	GS02 08	C08-2	2 Position, 2 Way, N.C.	38/10	350/5000
	GS04 08	C10-2	2 Position, 2 Way, N.C.	75/20	350/5000
	GS06 08	C16-2	2 Position, 2 Way, N.C.	285/75	350/5000
	GS06 07	C16-2	2 Position, 2 Way, N.C.	190/50	350/5000
	GS04 17	C10-2	2 Position, 2 Way, N.O.	68/18	210/3000
	GS06 18	C16-2	2 Position, 2 Way, N.O.	285/75	350/5000
	GS06 17	C16-2	2 Position, 2 Way, N.O.	228/60	350/5000
	**2 WAY SPOOL TYPE**				
	GS02 22*	2X / C09-2	2 Position, 2 Way, N.C. Spool	19/5	350/5000
	GS02 27*	2X / C09-2	2 Position, 2 Way, N.O. Spool	19/5	350/5000
	GS04 27	C10-2	2 Position, 2 Way, N.O. Spool	30/8	350/5000
	**These valves fit the C09-2 Parker cavity.*				
	**3 WAY SPOOL TYPE**				
	GS02 31/32	C08-3	2 Position, 3 Way	19/5	350/5000
	GS04 31/32	C10-3	2 Position, 3 Way	30/8	350/5000
	**4 WAY, 2 POSITION SPOOL TYPE**				
	GS02 42	C08-4	2 Position, 4 Way	19/5	350/5000
	**2 WAY POPPET TYPE**				
	DSL081	C08-2	2 Position, 2 Way, N.C. or N.O.	30/8	250/3600
	DSH081	C08-2	2 Position, 2 Way, N.C. or N.O.	30/8	350/5000
	DSL101	C10-2	2 Position, 2 Way, N.C. or N.O.	60/15	250/3600
	DSH101	C10-2	2 Position, 2 Way, N.C. or N.O.	60/15	350/5000
	DSH121	C12-2	2 Position, 2 Way, N.C. or N.O.	90/24	350/5000
	DS161	C16-2	2 Position, 2 Way, N.C. or N.O.	150/40	210/3000
	DS201	C20-2	2 Position, 2 Way, N.C. or N.O.	260/70	210/3000
	GH02 01	C08-2	2 Position, 2 Way, N.C., with Flow Adj.	11/3	285/4000
	GS02 72/73	C08-2	Bi-Directional Poppet, N.C.	1.7/.45	210/3000
	GS02 80*/81	C08-2	Bi-Directional Poppet, N.C.	58/15	350/5000
	GS04 80*/81	2R	Bi-Directional Poppet, N.C.	76/20	350/5000
	GS06 80*/81	C16-2	Bi-Directional Poppet, N.C.	285/75	350/5000
	GS02 77/78	C08-2	Bi-Directional Poppet, N.O.	1.7/.45	210/3000
	GS02 85*/86	C08-2	Bi-Directional Poppet, N.O.	58/15	350/5000
	GS04 85*/86	2R	Bi-Directional Poppet, N.O.	76/20	350/5000
	GS06 85*/86	C16-2	Bi-Directional Poppet, N.O.	285/75	350/5000
	**210/3000 psi rating*				

Contents

Solenoid Valves

	SERIES	CAVITY	DESCRIPTION	FLOW LPM/GPM	PRESSURE BAR/PSI
	**2 WAY SPOOL TYPE**				
	DSL082	C08-2	2 Position, 2 Way	15/4	250/3600
	DSH082	C08-2	2 Position, 2 Way	15/4	350/5000
	DSL102	C10-2	2 Position, 2 Way	30/8	250/3600
	DSH102	C10-2	2 Position, 2 Way	30/8	350/5000
	DS162	C16-2	2 Position, 2 Way	75/20	210/3000
	**3 WAY SPOOL TYPE**				
	DSL083	C08-3	2 Position, 3 Way	15/4	250/3600
	DSH083	C08-3	2 Position, 3 Way	15/4	350/5000
	DSL103	C10-3	2 Position, 3 Way	30/8	250/3600
	DSH103	C10-3	2 Position, 3 Way	30/8	350/5000
	DS163	C16-3	2 Position, 3 Way	57/15	210/3000
	**4 WAY, 2 POSITION SPOOL TYPE**				
	DSL084	C08-4	2 Position, 4 Way	15/4	250/3600
	DSH084	C08-4	2 Position, 4 Way	15/4	350/5000
	DSL104	C10-4	2 Position, 4 Way	30/8	250/3600
	DSH104	C10-4	2 Position, 4 Way	30/8	350/5000
	4 WAY, 3 POSITION SPOOL TYPE				
	GS02 51	C08-4	3 Position, 4 Way	17/4.5	350/5000
	GS04 52D	C10-4	3 Position, 4 Way	20/8	350/5000
	GS02 53	C08-4	3 Position, 4 Way	15/4	350/5000
	GS04 54D	C10-4	3 Position, 4 Way	38/10	350/5000
	GS02 57	C08-4	3 Position, 4 Way	13/3.5	350/5000
	GS04 57D	C10-4	3 Position, 4 Way	42/11	350/5000
	GS02 59	C08-4	3 Position, 4 Way	13/3.5	350/5000
	GS04 59D	C10-4	3 Position, 4 Way	42/11	350/5000

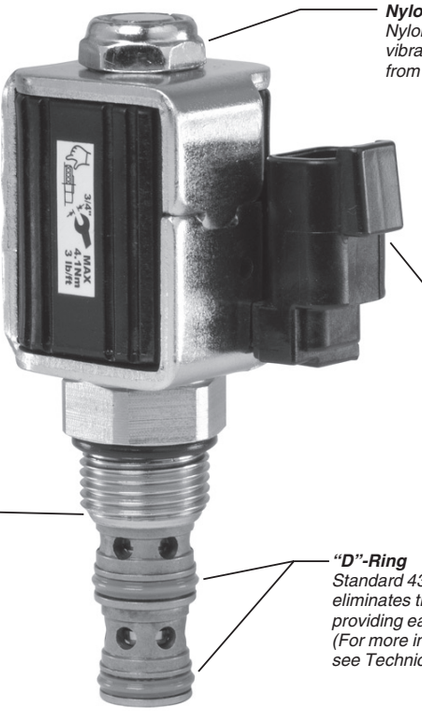
INTRODUCTION

This technical tips section is designed to help familiarize you with the Parker line of Solenoid Valves. In this section we highlight new products to this catalog as well as some design features of our solenoid valves. In addition we present common options available to help you in selecting products for your application. Finally, we give a brief synopsis of the operation and applications of the various products offered in this section. Some tips in applying and selecting our products are provided throughout this guide.

NEW PRODUCTS

There are several new additions and product improvements to our Solenoid Valve product line.

Here are just some of the design features and advantages to the product line.



Nylon Insert Nut
Nylon inserted jam nut resists vibration preventing the nut from backing out.

New Super Coil
Exceeds IP69K specifications with Deutsch molded connector.

Crimp Design
Fold over crimp provides secure holding and eliminates the need for adhesive.

"D"-Ring
Standard 4301 Polyurethane Seal eliminates the need for backup rings providing easier manifold installation. (For more information on "D"-Ring see Technical Data Section)

New Parker *SUPER COIL* Now Available!

Exceeds IP69k Specifications

After exhaustive testing, the new Super Coil has clearly distanced itself from the competition. This coil was subjected to the rigors of this environmental standard and the results were excellent. This coil stands up to most rugged of environmental conditions including weather, dust, and extreme temperature variations.

Water Dunk Test Qualified

The Super Coil was taken to task in a repeated water dunk thermal cycle test program with alternate exposure to high and low temperature, only to perform with outstanding results.

Endurance Tested

The goal of this test was to cycle the coil to high temperature extremes in order to validate the coils ability to perform in extreme temperature environments.

Water Spray and Chemical Solvent Compatibility

The Super Coil was subjected to numerous chemical solvents in a rigorous test which established the fact that these coils can withstand harsh and unusual environments. Also, the coils were subjected to a high pressure water spray test. Once again, the Super Coil passed this test.

Deutsch molded connector is highly recommended.

COMMON OPTIONS

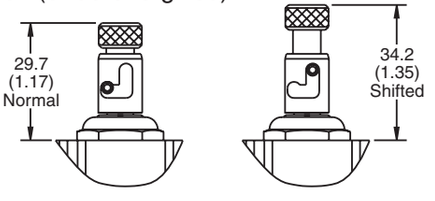
As you will see, Parker offers a variety of solenoid valve products. As such, some of the options mentioned below may not be available on all valves. Consult the model coding and dimensions for each valve for more specifics. Here are some of the common options available.

Seals: The Winner's Circle products feature a standard Polyurethane "D"-Ring. The "D"-Ring eliminates the need for backup rings. For more information on the "D"-Ring see the Technical Data section of the catalog. The majority of the products are available in Nitrile or Fluorocarbon Seals. You should always match the seal compatibility to the temperature and fluid being used in your application.

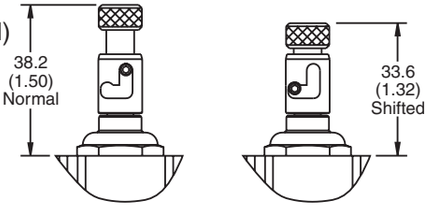
Coils: Coils can be ordered as part of the full assembly or separately. Various terminations and voltages are available. For detailed information on the coil options consult the coil section of the catalog. The ordering information for each valve will direct you to the proper coil.

Manual Overrides: Many of our solenoid valves are also offered with a manual override. The override allows the user to shift the valve when coil force is not available. They provide a means of shifting the solenoid valve due to a loss of power or a coil failure. Overrides are intended for infrequent usage and are not designed to be used as a primary method of valve actuation.

The most common override option for the 2 Position valves is the push & twist style shown below. With a normally closed valve or a pull style tube, the valve is in normal operation (or de-energized) when the pin is seated in the slotted groove at the lowest position. To shift the valve manually, the operator pushes down on the knob and twists it counterclockwise. When the pressure is removed from the knob, an internal spring pushes the pin up the slotted groove to the upper position of the override. With a normally open valve, or push style tube, the actuation is reversed. The valve is in the normal position (or de-energized) when the pin is in the upper position of the override. To shift the valve manually, the operator pushes down on the knob and twists is clockwise. Once the pin is seated in the slotted groove, the operator can remove pressure and the valve will stay actuated.

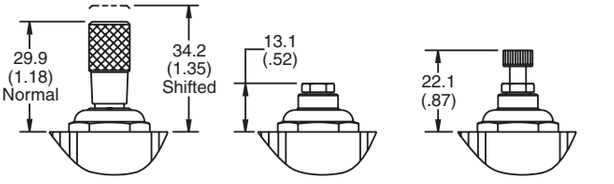


Normally Closed Pull Type Tube



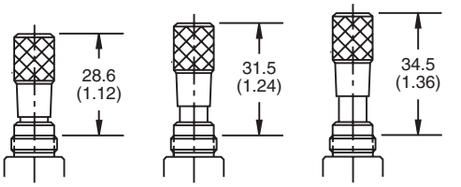
Normally Open Push Type Tube

In addition to the push and twist style override, normally closed (pull style tube) 2 position valves can be ordered with a pull and release override. Normally open (push style) 2 position valves are available with flush style and extended style overrides. These overrides are not detented. Each style is shown below.



Pull and Release Manual Override ***Flush Manual Override*** ***Extended Manual Override***

3 Position valves are offered with a Push / Pull style override. This override is not detented. Springs hold the spool of the valve in the center position of the valve. When the knob is pulled, the spool is moved upward simulating the action of the upper coil. When the override is pushed, the spool moves downward simulating the action of the lower coil. When no pressure is applied to the knob, it centers the spool.



Push Position ***Normal Position*** ***Pull Position***

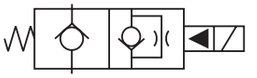
Screens: 2 way valves can be ordered with a small mesh screen (60 x 60 mesh) placed over the cage of the cartridge valve. This screen is intended for cursory protection of the internal components of the solenoid valve. It should not be used as the primary method of filtration. The mesh catches small pieces of debris that could impede spool or poppet movement. Note that a screen will trap debris from both directions. Thus, any debris coming from the nose of the cartridge would be trapped inside the valve. As such, we recommend that screens be implemented in only applications where hydraulic fluid passes through the cartridge from the side of the cage to the nose. It should also be noted that the pressure drop through the cartridge will be increased slightly due to the small restriction of the mesh. As the screen fills with debris, pressure drop will continue to rise.

PRODUCT TYPES / APPLICATIONS

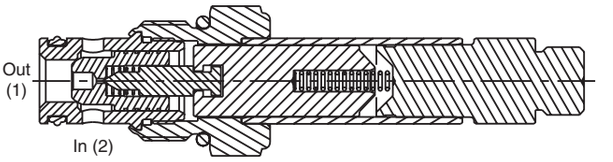
Two Way Poppet Valves

Two way poppet valves are pilot operated, low leakage solenoid actuated valves. Two way poppet valves control the flow of a two way function by blocking flow in one direction (similar to a check valve). They are generally selected due to their low leakage and ability to meet higher flow requirements. Poppet valves are often used on single operation actuators or in unloading functions. They are available in normally closed and normally open types. In addition, free reverse flow and fast response versions are available.

Normally Closed Poppet

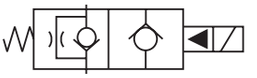


Normally closed two way poppet valves act as a check valve when de-energized, blocking flow from one direction and allowing restricted free flow in the reverse condition. When energized, the poppet lifts allowing free flow from the side to the nose of the cartridge. Should the application require free flow in both directions, the free reverse flow option should be chosen.

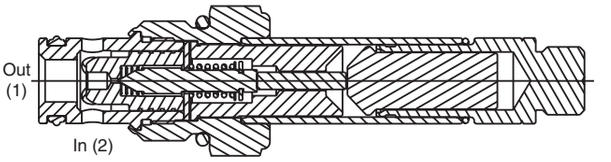


OPERATION - The valve pilot is held on its seat by spring force, blocking pilot flow. This allows pressure at the inlet (port 2) to hold the poppet on its seat, thus, preventing flow through the valve (2-1). If the nose of the cartridge (port 1) is pressurized, the pressure will overcome the spring force, pushing the poppet off of its seat, allowing free flow through the cartridge (1-2). When the coil is energized, the valve pilot is pulled off of its seat. This vents the pressure inside the poppet to port 1, creating a pressure imbalance across the main poppet. This differential lifts the poppet allowing flow from the side to nose (2-1). Since poppet valves are piloted operated, a minimum amount of pressure differential (25-50 psi) and flow between ports 2 and 1 must be present to overcome the spring and lift the poppet.

Normally Open Poppet



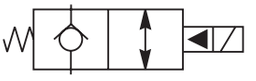
Normally open two way poppet valves, when de-energized, allow free flow from the side (port 2) of the cartridge to the nose (port 1). Flow in the reverse direction is restricted. Should free flow be required in both directions, the free reverse flow option should be specified. Once the coil is energized the normally open poppet valve acts as a check valve, blocking flow from one direction and allowing restricted free flow in the reverse condition.

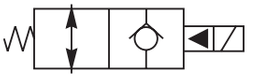


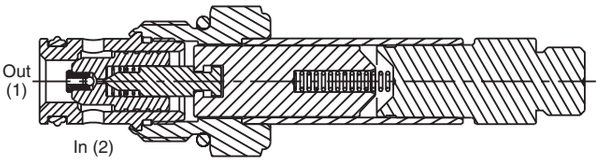
OPERATION - The valve pilot is held off its seat by spring force. Pilot flow is vented to port 1, creating a pressure imbalance that moves the main poppet. This differential lifts the poppet allowing flow from the side to nose (2-1). Since poppet valves are piloted operated, a minimum amount of pressure differential (25-50 psi) between ports 2 and 1 must be present to overcome the spring and lift the poppet. When the coil is energized, the coil force overcomes the spring force to drive the valve pilot and main poppet into their seats, thus blocking flow from port 2-1. If the nose of the cartridge (port 1) is pressurized, the pressure will overcome the spring force and solenoid force, pushing the poppet off of its seat, allowing restricted flow through the cartridge (1-2).

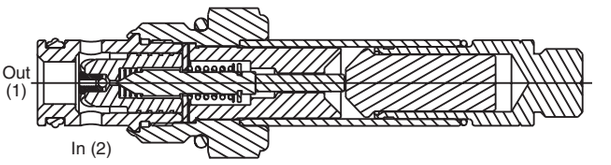
Free Reverse Flow

The free reverse flow versions are available on both the normally closed and normally open poppet valves. As mentioned above, the operation is the same as the standard poppet valve except flow through the reverse direction is not restricted. The free reverse flow option is only needed if the application requires flow to pass through the cartridge valve from the nose to side (port 1 to port 2).









Fast Response

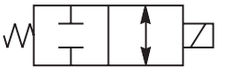
Since poppet valves are pilot operated valves, a few milliseconds are needed to move the pilot and allow the poppet to lift. Should a faster response time be required on normally closed poppet valves, this option can be chosen. The fast response is accomplished by reducing the movement of the pilot. Thus, the flow capacity of the poppet valve is also decreased.

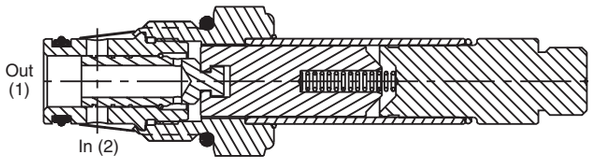
Two Way Spool Valves

Two way spool valves are direct acting, fast responding solenoid actuated valves. Like the poppet valves described earlier, they block the flow of a two way function. Unlike two way poppet valves, spool valves block flow from both the side port and the nose port. They do not have the check like function of the poppet valve, thus they are either open or closed. Spool valves are directed operated, so they respond more quickly to coil voltage than poppet valves. Spool valves operate via a sliding spool, thus, some leakage will be present due to the required spool clearance. Spool valves block flow in both directions, but the preferred flow path is still from the side of the cartridge to the nose due to the flow forces acting on the spool. Two way spool valves are available in normally open and normally closed types.

Normally Closed Spool

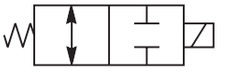
When de-energized, the spool is positioned by the spring force to cover both the side (2) and nose (1) ports of the valve. Thus, no flow is allowed from either direction. Once the coil is energized, the spool shifts exposing a flow path between the two ports. Flow can then be passed through the valve from either direction.

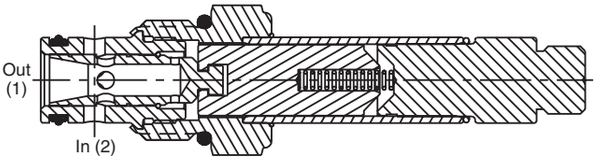




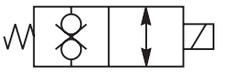
Normally Open Spool

When de-energized, the spool is positioned by the spring force so that a flow path between the side (2) and nose (1) ports is exposed, allowing flow through the valve from either direction. Once the coil is energized, the spool shifts to cover both the side (2) and nose (1) ports of the valve. Thus, no flow is allowed from either direction.

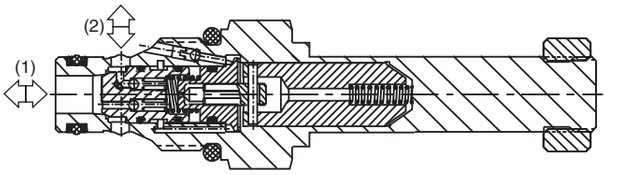




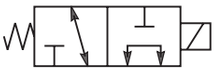
Bi-Directional Poppet Valve



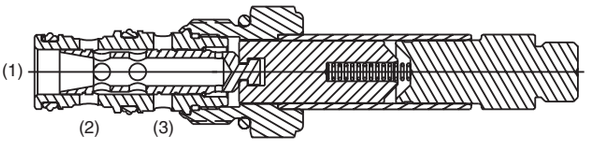
Bi-directional poppet valves combine the dual blocking function of spool valves with the lower leakage capabilities of poppet valves. Bi-directional poppet valves are not recommended for load holding applications. These valves also have a limited flow capacity compared to standard poppet or spool valves.



Two Position, Three Way Spool Valve

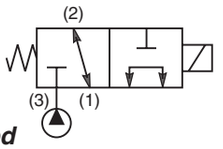


Three way spool solenoid valves provide directional control of flow. Each three way valve has a special internal spool which connects two of the three valve ports. When actuated, the spool connects a different combination of valve ports. These valves are often used for raise and lower functions of a single acting cylinder, control of a uni-directional motor, or as a circuit selector.

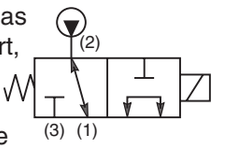


OPERATION - In the de-energized mode, the spool is positioned by spring force. When energized, the coil force directly shifts the spool against the spring, thus changing the flow through the valve. Each spool type can be used as a normally open, normally closed, or selector valve. To explain this we will review the DSL103A which is pictured here. When the valve is de-energized, ports 1 and 2 are open to one another. When energized, ports 1 and 3 are connected.

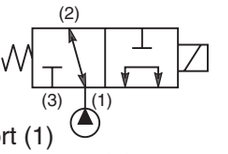
Thus, if we use port 3 as our pressure port, we have a ***normally closed valve***. The pressure port (3) is blocked, while the actuator port (1) is drained to tank (2).



If we use port 2 as our pressure port, we have a ***normally open valve***. The pressure port (2) is connected to the actuator port (1), and the tank port (3) is blocked.

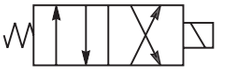


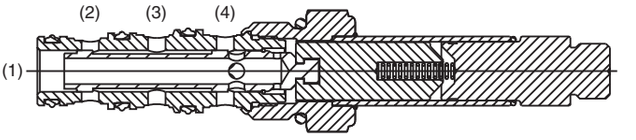
If we use port 1 as our pressure port, we have a ***selector valve***. The pressure port (1) is either connected to port (2) or port (3). Thus, it is "selecting" which port will get the system pressure and flow.



Note that in all three examples, we were using the same valve. The flow forces acting on the spool change depending on which port is pressurized. Thus, if you will be shifting the three way valve under full flow and pressure, it is important to review the shift limit characteristics for the flow paths you have chosen to be sure the coil has enough force to shift the spool. Various spools are available in this catalog to maximize the flow and pressure capacities for the desired flow function.

Two Position,
Four Way Spool Valve

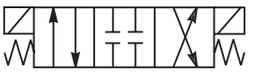


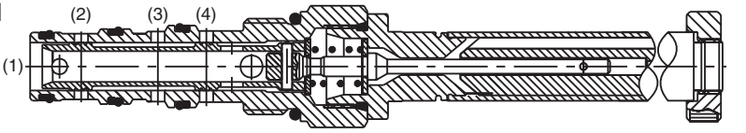


Four way spool solenoid valves provide directional control of flow. Each four way valve has a special internal spool which connects some combination of the four valve ports together. When actuated, the spool connects a different combination of valve ports. These valves are often used for the raise / lower function of a double acting cylinder, or as a forward / reverse function of bi-directional motors.

OPERATION - In the de-energized mode, the spool is positioned by spring force. When energized, the coil force directly shifts the spool against the spring, thus changing the flow through the valve. Each spool type is customized to provide the flow combination desired. The flow forces acting on the spool change depending on which port is pressurized. Thus, if you will be shifting the four way valve under full flow and pressure, it is important to review the shift limit characteristics for the flow paths you have chosen to ensure the coil has enough force to shift the spool. Various spools are shown in this catalog to maximize the flow and pressure capacities for the desired flow function.

Three Position,
Four Way Spool Valve



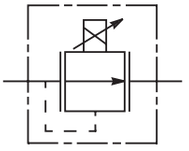
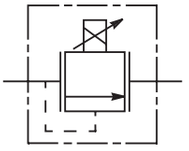
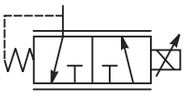
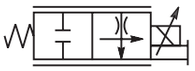
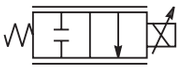
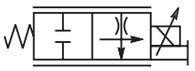
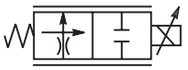


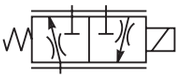
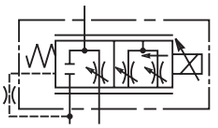
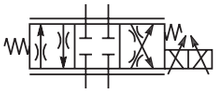
Three position, four way spool solenoid valves provide directional control of flow. Each four way valve has a special internal spool which connects some combination of the four ports together. When one coil is actuated, the spool connects a different combination of valve ports. When the other coil is actuated a third combination of valve ports are connected. These valves are often used for the raise / lower function of a double acting cylinder, or as a forward / reverse function of bi-directional motors. The center position can be used to stop the actuator in mid-stroke, or dump the pump flow.

OPERATION - In the de-energized mode, the spool is positioned by spring force. When energized, the coil force directly shifts the against the spring, thus changing the flow through the valve. Each spool type is customized to provide the flow combination desired. The flow forces acting on the spool change depending on which port is pressurized. Thus, if you will be shifting the four way valve under full flow and pressure, it is important to review the shift limit characteristics for the flow paths you chosen to ensure the coil has enough force to shift the spool. Various spools are shown in this catalog to maximize the flow and pressure capacities for the desired flow function.

Contents

Proportional Valves

	SERIES	CAVITY	DESCRIPTION	FLOW LPM/GPM	PRESSURE BAR/PSI
	**PRESSURE RELIEVING**				
	AP01B2YP	2G	Increase Pressure/Increase Current	5.3/1.4	350/5000
	AP02A2	C08-2	Increase Pressure/Increase Current	30/8	350/5000
	AP04G2YP	C10-2	Increase Pressure/Increase Current	45/12	350/5000
	ERV121N	C12-2	Increase Pressure/Increase Current	100/25	210/3000
	ERV161N	C16-2	Increase Pressure/Increase Current	150/40	210/3000
	AP01B2YR	2G	Decrease Pressure/Increase Current	5.3/1.4	350/5000
	AP02B2YR	C08-2	Decrease Pressure/Increase Current	5.3/1.4	350/5000
	AP04G2YR	C10-2	Decrease Pressure/Increase Current	95/25	350/5000
	**PRESSURE REDUCING**				
	GP01 30	54-1	Pressure Reducing Valve	1.9/.5	210/3000
	GTP02 34	C08-3	Pressure Reducing Valve	19/5	210/3000
	GTP04 34	3X	Pressure Reducing Valve	30/8	210/3000
	**FLOW CONTROLS**				
	DF122C	C12-2	Flow Control, N.C.	53/14	210/3000
	DF161C	C16-2	Flow Control, N.C.	150/40	210/3000
	DF201C	C20-2	Flow Control, N.C.	325/60	210/3000
	HP02C	2X	Flow Control, N.C.	23/6	210/3000
	JP02C	C08-3	Flow Control, N.C.	23/6	210/3000
	HP04C	C10-2	Flow Control, N.C.	36/9.5	210/3000
	JP04C 21	3X	Flow Control, N.C.	36/9.5	210/3000
	HP02P	2X	Flow Control, N.O.	19/5	210/3000
	JP02P	C08-3	Flow Control, N.O.	19/5	210/3000
	HP04P	C10-2	Flow Control, N.O.	30/8	210/3000
	JP04P	3X	Flow Control, N.O.	36/9.5	210/3000
	DF122N	C12-2	Flow Control, N.O.	53/14	210/3000

	SERIES	CAVITY	DESCRIPTION	FLOW LPM/GPM	PRESSURE BAR/PSI
	**FLOW CONTROL, 3-WAY**				
	DF083N	C08-3	Flow Control, 3-Way	11/3	210/3000
	JP04C 31	4C	Priority Flow Control, N.C.	30/8	210/3000
	**DIRECTIONAL CONTROL**				
	GP02 51	C08-4	4 Way, 3 Pos - Closed Center	21/5.5	350/5000
	GP04 51	C10-4	4 Way, 3 Pos - Closed Center	32/8.5	350/5000
	GP02 53	C08-4	4 Way, 3 Pos - Float Center	17/4.5	350/5000
	GP04 53	C10-4	4 Way, 3 Pos - Float Center	38/10	350/5000

INTRODUCTION

This technical tips section is designed to help familiarize you with the Parker line of Proportional Valves. In this section we present common options, technical terms, as well as a brief synopsis of the operation and applications of the various products offered in this section. The intent of this section is to help you in selecting the best products for your application.

COMMON OPTIONS

As you will see, Parker offers a variety of Proportional Valve products. As such, some of the options mentioned below may not be available on all valves. Consult the model coding and dimensions for each valve for specifics. Here are some of the common options available.

Seals: The majority of the products are available in Nitrile or Fluorocarbon Seals. The Winner's Circle products feature a standard 4301 Polyurethane "D"-Ring. The "D"-Ring eliminates the need for backup rings. You should match the seal compatibility to the temperature and fluid being used in your application.

Overrides: Overrides are standard on many of the Parker proportional valves. The override is generally a push type that is flush with the end of the tube. Consult the individual catalog pages for more details.

TECHNICAL TERMS

To help in applying our proportional valve line of product, we have listed some technical terms below, as well as some helpful hints in applying our valves.

Ohm's Law: Electrical current is generated as a result of the relationship between input voltage and the resistance to the flow of electrical current. It is represented in equation form by I = V/R (or V=IR), where I is current, V is voltage and R is resistance. This is an important relationship to remember when dealing with any electrically operated valves. Proportional valves allow varying control of flow or pressure, dependant on the current signal provided. As coils heat up, their resistance rises. This means a higher voltage must be available to maintain the same amount of pressure or flow. Thus, the application needs to be designed such that the full on position is about 70% of the initial current draw. On the individual catalog pages a maximum control current is specified to help in applying our proportional valves.

PWM: Pulse Width Modulation (PWM) is the preferred signal for controlling electrical current. PWM is on / off voltage in a square wave form. The percent "on" time or duty cycle provides the average voltage. The valve driver adjusts the duty cycle to obtain current control. We recommend valve drivers with current control for optimum performance. PWM signals also usually provide dither for the proportional valve. Dither is a small back and forth movement of the valve spool around its set position. This rapid movement reduces the friction of the valve and leads to faster, more accurate response.

PWM Frequency: The frequency of a PWM signal is the rate at which the signal is turned on and off. Parker's analog proportional valves are designed to work with low frequency responses between 100-400 Hz. The performance curves on our catalog pages were performed with a PWM signal at 200 Hz.

Hysteresis: Due to various factors, the performance of a proportional valve will show a slightly different performance when the current signal is increasing than it will when the signal is being decreased. This difference is usually expressed as a percentage of total input change and is referred to as the hysteresis of the valve.

Deadband: Cracking or deadband refers to the amount of the control signal that is needed to produce any movement of the spool. Thus, a 20% deadband means that 20% of the control signal is needed before the spool will move.

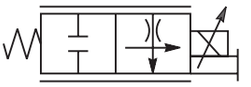
PRODUCT TYPES / APPLICATIONS

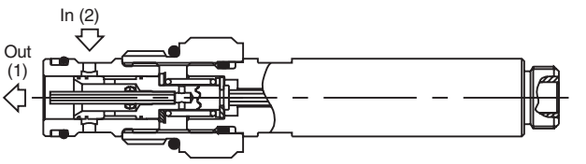
Proportional valves are nothing more than electrically adjustable hydraulic valves. They give the operator nearly infinite adjustment control and flexibility. Parker Hannifin offers various types of proportional flow control, pressure reducing, and relief valves.

Proportional Flow Control Valve

Proportional flow control valves provide pseudo pressure compensation and are used on systems requiring variable electronic control of flow. They allow the operator to vary the control signal to accelerate or decelerate an actuator. A compensator valve can be added to the circuit for enhanced compensation. Some typical applications would include the hoist control for a lift, or the speed control for a winch circuit. Parker offers both normally closed and normally open versions of proportional flow controls.

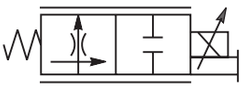
Normally Closed
Proportional Flow Control

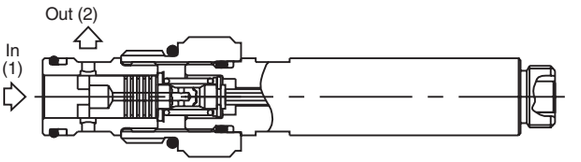




OPERATION - With the solenoid coil de-energized, the spool is held in a closed position by the spring force. When the solenoid coil is energized, the amperage of the signal moves the spool into an open position.
The spool is held in this position by a balance between spring force and electrical force. As the current increases, the spools opens further; allowing more flow. As the current decreases, the spool begins closing; allowing less flow. Pseudo compensation is obtained by the pressure drop across the orifices in the spool.

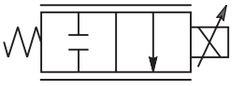
Normally Open
Proportional Flow Control



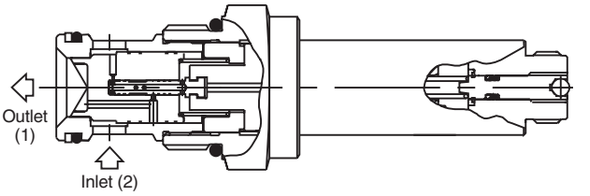


OPERATION - With the solenoid coil de-energized, the spool is held in an open position by spring force; allowing full flow to pass. As the solenoid coil is energized, the spool begins to move away from a full open position; allowing less flow to pass. Once a full electronic signal is given, the spool is held in a closed position; allowing no flow to pass. As the electronic signal is then reduced, the spool begins to open; allowing flow to pass again. Once a constant electronic signal is given, the spool is held in that position by a balance between electronic force and spring force. Pseudo compensation is obtained by the pressure drop across the orifices in the spool.

Normally Closed
Proportional Needle Valve

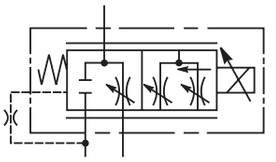


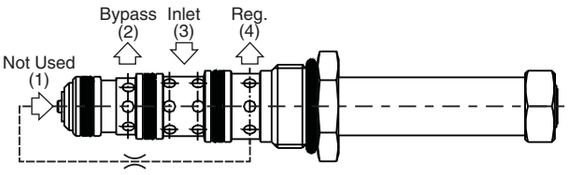
The proportional needle valves are electronic controlled variable needle valves. They are designed specifically for bleed off or unloading circuits as back pressure will affect performance.



OPERATION - With the solenoid de-energized, the main poppet is held in the closed position by spring force. When the solenoid is energized, the sensing spool moves into a partially open position relative to the percentage of rated current flowing through the coil. This action allows the main poppet to move away from the valve seat to a degree that corresponds to sensing spool position. The valve will maintain a fixed amount of opening as long as the electrical current remains constant and will vary proportionally with an increase or decrease in current.

Proportional Priority Bypass Flow Control

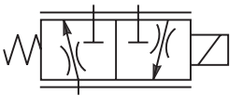


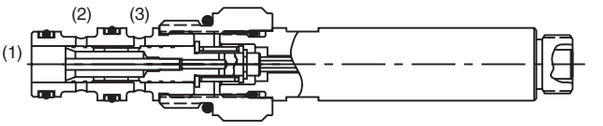


The proportional priority bypass flow controls allow electronic control of the flow setting for the priority flow circuit. The priority flow remains constant regardless of changes in load or pressure. The excess inlet flow is diverted or bypassed to tank. The bypass port must not have any restrictions or performance will be hindered.

OPERATION - Flow enters the valve through port 3. With the coil de-energized, flow is bypassed to port 2. When the coil is energized, the internal orifice is increased allowing pressure compensated flow to the priority port (port 4). The excess flow is bypassed to port 2. As input current is increased, the priority flow increases and the bypass flow decreases. As the current is decreased, priority flow decreases and bypass flow is increased.

Proportional 3-Way Flow Control

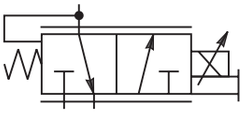


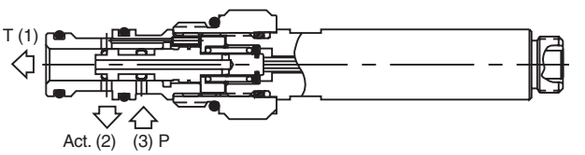


Proportional 3-Way flow controls allow the user to control the flow on a three way circuit. It can be used as either a normally open or normally closed three way valve. They are well suited for circuits requiring acceleration or deceleration control.

OPERATION - *Normally Closed* (Port 2 to Port 1) With the solenoid coil de-energized, the spool is held in a closed position by the spring force. When the solenoid coil is energized, the amperage of the signal moves the spool to an open position. The spool is held in this position by a balance between spring force and electrical force. As the electrical force increases, the spool opens further; allowing more flow. As the electrical force decreases, the spool begins closing; allowing less flow.
Normally Open (Port 1 to Port 3) With the solenoid coil de-energized, the spool is held in an open position by the spring force; allowing full flow to pass. As the solenoid coil is energized, the spool begins to move away from a full open position; allowing less flow to pass. Once a full electronic signal is given, the spool is held in a closed position; allowing no flow to pass. As the electrical signal is then reduced, the spool begins to open; allowing flow to pass once again. Once a constant electronic signal is given, the spool is held in that position by a balance between electronic force and spring force.

Direct Acting, Normally Closed Proportional Pressure Reducing Valve





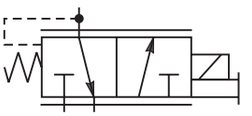
Direct acting, normally closed proportional pressure reducing valves are used to electronically reduce the inlet pressure to one leg of a hydraulic circuit. This valve is used when a fixed regulated pressure is required regardless of the inlet pressure. This valve could be used as a clutch control for power shift transmissions and PTO, or as a pilot control for directional control valves.

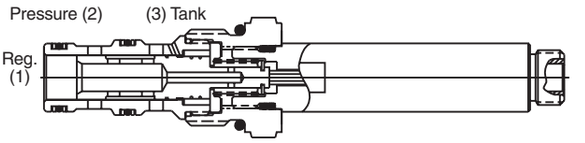
OPERATION - With the solenoid coil de-energized, the spool is held in a closed position by spring force. In this mode, the regulated pressure port is open to tank and the pressure inlet is blocked. As current is applied to the solenoid coil, the spool will begin to travel to a position where the pressure inlet port is connected to the regulated pressure port. At this point, reduced pressure becomes a function of the current signal. As long as the current signal is constant, the reduced pressure at the regulated pressure port will remain fixed regardless of any changes in inlet flow or inlet pressure. As the current signal increases or decreases, the reduced pressure at the regulated pressure port will change with respect to the changes in signal. Once the coil is fully energized, the reduced pressure of the regulated pressure port will be at the maximum reduced pressure for that valve.

Normally Closed Proportional Pressure Reducing / Relieving Valve

Normally Closed Proportional Pressure Reducing/Relieving Valves are used to electronically reduce the inlet pressure to one leg of a hydraulic circuit. In addition these valves act as a relief valve, relieving any shocks or surges that occur between its regulating port and the actuator. Parker offers direct acting and pilot operated versions of this valve. The direct acting valves are faster responding and generally have lower hysteresis, but are limited to smaller reduced pressures (generally below 800 psi depending on the valve.) Pilot operated are generally slower on response due to the two stage performance, but can have a reduced pressure as high as 3000 psi.

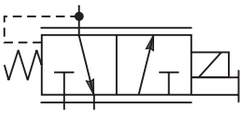
Direct Acting

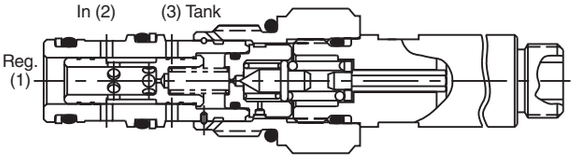




OPERATION - With the solenoid coil de-energized, the spool is held in a closed position by spring force. In this mode, the regulated pressure port is open to tank and the pressure inlet port is blocked. As an electronic signal is applied to the solenoid coil, the spool will begin to travel to a position where the pressure inlet port is connected to the regulated pressure port. At this point, reduced pressure becomes a function of the voltage signal. As long as the electronic signal is constant, the reduced pressure at the regulated pressure port will remain fixed regardless of any changes in inlet flow or inlet pressure. As the electronic signal increases or decreases, the reduced pressure at the regulated port will change with respect to the change in electronic signal. Once a full signal is given, the reduced pressure of the regulated pressure port will be at the maximum reduced pressure for that valve.

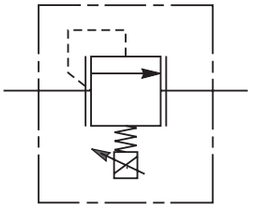
Pilot Operated

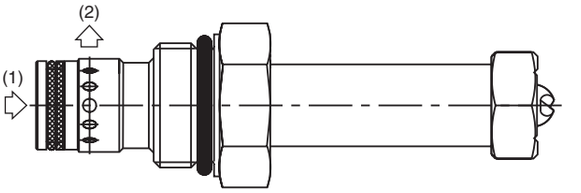




OPERATION - With the solenoid coil de-energized, the pilot dart is held open by the spring force. This allows the main spool to close and restricts flow from going from the inlet (2) port to the regulated port (1). As the electronic signal is applied to the coil, the pilot dart is moved towards the pilot seat restricting pilot flow. This restriction raises the effective pressure inside the chamber between the spool and the pilot seat, allowing the spool to travel away from the pilot seat to a position where the pressure at inlet (2) is connected to the regulated pressure port (1). At this point, reduced pressure becomes a function of the electronic signal. As long as the electronic signal is constant, the reduced pressure at the regulated pressure port (2) will remain fixed regardless of any changes in inlet flow or inlet pressure. As the electronic signal increases or decreases, the reduced pressure at port (1) will change with respect to the change in the electronic signal.

Normally Closed Proportional Relief Valve

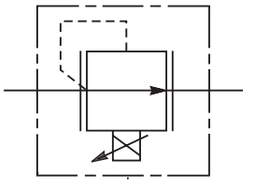


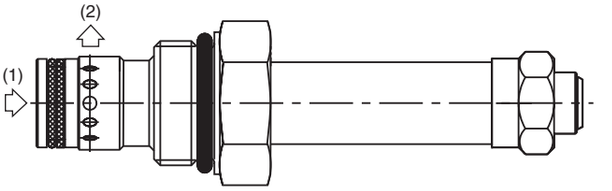


Normally closed proportional relief valves are used to electronically control the system pressure. These valves are ideal for circuits with varying system pressures demands. A small flow pilot version of the normally closed proportional relief is also offered for piloting a larger logic element or vented relief valve. The normally closed relief defaults to a maximum pressure setting (i.e. 3000 psi) when there is no current applied.

OPERATION - With the solenoid coil de-energized, the pilot dart is held closed by the spring. As current is applied to the coil, the pilot dart is moved creating less restriction of the pilot flow. As this restriction is reduced with the increasing current, the pressure setting also decreases. Once a constant electronic signal is given, the pilot dart is held in a given position, holding the pressure setting. This is maintained by the balance between the electronic spring force and the inlet pressure.

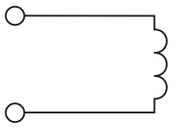
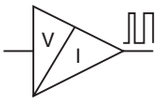
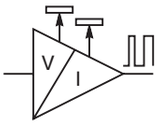
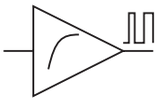
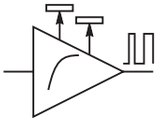
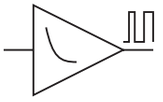
Normally Open Proportional Relief Valve





Normally open proportional relief valves are used to electronically control the system pressure. These valves are ideal for circuits with varying system pressure demands. A small flow pilot version of the normally open proportional relief is also offered for piloting a larger logic element or vented relief valve. The normally open relief defaults to minimum system pressure (i.e. 150 psi) when there is no current applied. Normally closed versions are also available upon request.

OPERATION - With the solenoid coil de-energized, the pilot dart is held open by the spring. This allows the main spool to open at minimum pressure 10.4 Bar (150 psi). As current is applied to the coil, the pilot dart is moved towards the pilot seat restricting pilot flow. This restriction raises the effective pressure setting of the valve. Once a constant electronic signal is given, the pilot dart is held in a given position, holding the pressure setting. This is maintained by a balance between electronic spring force and inlet pressure. As the electronic signal is reduced, the pilot dart is moved away from the pilot seat. This lowers the effective pressure setting of the valve.

SERIES	DESCRIPTION
	
SUPER COILS	
CC	1/2″ Solenoid Tubes
CA	5/8″ Solenoid Tubes
STANDARD COILS	
Unicoil	1/2″ Solenoid Tubes
Unicoil	5/8″ Solenoid Tubes
DS	1/2″ Solenoid Tubes
DS	5/8″ Solenoid Tubes
DS	1″ Solenoid Tubes
	
ELECTRONICS	
XPRO902	12 VDC PWM Controller, 110Hz, 19W
XPRO932	12 VDC PWM Controller, 110Hz, 30W
XPRO904	24 VDC PWM Controller, 110Hz, 19W
XPRO934	24 VDC PWM Controller, 110Hz, 30W
	
XPRO902d	12 VDC PWM Controller, 95-230Hz, 19W
XPRO932d	12 VDC PWM Controller, 95-230Hz, 30W
XPRO904d	24 VDC PWM Controller, 95-230Hz, 19W
XPRO934d	24 VDC PWM Controller, 95-230Hz, 30W
XPRO902rid	12 VDC PWM Controller, 95-230Hz, 19W, Multi-adj.
XPRO932rid	12 VDC PWM Controller, 95-230Hz, 30W, Multi-adj.
XPRO904rid	24 VDC PWM Controller, 95-230Hz, 19W, Multi-adj.
XPRO934rid	24 VDC PWM Controller, 95-230Hz, 30W, Multi-adj.
	
XPRO704	Soft Start Valve Controller, 12/24 VDC
	
XPRO704b	Soft Start and Stop Valve Controller, 12/24 VDC
	
XPRO804	Power Saver Controller, 12/24 VDC PWM

INTRODUCTION

This technical tips section is designed to help familiarize you with the Parker line of Coils. In this section we highlight the features and discuss some of the available options. We also use this section to present some common terminology related to coil and coil technology.

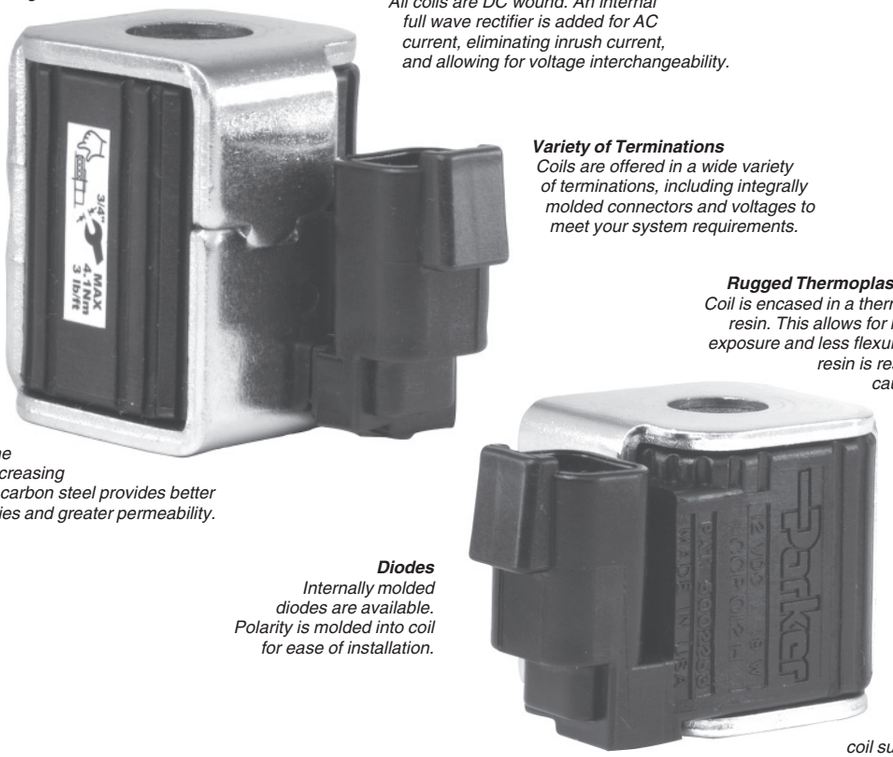
New Parker *SUPER COIL* Now Available!

Class N Magnetic Wire
Internal wires have a class N rating, providing longer life at typical temperatures.

DC Windings
All coils are DC wound. An internal full wave rectifier is added for AC current, eliminating inrush current, and allowing for voltage interchangeability.

Variety of Terminations
Coils are offered in a wide variety of terminations, including integrally molded connectors and voltages to meet your system requirements.

Rugged Thermoplastic Encapsulation
Coil is encased in a thermoplastic polyester resin. This allows for higher temperature exposure and less flexural creep. Also, this resin is resistant to moisture, caustic solutions, and fungus providing protection for coil windings.



Low Carbon Steel Frame
Zinc plated low carbon steel frame surrounds coil, increasing flux density. Low carbon steel provides better magnetic properties and greater permeability.

Diodes
Internally molded diodes are available. Polarity is molded into coil for ease of installation.

Ribbed Surface
External ridges provide a larger coil surface area, which allows for better heat dissipation.

****Exceeds IP69k Specifications***

After exhaustive testing, the new Super Coil has clearly distanced itself from the competition. This coil was subjected to the rigors of this environmental standard and the results were excellent. This coil stands up to most rugged of environmental conditions including weather, dust, and extreme temperature variations.

****Water Dunk Test Qualified***

The Super Coil was taken to task in a repeated water dunk thermal cycle test program with alternate exposure to high and low temperature, only to perform with outstanding results.

****Endurance Tested***

The goal of this test was to cycle the coil to high temperature extremes in order to validate the coils ability to perform in extreme temperature environments.

****Water Spray and Chemical Solvent Compatibility***

The Super Coil was subjected to numerous chemical solvents in a rigorous test which established the fact that these coils can withstand harsh and unusual environments. Also, the coils were subjected to a high pressure water spray test. Once again, the Super Coil passed this test.

****Deutsch connector required.***

COMMON OPTIONS

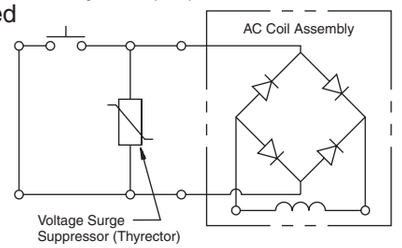
Below are some of the common options to the Unicoil product offering.

Continuous Duty: Parker's standard line of coils are rated for continuous duty operation. This means the coil can be left on continuously without fear of the magnet wire insulation breakdown, when used in standard climate conditions. The Unicoils and Super Coils are made of a high quality Class N magnet wire. This Class N rating signifies the internal wires are rated to 200°C (392°F).

Continuous duty does not mean the coil will have the same amount of power after hours of operation as it had at initial actuation. Coils do heat up during use. This internal heat rise increases the resistance of the coil and thus, decreases the current (V = IR). The performance curves presented on the solenoid valve pages are based on a coil at room temperature and 85% of voltage. Thus, when using a valve in continuous duty applications, you may need to derate the performance. In short, the continuous duty rating signifies that while the coil will get hot during use and resistance will increase, it will not generate enough heat to damage the coil.

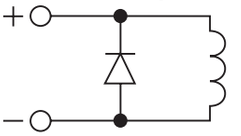
Terminations: Parker offers a wide variety of coil terminations for all coils to meet the demands of your application. Over the years, the dual lead wire and dual spade offerings have been popular due to their ease of installation and availability. In the past few years, the demand for more secure termination connections has increased. In addition, the integral connectors reduce cost and improve integrity by reducing the number of connections. As such, the Amp Junior, Weatherpack, Metri-Pack, and Deutsch have increased in popularity. We offer these connectors on a lead wire coil, as well as an internally molded version of the DIN, Amp Junior, and Metri-Pack coils. If you do not find your desired coil termination in our catalog, contact your factory sales representative. We entertain special requests and have several special terminations not listed in this catalog.

Current Types: Both direct current (DC) and alternating current (AC) versions are available for the Parker line of coils. The AC versions are essentially DC coils with a full wave rectifier integrally molded into the coil. The rectifiers are rated for voltage peaks up to 1000 volts maximum. For voltage transients greater than 1000 volts, a Harris Thyrector is recommended. The AC coils operate at 50/60 cycles (Hz). Since the AC versions are rectified DC coils, there is no inrush current like with "true" AC coils. It also means DC coils and AC coils are interchangeable.



Voltages: Parker has a wide selection of coils available to meet your needs. Most coil terminations are available with our standard voltages of 12V and 24V in DC, and 120V and 240V in AC. Voltages 6V, 10V, 18V, 36V, 48V DC and 440V AC are also available for many termination types at a slight premium. Contact your Parker representative should your application call for voltages other than our standard offering.

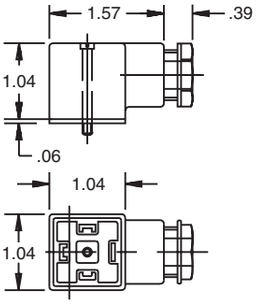
Diodes: The Parker Coils can be ordered with a diode molded internally. Parker Unicoils use a IN5062 diode. The Super Coils use a IN5627 diode. Diodes are sometimes used to protect sensitive, downstream electrical components from potential surges from the coil. By internally molding the diode into the coil, you can reduce the assembly time and cost associated with externally wiring a diode. One should be careful not to switch the polarity ("+" and "-" terminals), when wiring a coil with an internal diode. If these terminals are switched, the first time voltage is applied to the coil; the short circuit will destroy the diode and render the coil use-less. Parker coils with diodes have "+" and "-" molded near the termination outlet to help identify polarity.



DIN Connectors: Parker does offer connectors for use with the DIN style coils. As shown below, the DIN connectors are available in both rectified and non-rectified forms. The cable gland versions can be ordered for type PG9 or PG11.

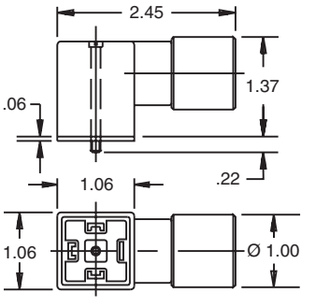
Cable Gland

Type	Non-Rectified	Rectified
PG9	710549-00	712126-01
PG11	710549-01	712126-00



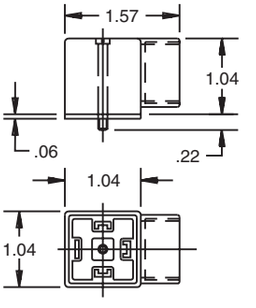
Conduit

Rectified
712704-00



Conduit

Non-Rectified
710549-02



SERIES	DESCRIPTION	BODY NO.
PARKER STANDARD BODIES AND CAVITIES		
C04-2	04 Size, 2 Way	B04-2-*
C04-3	04 Size, 3 Way	B04-3-*
C08-2	08 Size, 2 Way	B08-2-*
C08-3	08 Size, 3 Way	B08-3-*
C08-4	08 Size, 4 Way	B08-4-*
C09-2	09 Size, 2 Way	B09-2-*
C10-2	10 Size, 2 Way	B10-2-*
C10-2T	10 Size, 2 Way, “T” Body	B10-2T-*
C10-3	10 Size, 3 Way	B10-3-*
C10-3S	10 Size, 3 Way, Short	B10-3S-*
C10-4	10 Size, 4 Way	B10-4-*
C11-3	11 Size, 3 Way	4082075
C12-2	12 Size, 2 Way	B12-2-*
C12-3	12 Size, 3 Way	B12-3-*
C12-3L	12 Size, 3 Way, Long	B12-3L-*
C12-4	12 Size, 4 Way	B12-4-*
C12-4L	12 Size, 4 Way, Long	B12-4L-*
C16-2	16 Size, 2 Way	B16-2-*
C16-3	16 Size, 3 Way	B16-3-*
C16-3S	16 Size, 3 Way, Short	B16-3S-*
C20-2	20 Size, 2 Way	B20-2-*
C20-3S	20 Size, 3 Way, Short	B20-3S-*
COUNTERBALANCE CAVITIES AND BODIES		
MHC-010	Single and Dual Counterbalance Bodies	MHC-010-*
MHC-022	Single and Dual Counterbalance Bodies	MHC-022-*
MHC-025	Single and Dual Counterbalance Bodies	MHC-025-*
MHC-050	Single and Dual Counterbalance Bodies	MHC-050-*
PILOT PISTON CAVITIES		
10 Size	10 Size Cavity for Single Check and Pilot Piston	
16 Size	16 Size Cavity for Single Check and Pilot Piston	
10 Size	10 Size Cavity for Dual Check and Pilot Piston	
16 Size	16 Size Cavity for Dual Check and Pilot Piston	
STANDARD CAVITY PLUGS		
Cavity Plugs		
CARTPAK BODIES		
BD03-PN	P Port Interrupt, 2-Way, Body Only	BD03-PN-*
BD03-PN2	P Port Interrupt, 2-Way, Body Only	BD03-PN2-*
BD03-PNR	P Port Interrupt, Reducing Function, Body Only	BD03-PNR-*
BD03-PNS	P Port Interrupt, Sequencing Function, Body Only	BD03-PNS-*
BD03-PT	P to T, Body Only	BD03-PT-*
BD03-ABN	A and B Port Interrupt, Body Only	BD03-ABN-*
BD03-ABX	A and B Port Crossover, Body Only	BD03-ABX-*
BD03-ABT	A and B Ports to Tank, Body Only	BD03-ABT-*
BD03-DDX	Ports A and B Drain to Crossover Port, Body Only	BD03-DDX-*
BD03-BDA	B Port Drain to A, Body Only	BD03-BDA-*
BD03-ADB	A Port Drain to B, Body Only	BD03-ADB-*

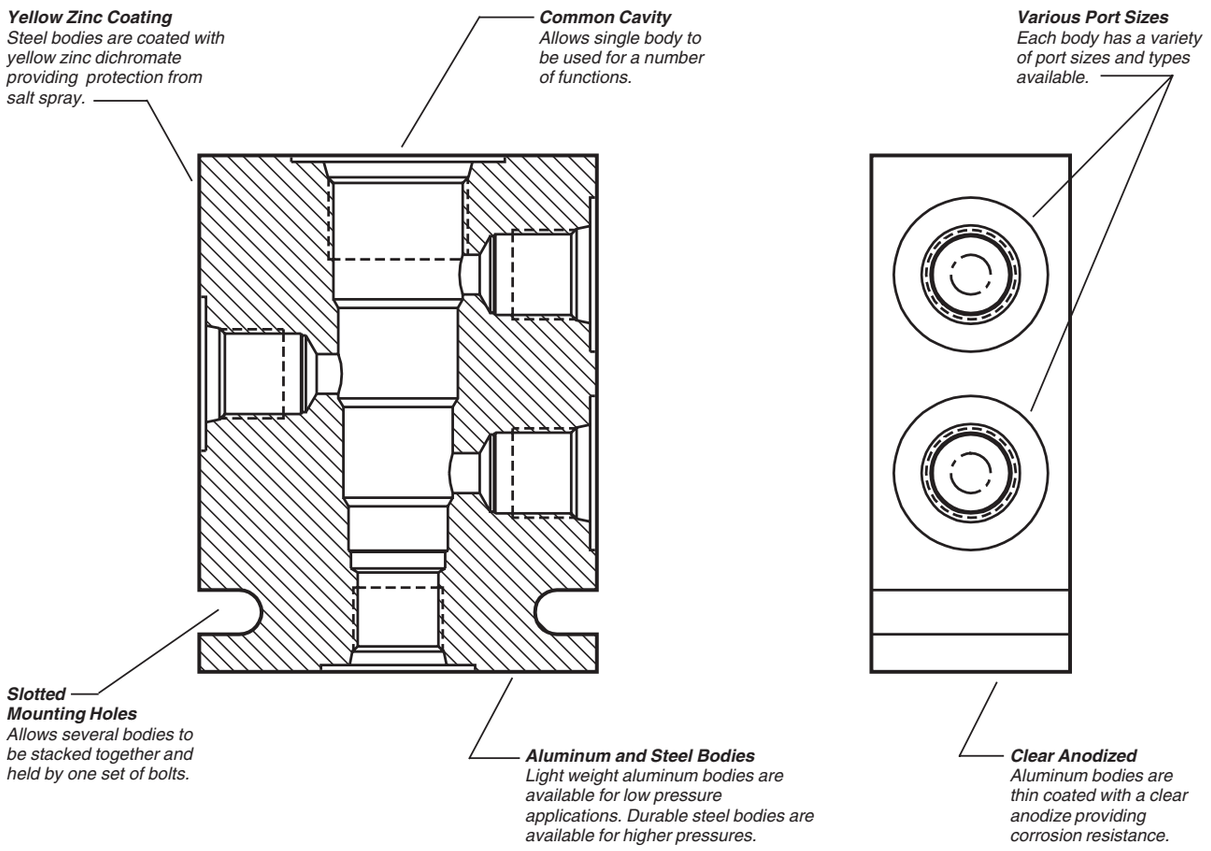
SERIES	DESCRIPTION	BODY NO.
SPECIAL BODIES AND CAVITIES		
CAV0W-2	2 Port	LB1079*
CAVSW-3	3 Port	LB1081*
CAVT11A	3 Port or 4 Port Dual	LB1082*
CAVT21A	4 Port	LB1083*
2C	2 Port	LB1021*
2G	2 Port	LB1032*
2R	2 Port	LB105**
2U	2 Port	LB102**
2X	2 Port	LB1051*
3A	3 Port	LB100**
3C	3 Port or 4 Port Dual	LB100**
3J	3 Port	LB1009*
3K	3 Port	
3M	3 Port or 4 Port Dual	LB100**
3X	3 Port	LB1055*
3Z	3 Port	LB103**
4C	4 Port	LB1056*
5A	5 Port	LB103**
53-1	3 Port or 4 Port Dual	LB1031*
54-1	3 Port	LB10591
68-1	3 Port or 4 Port Dual	LB102**
91-1	3 Port	LB1015*
100-1	5 Port	LB1031*

INTRODUCTION

This Technical Tips section is split into three parts; Standard Line Bodies, Cavities, and Cartpaks. In the standard line bodies section, we highlight the features and options of our standard offering of line bodies. In the cavity section we discuss “common” cavities and form tools. In the Cartpak section, we present the features and options to Parker’s line of D03 style sandwich bodies. The Technical Tips are provided to help you become more familiar with Parker Hannifin’s line of product and assist you in applying our product.

STANDARD LINE BODIES

Parker offers standard line bodies for each valve and cavity size. Below are some of the features of Parker’s standard line bodies.



COMMON OPTIONS & FEATURES

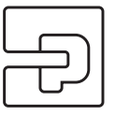
Aluminum vs. Steel: Parker offers standard line bodies in both aluminum and steel. Aluminum bodies are most often used for general applications. They are lightweight and less costly than steel bodies. Parker’s aluminum bodies are coated with a clear anodize to provide a corrosion resistant protection. Aluminum bodies should never be used in applications above 210 bar (3000 psi.) Steel bodies are more durable and heavier than aluminum bodies. They are ideal for applications with elevated pressures or where rugged construction is desired. Steel bodies are suitable for applications up to 350 bar (5000 psi.) Parker’s steel bodies are coated with yellow zinc dichromate providing corrosion resistance. Yellow zinc dichromate even provides the steel body many hours of protection from salt spray.

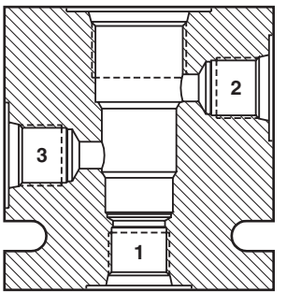
COMMON OPTIONS & FEATURES (Cont.)

Pressure Drop: The pressure drop through a line body is fairly minimal. Each catalog page shows a pressure drop curve. This should be added to the pressure drop through the cartridge when trying to estimate total pressure drop for a function.

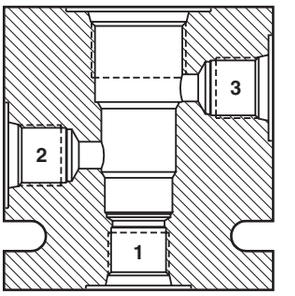
Porting: Parker offers a variety of port sizes and types for each line body. While NPT or pipe ports were once very popular and are still offered, we recommend SAE ports for new applications. SAE ports and fittings provide a more secure connection than pipe ports. BSPP ports are also available.

Port Numbering Change: With this catalog, we have re-numbered the ports on our 3-way line bodies. In the past, three way bodies were numbered with the nose being port 1, the middle port labeled (3), and the top port labeled (2). Over the years, this has caused some confusion, so we have relabeled the ports sequentially from the bottom. For identification, the current design will be marked with a Parker symbol like the one shown.





Previous Design



Current Design

CAVITIES

The hole that the cartridge valve is screwed into is called a cavity. Many cartridge producers manufacture valves that fit a “common” cavity. With a “common” cavity, a valve theoretically could be removed from a cavity and replaced by another manufacturer’s product. One should be careful though to check cross drill ports and thread depths when pursuing this activity. While it is true that many manufacturer’s products fit inside another’s cavity, the cross drills sometimes expose an o-ring to pressure, causing the o-ring to be extruded.

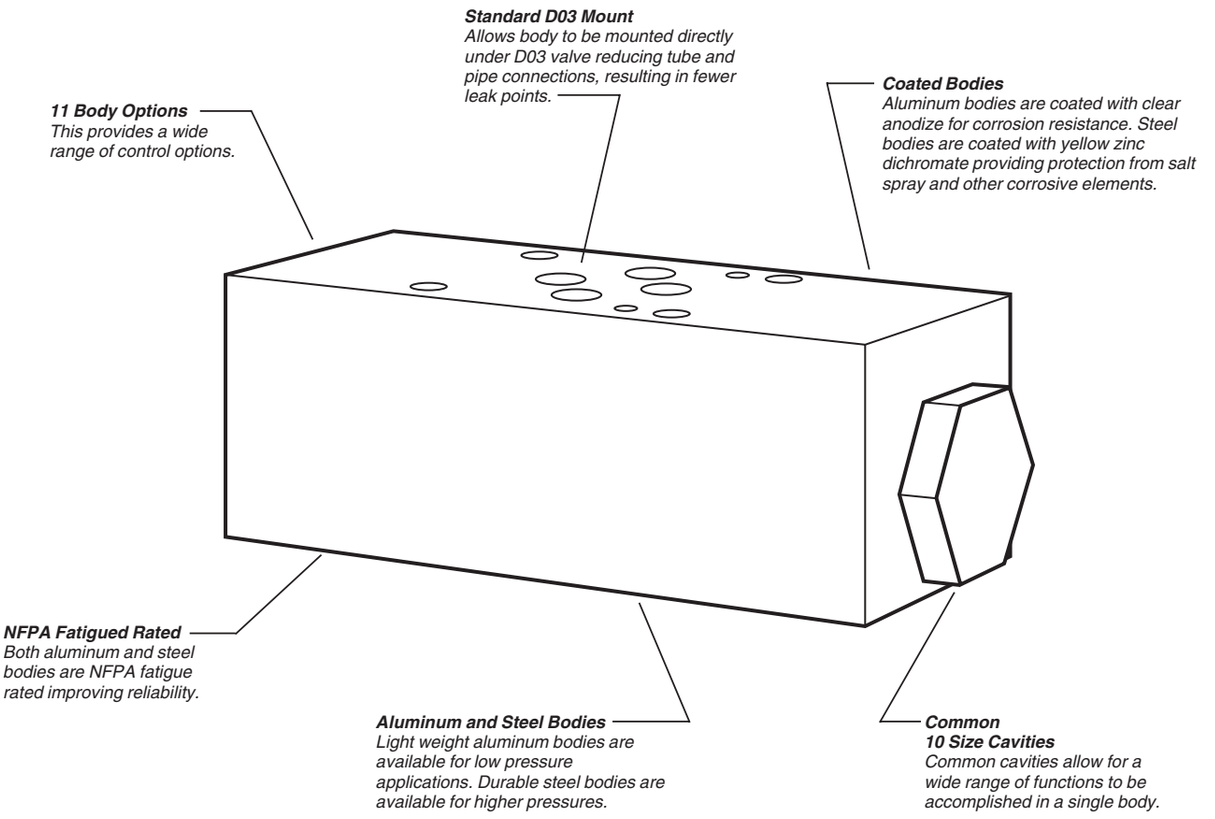
Valve / Cavity Compatibility Chart: Through acquisition, Parker Hannifin has accumulated a number of manufacturers with “common” cavities. To accommodate all of our product lines, we have released a new cavity for our Winner’s Circle product line. The cavities shown in this catalog are considered Winner’s Circle Cavities. The Winner’s Circle valves are downward and upward compatible with the Parker Series of product. On each catalog page, you will find a chart like the one shown on this page. The purpose of this chart is to help identify if a valve from one acquisition can be replaced by the Winner’s Circle valve, or another acquisition. The valves are designated by the columns of the chart and the cavities by the rows. If you have an existing cavity, you find it on the chart and follow across to see which valves you may put in the cavity. For instance, using the chart below, let’s say you have an existing manifold in which you had manufactured a FPS cavity (maybe you were using a SV2A-10). By finding the row labeled FPS and following across, you find that you could use the new Winner’s Circle product, an FPS product, or a CEC product of the same size in this cavity. A Parker or Waterman valve will not fit in this cavity without modifying the cavity. This chart is provided to help you in converting to the Winner’s Circle product line.

		VALVE				
		Winner’s Circle	Parker	Waterman	FPS	CEC
CAVITY	Winner’s Circle	X	X	X	X	X
	Parker	X	X	X		
	Waterman	X	X	X		
	FPS	X			X	X
	CEC	X			X	X

Cavity Tools: On each catalog page, cavity tools are listed for your use in creating special manifolds. More is discussed on manifold construction in the Technical Data section of this catalog. For 3-way and 4-way valves, you will find a roughing and a finishing tool. The rougher is a step drill used to prep the cavity for the finishing tool. The rougher removes the mass of material and is necessary because the finisher is not designed for primary forming. The finisher is a precision tool used to provide the final dimensions of the cavity. No rougher is offered for 2-way cavities because a standard drill bit can be used to remove the mass of material.

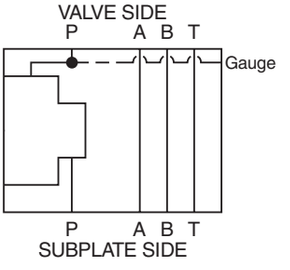
CARTPAK BODIES

Parker Cartpak sandwich mounted bodies are designed to be mounted under a standard ISO 4401-03, NFPA D03, CETOP 3 size valve, and provide a multitude of different functions. The bodies are designed to accept a common 10 size cartridge valve allowing the designer the flexibility to use a single body to provide pressure, directional, flow, or load control. One or more Cartpak bodies may be "sandwiched" underneath a Parker D1 Series directional valve to provide the control functions for all portions of a hydraulic circuit. The ISO standard fatigue rated bodies are available in either aluminum or ductile iron.



Catalog Pages: Each Cartpak catalog page is laid out in a similar format and is designed to help you select the proper body for your application. In the top left corner of the page there is a brief description and body schematic. The body schematic shows the cartridge cavity and the ports connecting to it. This schematic can be used to understand which valves can be used in the body. For instance, in the example shown here, flow from the subplate in port P is directed into the nose of the cartridge. The side port of the cartridge is connected to the valve side of port P. Thus, you want to choose cartridges providing the function desired, and use the nose as the inlet. For instance, a FC101 meters flow from its nose port to its side port and would be ideal for the p-port interrupt body shown.

UPRIGHT



In addition to the body schematic, we also provide a hydraulic schematic at the bottom of each catalog page. This schematic shows a variety of Parker cartridge part numbers that can be used with this body. This list is not intended to be comprehensive, but it is intended to show the wide variety of options that can be achieved with each body. You will also note, the product listing shows the orientation of the block (upright or inverted), the cavity for the cartridge, and cavity plugs (when necessary.) Once again, many options can be achieved with each body.

O-Ring Plates: Since many of the Cartpak bodies can be "flipped" to achieve extra functions, the faces of the bodies must be flat. Thus, an o-ring plate with o-rings must be used to seal the mounting surface. One plate with o-rings will be provided with any body that can be inverted. *Below are the kit numbers;*

Nitrile Kit - 717939 Fluorocarbon Kit - 717939V

Flipping Cartpaks: As mentioned before, many Cartpak bodies can be flipped to create extra options. The catalog pages show some of the functions that can be achieved by "flipping." The words "upright" and "inverted" are written on the bodies to help you identify which side you are looking at. To invert the body, while facing the long face of the body (in other words, the sides without any ports or cavities), rotate the valve 180 degrees away from your body in an upward fashion. By doing this, you have essentially switched the P port and T port.

Stacking Cartpaks: Cartpak bodies can be stacked on top of one another to provide a number of functions in a single assembly. When stacking Cartpak bodies though, you want to take some care in the order in which the bodies are stacked. In general, flow controls should be stacked as close to the subplate stack as possible, while pilot operated check valves or counterbalance valves should be stacked as close to the D03 valve as possible.

The D03 line of bodies has a common height of 40mm (1.58 in.). Below is a list of bolt kits available from Parker.

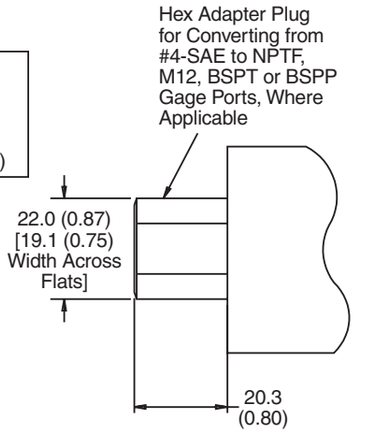
UNC Bolt Kits for use with D1V Directional Control Valves & Manapaks/Cartpaks (D1V*-75 Design, Solenoid Operated)					
	Number of Manapaks/Cartpaks @ 1.58" (40mm) thickness				
	0	1	2	3	4
D1V-75	BK209 1.25"	BK243 2.88"	BK225 4.38"	BK244 6.00"	BK245 7.50"
D1V-75 Plus Tapping Plate	BK176 2.25"	BK56 3.81"	BK212 5.38"	BK107 7.00"	BK106 8.50"

Note: All bolts are SAE grade 8, 10-24 UNC-2A thread, torque to 5.6 N.m. (50 in.-lbs.)

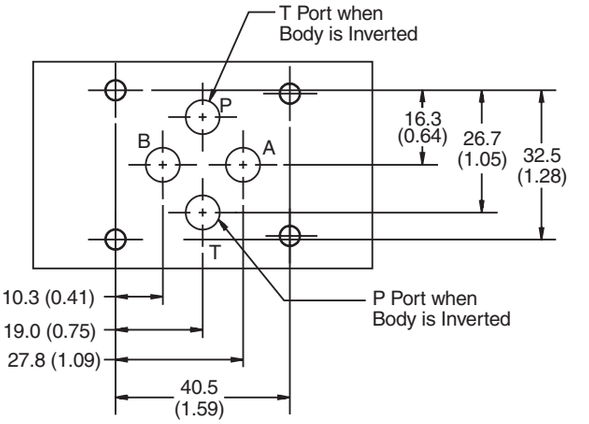
Gauge Ports: Several of the Cartpak bodies are equipped with a SAE #4 gauge port to assist the user during installation and troubleshooting. We offer hex adapter plugs, should your pressure gauge have a different thread type.

Hex Adapter Plug to convert from SAE #4

1830016	BSPP
1830017	BSPT
1830018	NPTF
1830019	Metric (M12)

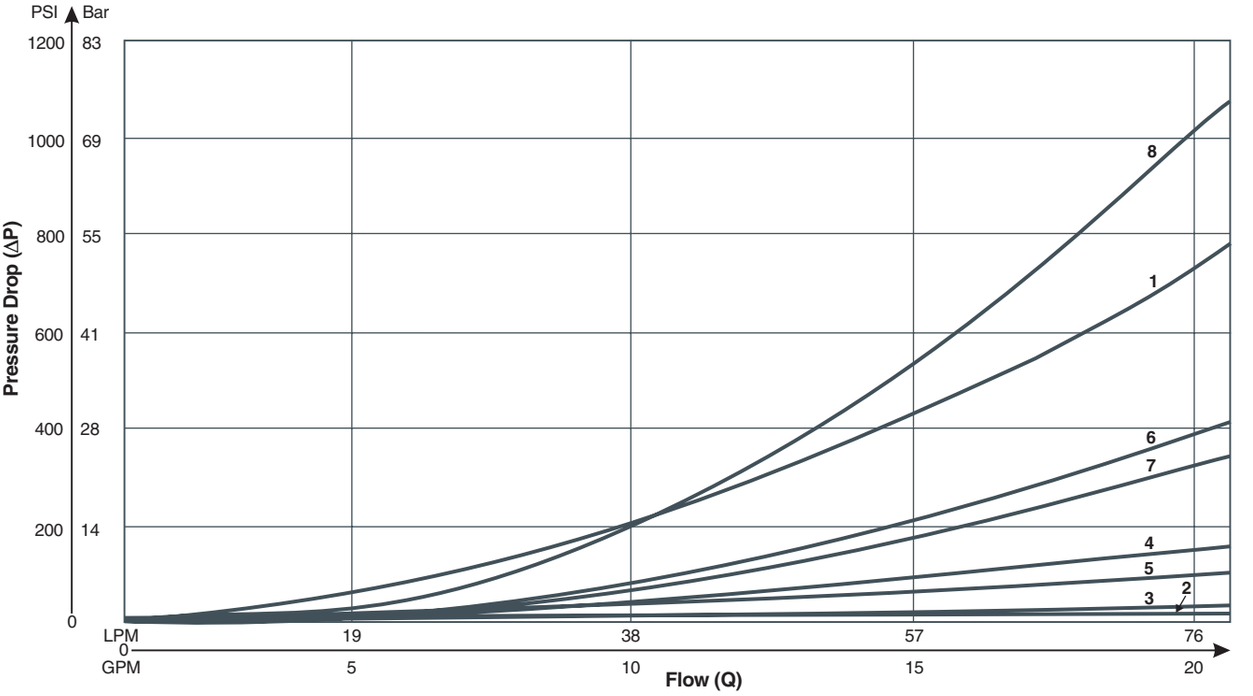


D03 Pad Dimensions: Below is the common dimensions of the standard D03 mount pad. Since these dimensions are common to all Cartpak bodies, we do not identify them on the individual valve pages.



PRESSURE DROP CHART

The following charts outline the pressure drop through the Parker Cartpak bodies.
The pressure drop is minus the cartridge valve.



Body	Orientation	P	T	A	B
BD03-PN	Upright Inverted	1 2	2 1	3 3	3 3
BD03-PT	Upright Inverted	3 3	3 3	3 3	3 3
BD03-ABN	Upright Inverted	3 3	3 3	4 4	4 4
BD03-ABT	Upright Inverted	3 3	3 3	3 3	3 3
BD03-ABX	Upright	5	5	3	3
BD03-PNR	Upright	6	3	3	3
BD03-PNS	Upright	7	3	3	3
BD03-DDX	Upright	3	3	1	1
BD03-BDA	Upright	6	3	3	3
BD03-ADB	Upright	6	3	3	3
BD03-PN2	Upright Inverted	8 3	3 8	3 3	3 3

DESCRIPTION

Basic Hydraulic Formulas .....
Ratings and Testing .....
Temperature Ratings .....
Viscosity .....
Pressure Ratings .....
Thermal Shock .....
Service and Components .....
Limitations in Use .....
Seal Material Selection .....
Hydraulic Fluids .....
Hydraulic Filtration .....
Application of Product .....
Offer of Sale .....

INTRODUCTION

In this section you will find a variety of technical information pertinent to general hydraulics as well as cartridge valve technology.

HYDRAULIC FORMULAS

Below are a few of the common hydraulic formulas to assist you in calculating the requirements for your system:

Voltage = *Current × Resistance*

Flow = *Volume ÷ Unit of Time*

Pressure = *Force ÷ Area*

Horsepower = *Flow × Pressure ÷ (1714 × Efficiency)*

$$\textbf{Hydraulic power (kW)} = \frac{\Delta p \text{ (Bar) x flow rate (LPM)}}{600}$$

where Δp = pressure drop

$$\textbf{Hydraulic power (HP)} = \frac{\Delta p \text{ (PSI) x flow rate (GPM)}}{1714}$$

RATINGS & TESTING

All Parker cartridge valve products have been performance tested with the results shown on the individual valve catalog pages. The performance data shown represents typical operation characteristics of the product. In addition, our valves are endurance tested. Validation is conducted by testing or similarity in designs.

Note: Not every cartridge option is endurance tested. In other words, one three way spool is endurance tested, and the others are assumed by similarity.

TEMPERATURE RATINGS

Product operating limits are broadly in the range -30°C to 150°C (-20°F to 300°F) but satisfactory operation within the specification may not be accomplished. Leakage and response will be affected when used at temperature extremes and it is the user's responsibility to determine acceptability at these levels.

Seals used in these products generally have the following temperature limitations:

Nitrile (Buna N)	-30°C to 100°C (-20°F to 210°F)
Fluorocarbon	-20°C to 150°C (-4°F to 300°F)
Hytrel	-54°C to 135°C (-65°F to 275°F)
GTPFE	-30°C to 150°C (-20°F to 300°F)

VISCOSITY

Catalog data is from tests conducted on mineral oil at a viscosity of 30 cSt (140 SSU) using an ISO VG:46 test fluid.

Product should ideally be used at viscosities in the range of 15 to 50 cSt (80 to 230 SSU).

Product will perform with reduced efficiency in the ranges, 5 to 15 cSt (42 to 80 SSU) and 50 to 500 cSt (230 to 2300 SSU). These extreme conditions must be evaluated by the user to establish suitability of the product's performance.

PRESSURE RATINGS

Unless otherwise stated, all Parker cartridges have a continuous duty pressure ratings as shown in the catalog. All pressure ratings are based on the cartridge valve only. Exposure to elevated pressures may affect the performance and fatigue life of the product. The material chosen for the body or carrier may affect the pressure rating we recommend. Parker does not recommend the use of cartridge valves in aluminum bodies at pressures above 207 bar (3000 psi).

THERMAL SHOCK

It is unreasonable to expect product to withstand rapid temperature changes - this could affect both performance and life and care should be taken to protect the product from such situations.

SERVICE & COMPONENTS

One of the advantages of integrated hydraulic circuits is their serviceability. Should a valve need to be replaced for any reason, a user only needs to unscrew the valve from the manifold and screw the replacement into the cavity. As such, there are few replacement parts available for the Parker cartridge products. As with any hydraulic system, the operator should bleed off any trapped pressure and consult machine service manuals prior to service. Parker does not offer any service parts for internal components, but external components such as coils, knobs, and seals are available.

LIMITATIONS IN USE

Parker cartridge valves are designed for a wide variety of industrial and mobile applications. Despite their flexibility, Parker Hannifin does not recommend or support the use of our cartridge valves in any on highway or aerospace applications. We also do not recommend our products for use in the transport of explosive products or in hazardous environments.

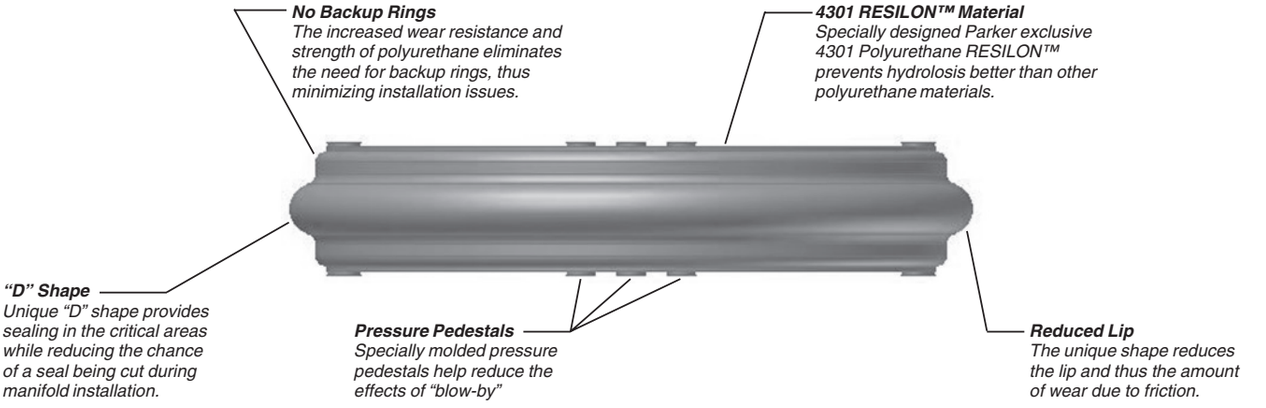
SEAL MATERIAL SELECTION

You should match the seal compatibility to the temperature and fluid being used in your application. Parker offers three seal materials to meet your application requirements. Parker's standard material is a 4301 Polyurethane RESILON™ material "D"-Ring. We also offer Fluorocarbon and Nitrile seals. A brief synopsis of each seal material is given below to help you choose the best seal for your application.

"D"-Ring (4301 Polyurethane RESILON™ Material)
The "D"-Ring is the standard seal material on the Winner's Circle threaded cartridge valves. The "D"-Ring is molded of a special 4301 Polyurethane RESILON™. Polyurethane materials exhibit better wear resistance and tensile strength than standard Nitrile or Fluorocarbon material. In addition, it has an excellent resistance to compression set. This increased strength eliminates the need for back-rings and simplifies installation.

The 4301 compound is a Parker exclusive material designed to prevent hydrolysis at high temperatures. Thus, the "D"-Ring outperforms standard polyurethane o-rings, especially when using high water content fluids at elevated temperatures. The "D"-Ring is compatible with most water-glycol, water/oil emulsions, and high grade petroleum based hydraulic fluids at temperatures between -45°C to +93°C (-50°F to +200°F)

The unique shape of the Parker "D"-Ring also provides a variety of design advantages. The seal is molded into a "D" shape where the seal is higher in the middle and lower on the ends. This prevents the seal edge from folding over on a corner inside the manifold during installation. In addition, this design has a minimal lip, thus, friction is reduced. Another unique feature of the "D"-Ring is its symmetrical design, resulting in no performance degradation from the reverse direction, or worry of backward installation. The "D"-Ring is also equipped with "pressure pedestals" to reduce the effects of "blow-by" common in reverse cycling. The pressure pedestals increase the sealing capability of the "D"-Ring, by reducing the radial pressure forces that compress the sealing face of the o-ring. The drawing below depicts the shape and highlights the features.



Nitrile
Nitrile o-rings are also compatible with most water-glycol, water/oil emulsions, and high grade petroleum based hydraulic fluids. Parker only recommends Nitrile o-rings for temperatures between -40°C to +93°C (-40°F to +200°F). Nitrile o-rings do require a full back-up ring, or two half back-ups.

Fluorocarbon
Fluorocarbon o-rings are compatible with most phosphate ester fluids and phosphate ester blends. Parker only recommends Fluorocarbon seals for temperatures between -32°C to +121°C (-25°F to +250°F). Fluorocarbon o-rings do require a full back-up ring, or two half back-ups.

HYDRAULIC FLUIDS

Parker recommends using top-quality mineral based or synthetic hydraulic fluids with lubricating properties at viscosities of 45 to 2000 SSU (6 to 420 cSt) at 38°C (100°F). The absolute viscosity range 80 to 1000 SSU (16 to 220 cSt.). Fluids should have high anti-wear characteristics and be treated to protect against oxidation.

HYDRAULIC FILTRATION

Hydraulic systems that include Parker valves should be carefully protected against fluid contamination. The proper cleanliness level for Parker cartridge valves should be maintained at an ISO cleanliness level of 18/16/13.

75% of all system failures are a direct result of contamination. Contamination interferes with four functions of hydraulic fluids.

1. To act as an energy transmission medium.
2. To lubricate internal moving parts of components.
3. To act a heat transfer medium.
4. To seal clearances between moving components.

A properly selected filter will provide adequate protection and reduce operating cost. This is achieved by increasing the expected life of the valves and reducing the cost of maintenance and repairs. Operation will be smoother and more precise.

There is no direct correlation between using a specific ISO cleanliness classification. Numerous other variables should be considered such as particulate ingression, actual flow through filters, and filter location.

A number of interrelated system factors combine to determine proper media and filter combinations. To accurately determine which combination is ideal for your system, all these factors need to be accounted for. With the development of filtration sizing software such as Parker inPHorm, this information can be used to compute the optimal selection. In many instances the information available may be limited. In these cases, “rules of thumb” based on empirical data and proven examples are applied to get an initial starting point.

APPLICATION OF PRODUCT

CAUTION - It is important to note that the Parker Hydraulic Cartridge Systems Division makes a variety of valves, many of which fit into the same cavity. However, their functionality may differ considerably from one valve type to another. **Accordingly *fit* interchangeability does not necessarily mean *form* or *function* interchangeability.** Users should ensure that the appropriate valve is installed in the cavity by cross checking the part number stamped on the valve with that published in approved service literature or in the installation drawing.

Offer of Sale

The items described in this document and other documents or descriptions provided by Parker Hannifin Corporation, its subsidiaries and its authorized distributors are hereby offered for sale at prices to be established by Parker Hannifin Corporation, its subsidiaries and its authorized distributors. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer's order for any such items, when communicated to Parker Hannifin Corporation, its subsidiary or an authorized distributor ("Seller") verbally or in writing, shall constitute acceptance of this offer.

1. Terms and Conditions of Sale: All descriptions, quotations, proposals, offers, acknowledgments, acceptances and sales of Seller's products are subject to and shall be governed exclusively by the terms and conditions stated herein. Buyer's acceptance of any offer to sell is limited to these terms and conditions. Any terms or conditions in addition to, or inconsistent with those stated herein, proposed by Buyer in any acceptance of an offer by Seller, are hereby objected to. No such additional, different or inconsistent terms and conditions shall become part of the contract between Buyer and Seller unless expressly accepted in writing by Seller. Seller's acceptance of any offer to purchase by Buyer is expressly conditional upon Buyer's assent to all the terms and conditions stated herein, including any terms in addition to, or inconsistent with those contained in Buyer's offer, Acceptance of Seller's products shall in all events constitute such assent.

2. Payment: Payment shall be made by Buyer net 30 days from the date of delivery of the items purchased hereunder. Amounts not timely paid shall bear interest at the maximum rate permitted by law for each month or portion thereof that the Buyer is late in making payment. Any claims by Buyer for omissions or shortages in a shipment shall be waived unless Seller receives notice thereof within 30 days after Buyer's receipt of the shipment.

3. Delivery: Unless otherwise provided on the face hereof, delivery shall be made F.O.B. Seller's plant. Regardless of the method of delivery, however, risk of loss shall pass to Buyer upon Seller's delivery to a carrier. Any delivery dates shown are approximate only and Seller shall have no liability for any delays in delivery.

4. Warranty: Seller warrants that the items sold hereunder shall be free from defects in material or workmanship for a period of 18 months from date of shipment from Parker Hannifin Corporation. **THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO ITEMS PROVIDED HEREUNDER. SELLER MAKES NO OTHER WARRANTY, GUARANTEE, OR REPRESENTATION OF ANY KIND WHATSOEVER. ALL OTHER WARRANTIES, INCLUDING BUT NOT LIMITED TO, MERCHANTABILITY AND FITNESS FOR PURPOSE, WHETHER EXPRESS, IMPLIED, OR ARISING BY OPERATION OF LAW, TRADE USAGE, OR COURSE OF DEALING ARE HEREBY DISCLAIMED. NOTWITHSTANDING THE FOREGOING, THERE ARE NO WARRANTIES WHATSOEVER ON ITEMS BUILT OR ACQUIRED WHOLLY OR PARTIALLY, TO BUYER'S DESIGNS OR SPECIFICATIONS.**

5. Limitation Of Remedy: SELLER'S LIABILITY ARISING FROM OR IN ANY WAY CONNECTED WITH THE ITEMS SOLD OR THIS CONTRACT SHALL BE LIMITED EXCLUSIVELY TO REPAIR OR REPLACEMENT OF THE ITEMS SOLD OR REFUND OF THE PURCHASE PRICE PAID BY BUYER, AT SELLER'S SOLE OPTION. IN NO EVENT SHALL SELLER BE LIABLE FOR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES OF ANY KIND OR NATURE WHATSOEVER, INCLUDING BUT NOT LIMITED TO LOST PROFITS ARISING FROM OR IN ANY WAY CONNECTED WITH THIS AGREEMENT OR ITEMS SOLD HEREUNDER, WHETHER ALLEGED TO ARISE FROM BREACH OF CONTRACT, EXPRESS OR IMPLIED WARRANTY, OR IN TORT, INCLUDING WITHOUT LIMITATION, NEGLIGENCE, FAILURE TO WARN OR STRICT LIABILITY.

6. Changes, Reschedules and Cancellations: Buyer may request to modify the designs or specifications for the items sold hereunder as well as the quantities and delivery dates thereof, or may request to cancel all or part of this order, however, no such requested modification or cancellation shall become part of the contract between Buyer and Seller unless accepted by Seller in a written amendment to this Agreement. Acceptance of any such requested modification or cancellation shall be at Seller's discretion, and shall be upon such terms and conditions as Seller may require.

7. Special Tooling: A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture items sold pursuant to this contract. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the items sold hereunder, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

8. Buyer's Property: Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Buyer's property, may be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer placing an order for the items which are manufactured using such property, Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

9. Taxes: Unless otherwise indicated on the face hereof, all prices and charges are exclusive of excise, sales, use, property, occupational or like taxes which may be imposed by any taxing authority upon the manufacture, sale or delivery of the items sold hereunder. If any such taxes must be paid by Seller or if Seller is liable for the collection of such tax, the amount thereof shall be in addition to the amounts for the items sold. Buyer agrees to pay all such taxes or to reimburse Seller therefore upon receipt of its invoice. If Buyer claims exemption from any sales, use or other tax imposed by any taxing authority, Buyer shall save Seller harmless from and against any such tax, together with any interest or penalties thereon which may be assessed if the items are held to be taxable.

10. Indemnity For Infringement of Intellectual Property Rights: Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Part 10. Seller will defend and indemnify Buyer against allegations of infringement of U.S. Patents, U.S. Trademarks, copyrights, trade dress and trade secrets (hereinafter 'Intellectual Property Rights'). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that an item sold pursuant to this contract infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If an item sold hereunder is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using said item, replace or modify said item so as to make it noninfringing, or offer to accept return of said item and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to items delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any item sold hereunder. The foregoing provisions of this Part 10 shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights. If a claim is based on information provided by Buyer or if the design for an item delivered hereunder is specified in whole or in part by Buyer, Buyer shall defend and indemnify Seller for all costs, expenses or judgments resulting from any claim that such item infringes any patent, trademark, copyright, trade dress, trade secret or any similar right.

11. Force Majeure: Seller does not assume the risk of and shall not be liable for delay or failure to perform any of Seller's obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter 'Events of Force Majeure'). Events of Force Majeure shall include without limitation, accidents, acts of God, strikes or labor disputes, acts, laws, rules or regulations of any government or government agency, fires, floods, delays or failures in delivery of carriers or suppliers, shortages of materials and any other cause beyond Seller's control.

12. Entire Agreement/Governing Law: The terms and conditions set forth herein, together with any amendments, modifications and any different terms or conditions expressly accepted by Seller in writing, shall constitute the entire Agreement concerning the items sold, and there are no oral or other representations or agreements which pertain thereto. This Agreement shall be governed in all respects by the law of the State of Ohio. No actions arising out of the sale of the items sold hereunder or this Agreement may be brought by either party more than two (2) years after the cause of action accrues.

9/91-P

Notes

Extensive Hydraulic Product Offering

Accumulators

Piston, bladder and diaphragm type accumulators, gas bottles and Kleen-Vent reservoir isolators.

www.parker.com/accumulator

Compact Hydraulics

Self-contained with a motor, gear pump, reservoir, internal valving, load hold checks and relief valves.

www.parker.com/oildyne

Cylinders

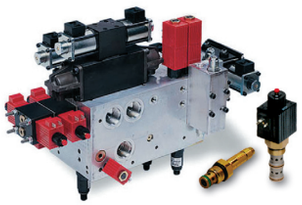
Standard and custom hydraulic cylinders for industrial and mobile applications.

www.parker.com/hydcyl

Filtration

Pressure and return line filters enhances machine life, reduces maintenance and lowers costs.

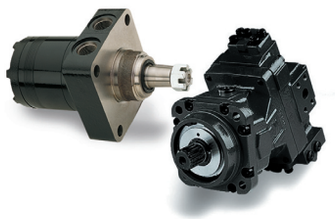
www.parker.com/hydraulicfilter



Integrated Hydraulic Circuits

Solutions for complex circuits that include threaded cartridge valves integrated into a single manifold.

www.parker.com/hcs



Motors

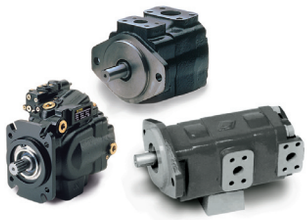
Full line of high and low speed motors provides power up to 15,000 in-lbs of torque.

www.parker.com/pumpmotor

Power Units

The most complete line of standard, pre-engineered, cataloged hydraulic power units in the industry.

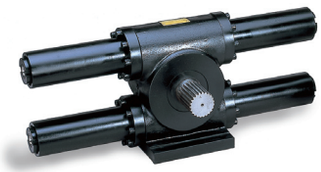
www.parker.com/hydraulicpump



Pumps

Broad line of energy- efficient hydraulic pumps that includes piston, vane and gear pumps.

www.parker.com/hydraulicpump



Rotary Actuator

Industry leader in the design and manufacture of hydraulic rack and pinion, and vane style rotary actuators.

www.parker.com/actuator

Electronics/Remote Controls

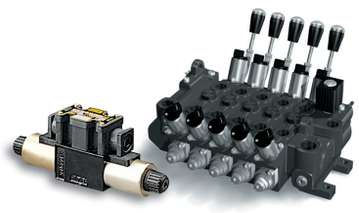
Parker's unique IQAN approach combines sturdy, well-tested hardware with intelligent, flexible computing power.

www.parker.com/iqan

Power Take Off

Parker Chelsea leads the industry for engineering, innovation and performance in auxiliary power systems.

www.parker.com/chelsea



Valves and Controls

Hydraulic valves for virtually every hydraulic equipment application, from simple to precise control.

www.parker.com/hydraulicvalve

Sales Offices

Argentina, Buenos Aires
Tel: (54) 33 2744 4129

Australia, Castle Hill
Tel: (61) 2 9634 7777

Austria, Wiener Neustadt
Tel: (43) 2622 23501 0

Belgium, Nivelles
Tel: (32) 67 280 900

Brazil, Cachoeirinha RS
Tel: (55) 51 3470 9144

Canada, Milton, Ontario
Tel: (905) 693 3000

China, Beijing
Tel: (86) 10 6561 0520

China, Shanghai
Tel: (86) 21 5031 2525

Czech Republic and Slovakia,
Klecany
Tel: (420) 284 083 111

Denmark, Ballerup
Tel: (45) 4356 0400

Finland, Vantaa
Tel: (358) 20 753 2500

France, Contamine-sur-Arve
Tel: (33) 4 50 25 80 25

Germany, Kaarst
Tel: (49) 2131 4016 0

Greece, Athens
Tel: (30) 210 933 6450

Hong Kong
Tel: (852) 2428 8008

Hungary, Budapest
Tel: (36) 1 220 4155

India, Mahape, Navi Mumbai
Tel: (91) 22 6513 7081

Ireland, County Dublin, Baldonnell
Tel: (353) 1 466 6370

Italy, Corsico, Milano
Tel: (39) 02 45 19 21

Japan, Tokyo
Tel: (81) 3 6408 3900

Korea, Seoul
Tel: (82) 2 559 0400

Malaysia, Subang Jaya
Tel: (60) 3 5638 1476

Mexico, (Mobile)
Apodaca, N.L.
Tel: (52) 81 8156 6000

Mexico, (Industrial)
Toluca, Edo. de Mexico
Tel: (52) 72 2275 4200

The Netherlands, Oldenzaal
Tel: (31) 541 585000

New Zealand, Mt. Wellington
Tel: (64) 9 574 1744

Norway, Ski
Tel: (47) 64 91 10 00

Poland, Warsaw
Tel: (48) 22 57 32400

Portugal, Leca da Palmeira
Tel: (351) 22 999 7360

Romania, Bucharest
Tel: (40) 21 252 1382

Russia, Moscow
Tel: (7) 495 645 2156

Singapore, Jurong Town
Tel: (65) 6 887 6300

Slovenia, Novo Mesto
Tel: (386) 7 337 6650

South Africa, Kempton Park
Tel: (27) 11 961 0700

Spain, Madrid
Tel: (34) 91 675 7300

Sweden, Spånga
Tel: (46) 8 597 95000

Taiwan, Taipei
Tel: (886) 2 2298 8987

Thailand, Bangkok
Tel: (662) 717 8140

Turkey, Istanbul
Tel: (90) 212 482 9106

Ukraine, Kiev
Tel: (380) 44 494 2731

United Arab Emirates, Abu Dhabi
Tel: (971) 2 678 8587

United Kingdom, Warwick
Tel: (44) 1926 317878

USA, (Industrial)

Chicago Region, Naperville, IL
Tel: (630) 964 0796

Great Lakes Region, Fairlawn, OH
Tel: (330) 670 2680

Gulf Region, Houston, TX
Tel: (317) 619 8490

Northeast Region, Lebanon, NJ
Tel: (908) 236 4121

Pacific Region, Buena Park, CA
Tel: (714) 228 2509

Southern Region, Alpharetta, GA
Tel: (770) 619 9767

USA, (Mobile)

Central Region, Lincolnshire, IL
Tel: (847) 821 1500

Eastern Region, St. Helena Island, SC
Tel: (843) 838 2070

Midwest Region, Hiawatha, IA
Tel: (319) 393 1221

Southern Region, Aledo, TX
Tel: (817) 441 1794

Western Region, San Ramon, CA
Tel: (925) 735 9573

USA, Miami, FL
(Pan American Division)
Tel: (305) 470 8800

Venenzuela, Caracas
Tel: (58) 212 238 5422

12/08 HY15-3501.2PSG

Parker Hannifin Corporation
Hydraulic Cartridge Systems
595 Schelter Road
Lincolnshire, IL 60069
877-WNRCRCL (967-2725)
phone 847-955-5000
fax 847-383-8905
www.parker.com/hcs

Parker Hannifin Ltd.
Hydraulic Cartridge Systems
Blacknell Lane
Crewkerne, Somerset,
TA18 8LL, UK
phone +44 (0) 1460 271800
fax +44 (0) 1460 271801