

# Valves

## Technical support

Refer to the “Yellow Pages” of this catalogue for:

- Safety instructions
- Basic hydraulic information
- Advanced hydraulic technology
- FMS (Flexible Machining Systems) technology
- Conversion charts and hydraulic symbols.

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Controlling the operation of your clamping system requires the use of many specialized directional, pressure and flow control valves. Enerpac has the complete line of valving components to complement any hydraulic system. Choose from either manual or electric directional valves, and a wide variety of pressure control, flow control and specialty valves to provide the control and automation that your application needs.





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Shown: VP-12



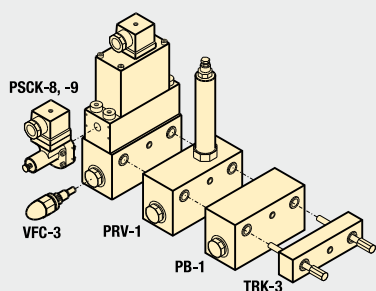
## VP-series

Solenoid directional valves control the direction of the oil flow to each cylinder port.

### Application

VP-series valves in combination with all its options in the illustration and photo below. With the use of a code 12 manifold (see page 117, 121) these valves allow quick and easy assembly on your Enerpac ZW-series pump. For remote mounting of these valves use a WM-10 manifold.

### VP-series



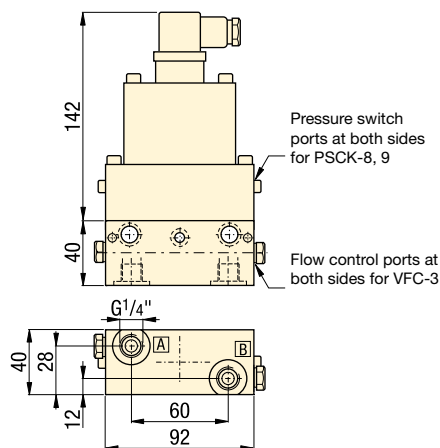
■ Enerpac VP-series valves mounted on -12 manifold, mounted on a ZW-series workholding pump.



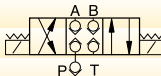
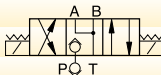
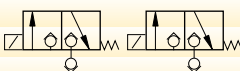
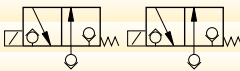
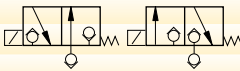
## Solenoid directional valves

- Dual poppet valve design for zero internal leakage
- Inlet check-valve standard
- High cycle switching
- Stackable to 8 valve stations high
- 17-350 bar operational pressure
- Oil flow capacity 7 l/min @ 350 bar
- Oil flow capacity 15 l/min @ 0 bar
- G1/4" oil connections and integrated filtration
- 24 VDC and 110 VAC available.

### VP series



## Product selection

Voltage @ current	Model number	Flow path	Used with cylinder(s)
at 50/60 Hz			
▼ 4/3 Closed center			
24 VDC @ 1,13 A	VP-11		1x Double-acting
110 VAC @ 500 mA	VP-12		1x Double-acting
▼ 4/3 Float center			
24 VDC @ 1,13 A	VP-21		1x Double-acting
110 VAC @ 500 mA	VP-22		1x Double-acting
▼ 3/2 Normally closed			
24 VDC @ 1,13 A	VP-31		1x 1x Dbl-act. / 2x Sgl-act.
110 VAC @ 500 mA	VP-32		1x Dbl-act. / 2x Sgl-act.
▼ 3/2 Normally open			
24 VDC @ 1,13 A	VP-41		1x Dbl-act. / 2x Sgl-act.
110 VAC @ 500 mA	VP-42		1x Dbl-act. / 2x Sgl-act.
▼ 3/2 1 port normally closed, 1 port normally open			
24 VDC @ 1,13 A	VP-51		1x Dbl-act. / 2x Sgl-act.
110 VAC @ 500 mA	VP-52		1x Dbl-act. / 2x Sgl-act.

Note: DIN 43650 electrical connector included. Valve weight 3,0 kg.

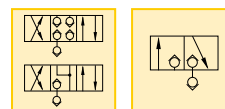
Pressure: 350 bar

Max. Flow: 15 l/min

E Válvulas de control

F Electro distributeurs

D Wegesitzventile



## Options

WM-10 remote manifold

139 ▶

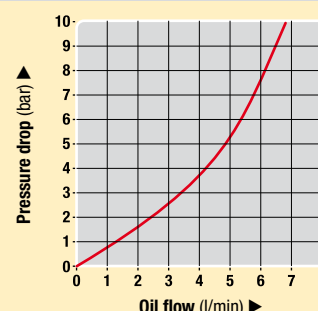


TRK-series Tie rod kits

139 ▶



### Oil flow vs pressure drop





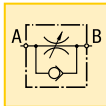
# PSCK, VFC-series Pressure switches, Flow control valve

Pressure: 350 bar

Flow: 7 l/min @ 350 bar

Voltage: 115 VAC, 24 VDC

- E** Presostatos
- F** Pressostats
- D** Druckschalter



## To control your hydraulic system

- Mounts directly into VP-series modular valves
- In-line installation
- Cartridge type flow control valve and pressure switches can be manifold mounted for remote use
- Lockable adjustment screw on PSCK models.

Shown: PSCK-8, VFC-3



## Options

### PB-1 Auxiliary block

139 ▶

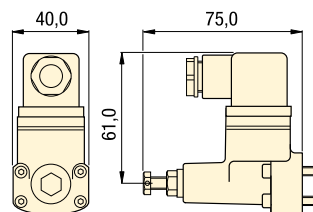


### Pressure reducing valves

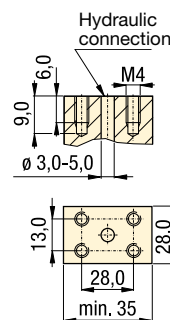
138 ▶



PSCK-8, 9



PSCK-8, 9 mounting dimensions



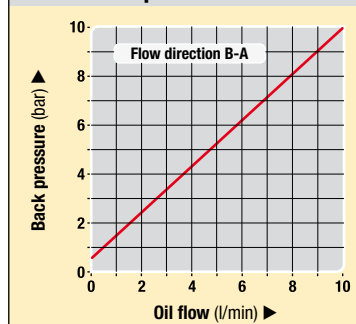
## PSCK-8, 9

Adjustable pressure switches will open or close electrical contacts when the desired pressure value is reached.

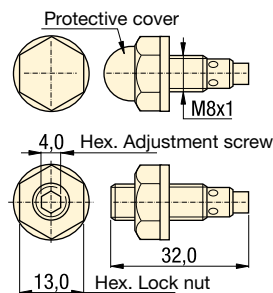
### Application

To open or close an electric circuit when a preset pressure value is reached. The electrical circuit is used to control further working cycles, such as actuating control valves or to terminate a working cycle. Directly mounted into Enerpac VP-series valves.

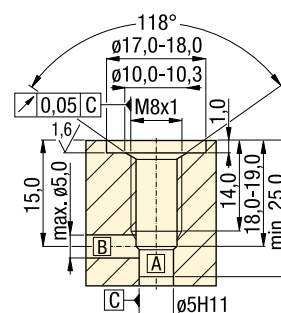
VFC-3 Back pressure vs flow return



VFC-3



VFC-3 mounting dimensions






## VFC-3

Screw-in throttle type valve to control the amount of oil flow to the hydraulic cylinder.

### Application

Used to control cylinder speed in hydraulic circuits. Directly mounted into Enerpac VP-series valves or custom made manifolds for remote applications.

## Product selection

Solenoid voltage @ current	Model number	Hydraulic scheme	Pressure range	Deadband	Maximum oil flow
at 50/60 Hz			bar	bar	l/min
▼ Pressure switch					
24 VDC @ 2 A	PSCK-8		100 - 350	18 - 35	7
115 VAC @ 2 A					
▼ Pressure switch					
24 VDC @ 2 A	PSCK-9		20 - 210	6 - 15	7
115 VAC @ 2 A					
▼ Flow control valve					
screw-in	VFC-3		0-350	-	7
throttle					
valve					

■ PSCK-8 and VFC-3 directly mounted on VP-valves.





Shown: PRV-1



## PRV series

These valves regulate system pressure for all subsequent valves, according to the adjusted pressure. Maintains a constant pressure in a secondary circuit. Includes a check valve that prevents pressure drop on secondary side.

### Application

Used when a hydraulic supply with a higher pressure (primary side) must also be used for another circuit with a lower pressure (secondary circuit). PRV-1 can be stack built between VP-series valves.

## Precise control of hydraulic pressure

- Stackbuilding with VP series modular valves
- Stackable for multiple pressures on one valve stack assembly
- Tool adjustable knob can be locked
- Precise control of pressure

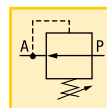
Pressure: 350 bar

Flow: 7 l/min

**E** Válv. reguladora de presión

**F** Valve de pression réglable

**D** Druckreduzierventil



## Options

VP-series  
Modular  
valves

136 ▶



Pressure  
switches

188 ▶

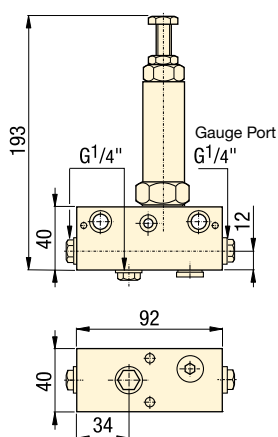


TRK-series  
Tie rod kits

139 ▶



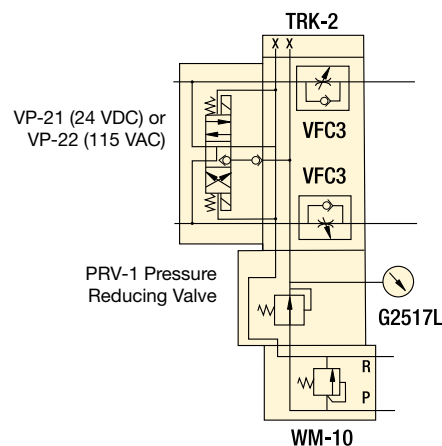
### PRV-1, PRV-5



▼ PRV-1 connected with remote manifold WM-10.



### Valve stacking example



## Product selection

Mounting style	Adjustable pressure range	Maximum pressure	Model number	Oil ports	Maximum oil flow	
	bar	bar		BSPP	l/min	kg
VP-series	30 - 300	350	PRV-1	G1/4"	7	1,6
VP-series	75 - 138	350	PRV-5	G1/4"	7	1,6



**Mounting:** 1-8 VP valve stations

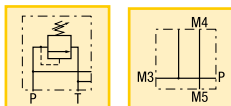
**Pressure:** 350 bar

**Flow:** 15 l/min

**E** Pernos de montaje de válv.

**F** Vis de montage de distrib.

**D** Zugstangen



## Simplifies valve and accessory mounting

### TRK-series tie rods

- Connects 1 to 8 VP-series valves station high
- Provide leak-free sealing valves
- G1/4" oil connection

### WM-10 remote manifold

- Allows remote VP-series valve mounting
- Adjustable relief valve incorporated
- G1/4" oil connection

### PB-1 porting manifold

- Provide 3 auxiliary pressure lines
- G1/4" oil connection

Shown: WM-10, TRK-4, PB-1



### TRK-series

Tie Rod Kits mount Enerpac VP-series modular valves to the WM-10 manifold and can accommodate one to eight VP-valve stations.



### WM-10

Remote manifold allows mounting of VP-series modular valves to a remote location from the pumping unit. This manifold has a built-in adjustable relief valve.



### PB-1

Porting manifold provides three pressure ports for auxiliary lines or accessories, such as a pressure gauge. Mounts between VP-series modular valve stations using TRK-series tie rod kits.

## Options

**Pressure switches**

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**VP-series directional valves**

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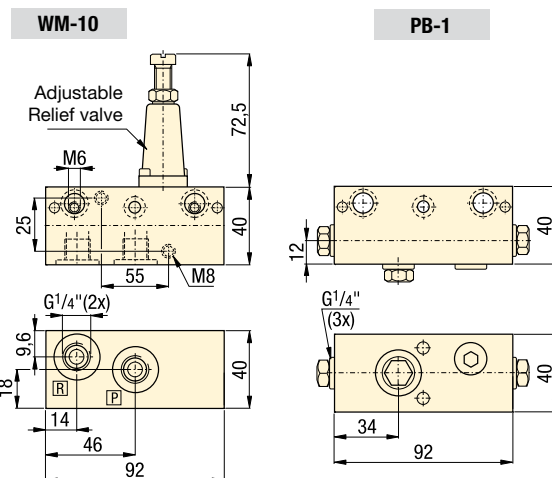
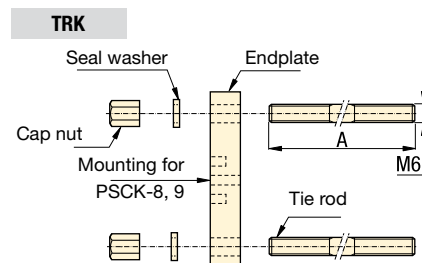
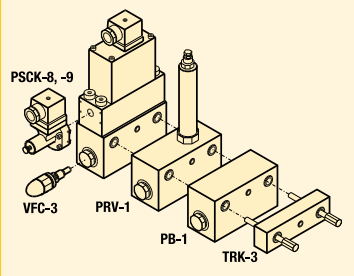


**Gauges**

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
**VP-series**



## Product selection

Quantity of stackable VP-series directional valves	Model number	Tie rod length A	Mounting thread
		mm	mm
▼ Tie rod kits			
1	TRK-1	85	M6
2	TRK-2	125	M6
3	TRK-3	165	M6
4	TRK-4	205	M6
5	TRK-5	245	M6
6	TRK-6	285	M6
7	TRK-7	325	M6
8	TRK-8	365	M6

## Product selection

Oil ports	Model number	Hydraulic schematic	Maximum pressure
BSPP			bar
▼ Remote manifold with pressure relief			
2x G1/4"	WM-10		350
▼ Porting manifold (P port connection)			
3x G1/4"	PB-1		350

■ Tie rods mount VP-series valves and accessories to manifold, providing leak-free sealing.





Shown: VST-1401D, VSS-2210D



## VSS, VST-series

Solenoid and air piloted directional control valves. Poppet design for zero leakage promote system efficiency. Increases the life of your workholding pump by decreasing internal valve leakage.

### Application

Advance and retract for single- and double-acting cylinders. The valves require check valves for positive load holding and can be installed for the same independent operation with single-acting cylinders by blocking the B port.

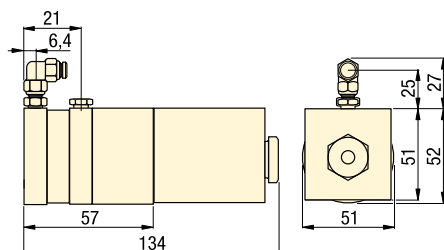
■ VSS-2210D mounted directly on a Turbo II air pump for use on positive clamping fixture.



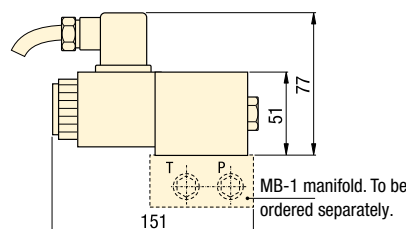
## Zero leakage poppet valves increase efficiency

- Poppet valve design for zero leakage
- 4-way, 2-position float offset or normally open
- D03 or CETOP 3 mounting pattern
- DIN-standard rectifier plugs for easy connection to power source
- Air operated models eliminate need for electricity
- Including O-rings and mounting bolts
- SAE manifold ports simplify plumbing
- Inline check valve provides positive load holding

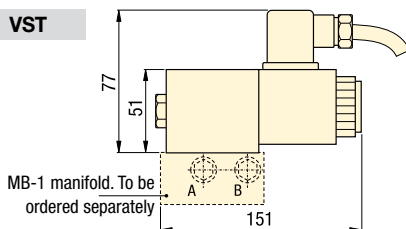
### VAS, VAT






### VSS



### VST



## Product selection

Valve flow path	Solenoid voltage @ current	Model number	Hydr. symbol	Pressure range	Pressure drop <sup>1)</sup>	Max. oil flow
	at 50/60 Hz			bar	bar	l/min
▼ Solenoid poppet valves – Normally open						
4-way, 2 position	4,1 - 6,8 bar	VAS-0710D		0-350	12	11,3
4-way, 2 position	24VDC @ 1,6 A	VSS-1410D		0-350	12	11,3
4-way, 2 position	115VAC @ 0,4 A	VSS-2210D		0-350	12	11,3
▼ Solenoid poppet valves – Normally closed						
4-way, 2 position	42-70 bar max.	VAT-0710D		0-350	12	11,3
4-way, 2 position	24VDC @ 1,6 A	VST-1410D		0-350	12	11,3
4-way, 2 position	115VAC @ 0,4 A	VST-2210D		0-350	12	11,3
▼ Inline check valve						
–	–	VD1P		0-350	0	11,3

<sup>1)</sup> Pressure drop from P-A or P-B at maximum oil flow of 11 l/min.

Pressure: 0 - 350 bar

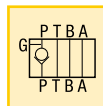
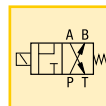
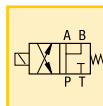
Flow: 11 l/min max.

Voltage: 115 VAC, 24 VDC

Ⓔ Electroválvulas

Ⓕ Electro distributeurs

Ⓓ Elektromagnetische Ventile



## Options

D03 Manifolds MB-series

144 ▶



Fittings

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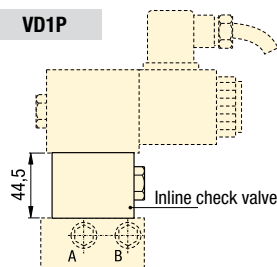


## Important

For multiple circuit applications, the VD1P inline check valve is recommended to prevent pressure drop on the holding circuit.

Order bolt kit BKD-71 to mount VD1P with VAS/VSS/VST valves.

### VD1P





Pressure: 0 - 350 bar

Flow: 6 - 57 l/min

Voltage: 24 VDC, 110 VAC

**E** Electroválvulas

**F** Electro distributeurs

**D** Elektromagnetische Ventile



Options

D03 Manifolds  
MB-series

144 ▶

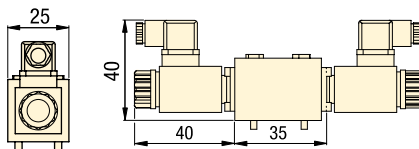


Fittings

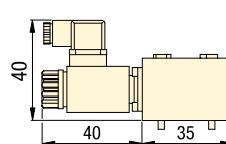
194 ▶



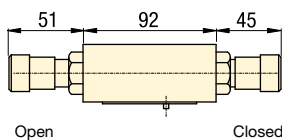
VP03-11, 12, 21, 22



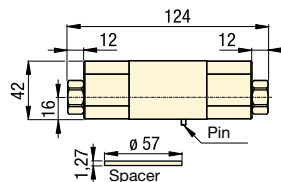
VP03-51, 52



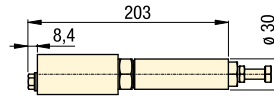
VFC-4



VD2P



PRV-6, PRV-7



Product selection

Valve flow path	Solenoid voltage 50/60 Hz	Model number	Hydraulic symbol	Pressure range bar	Maximum oil flow l/min
4/3 closed center	24 VDC	VP03-11		0-350	19
4/3 closed center	110 VAC	VP03-12		0-350	19
4/3 float center	24 VDC	VP03-21		0-350	19
4/3 float center	110 VAC	VP03-22		0-350	19
4-way / 2-position	24 VDC	VP03-51		0-250	15
	110 VAC	VP03-52		0-250	15
Dual flow control	–	VFC-4		0-350	38
Dual pilot operated check valve	–	VD2P		0-350	57
Pressure reducing valve	–	PRV-6		30-300	12
	–	PRV-7		5-138	6

Shown: VP03



VP03-series

VP03 valves are zero leakage, solenoid operated poppet valves.

## Application

Used to control the advance and retract of single acting and double acting cylinders.



Important

VP03 series valves are zero leakage and can be used with pressure shut down electric pumps and air driven Turbo II pumps.

■ VP03-11 valve on PASG-3002SB Turbo pump.





Shown: VEX-11 valve



## VE-series

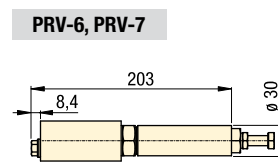
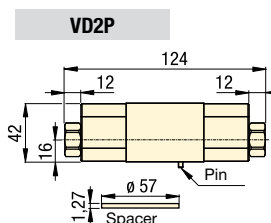
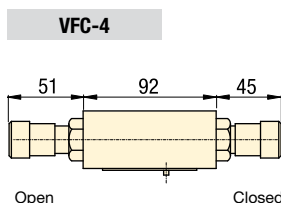
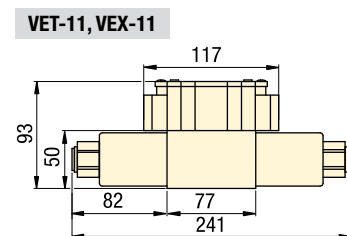
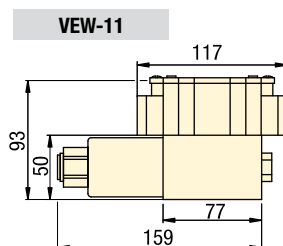
Spool style solenoid valves and control modules are used in circuits that do not require zero leakage.

### Application

Used to control the advance and retract of single acting and double acting cylinders. The dual check valve can be used to lock pressure in a group of cylinders. The dual flow control offers independent control of cylinder advance and retract speeds. The pressure reducing valve sets a circuit pressure lower than the main pump pressure.

## D03 Direction Valve and accessories

- D03 mounting pattern
- Directional valves
- Pilot operated check valve
- Dual flow control
- Pressure reducing valve



Pressure: 0 - 350 bar

Flow: 0,8 - 4,0 l/min

Voltage: 24 VDC

- E** Electroválulas
- F** Electro distributeurs
- D** Elektromagnetische Ventile

## Options

D03 Manifolds MB-series

144 ▶



Fittings

194 ▶



## Important

To hold the pressure in a clamping circuit, use the VEX11 valve with the VD2P check module. Do not use D03 spool valves with pressure shutdown pumps.

## Product selection

Valve flow path	Solenoid voltage 50/60 Hz	Model number	Hydraulic symbol	Pressure range bar	Pressure drop bar	Maximum oil flow l/min
4 way, 2 position	24 VDC 1,32 Amps	VEW-11		0-350	9	2,1
4/3 closed center	24 VDC 1,32 Amps	VET-11		0-350	10	2,1
4/3 float center	24 VDC 1,32 Amps	VEX-11		0-350	12	2,1
Dual flow control	—	VFC-4		0-350	—	2,6
Dual pilot operated check valve	—	VD2P		0-350	14	4,0
Pressure reducing valve	—	PRV-6 PRV-7		30-3000 5-138	—	0,8

■ VEX-11 valve on ZW5020HG-FT21 pump.





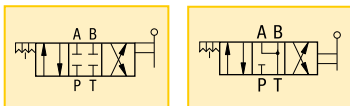
Pressure: 350 bar

Flow: 0,8 - 4,0 l/min

**E** Válvulas de control de 4 vías

**F** Distributeurs à 4 voies

**D** 4-Wege-Ventiler



## Options

**VD1P, Inline check valve**

◀ 140

**D03 Manifolds**

144 ▶



**Hoses and couplers**

192 ▶



**Fittings**

194 ▶



## Important

For multiple circuit applications, the VD1P inline check valve is recommended to prevent pressure drop on the holding circuit.

See page 145 for mounting bolt information.

Pressure on return side (tank) should not exceed 17 bar.

## Manual control of single and double-acting cylinders

- Near zero leakage pressure seal design
- 4-way, 3-position
- Detented handle positions
- Low handle effort 5 kg, even at full pressure
- Handle can be repositioned for side by side valve mounting
- Compact size for directly mounting on fixture for individual circuit control
- D03/CETOP 3 mounting pattern

Shown: VMMD-001, VMTD-001



## VMM and VMT-series

Manual directional control valves for single- and double-acting cylinder control. Lapped pressure seal surface provide near zero leakage.

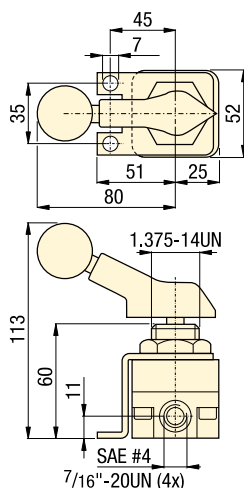
The VMTD series has threaded port connections and removable holding bracket for panel mounting.

## Application

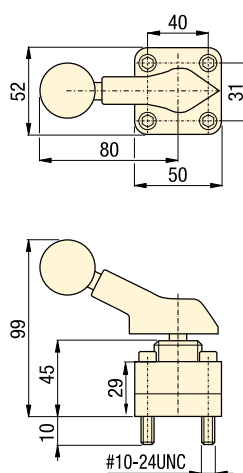
Panel mounting on fixtures for control of individual circuits. The blocked pressure port in the center position allows demand style pumps to stall out, saving energy.

The valves require check valves for positive load holding.

VMTD-001, 003



VMMD-001, -003



■ Several VMTD-001 valves mounted on fixture waiting to be transferred to machine.



## Product selection

Valve mounting pattern	Mounting bolts included	Oil ports	Model number	Hydraulic symbol	Pressure range	Pressure drop <sup>1)</sup>	Max. oil flow
					bar	bar	l/min
▼ 4-way, 3-position control valves							
Panel mtg.	—	SAE #4	VMTD-001		0-350	4,8	17
D03/CETOP 3	#10-24UN	—	VMMD-001		0-350	4,8	17
Panel mtg.	—	SAE #4	VMTD-003		0-350	4,8	17
D03/CETOP 3	#10-24UN	—	VMMD-003		0-350	4,8	17

<sup>1)</sup> Pressure drop from P-A or P-B at maximum oil flow of 17 l/min.  
Seal material: Buna-N, Polyurethane.



Shown: MB-4, MB-1



## MB-series

Single or multiple station manifolds allow installation of VSS and VST-series positive seal control valves or other D03/CETOP 3 valves. Ideal in applications where independent control of multiple cylinders is required.

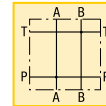
## When independent control of multiple cylinders is required

- Multi-station manifolds with SAE or CETOP 3 porting – minimizes plumbing
- Mounting patterns for:  
VSS and VST Valves (D03 or CETOP 3);  
VE Valves (D03 or CETOP 3);  
VP03 Valves (D03 or CETOP 3);  
VMMD Valves (D03 or CETOP 3)
- Manifolds allow use of accessories, such as pressure switches and gauges.

Mounting: 1 - 4 valves

Pressure: 350 bar

- E** Colectores
- F** Manifolds
- D** Verkettungsblöcke



## Options

VSS, VST-series valves

140 ▶



Pressure switches

188 ▶



Gauges and accessories

190 ▶



Fittings

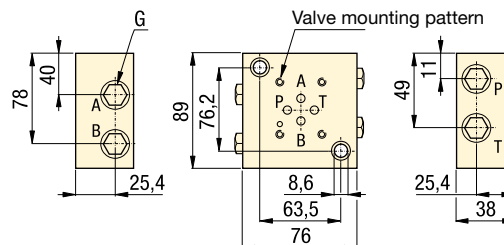
194 ▶



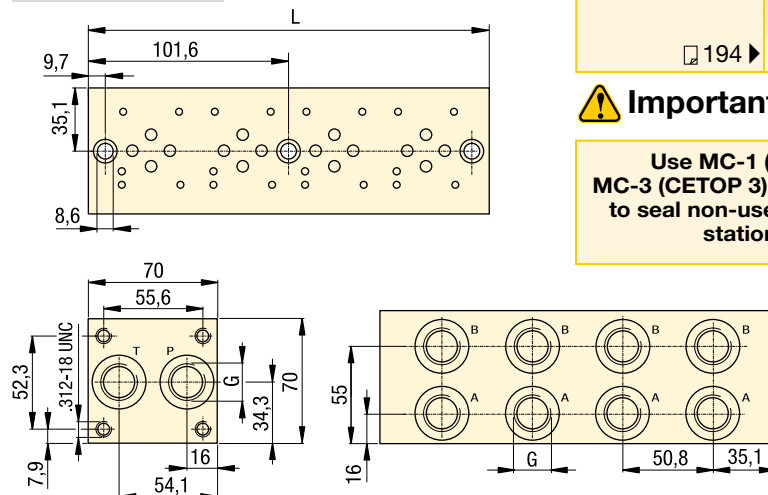
## Important

Use MC-1 (D03) or MC-3 (CETOP 3) cover plates to seal non-used manifold stations.

### MB-1, MB-12



### MB-2, -22, MB-4, -42



Each non-used valve station on manifolds must be sealed with MC-1 cover plate.



## Product selection

Valve mounting pattern	Number of valve stations	Model number	Oil ports cover plate	Coverplate model number *	Manifold	
			G		L	kg
					mm	
▼ Single station manifold						
CETOP 3	1	MB-12	G1/4"	–	–	0,5
D03	1	MB-1	SAE #4	–	–	0,5
▼ Multipler station manifolds						
CETOP 3	2	MB-22	G3/8"	MC-3	121	1,5
D03	2	MB-2	SAE #8	MC-1	121	1,5
CETOP 3	4	MB-42	G3/8"	MC-3	222	2,8
D03	4	MB-4	SAE #8	MC-1	222	2,8

\* Note: - MC-1 manifold cover plate must be ordered separately. Includes gasket and mounting bolts.



- E** Kits de fijación para válvulas
- F** Kits de montage robinet
- D** Zugstangen-Satz

## Options

**VD1P, Inline check valve**

◀ 140



**D03 Manifolds**

◀ 144



**Hoses and couplers**

192 ▶



**Fittings**

194 ▶



## Important

The mounting stud must project into the manifold a minimum of 9,5 mm. After installation, torque the stud nuts to 5 Nm.

To calculate the required stud length, add the stud length for the directional valve and each accessory module used in the valve stack. Add 20 mm to this length. The mounting studs should be cut to this total length.

## Use Stud Bolt Kits to assure the correct bolt length

- Studs are easily cut to length
- Stud nuts make installation easier
- Pre-mount the studs into the manifold to help guide the valve components into place.

Shown: BKD71, BKD72



## BKD-series

Always have the right bolt length required to mount the components in your valve stack by using these stud bolt kits.

Refer to chart to determine the required bolt length.

## Example

Description	Model number	Stud Length	
		mm	in
Directional valve	VP03-11	48	1.87
Dual flow control	VFC-4	40	1.57
Dual P.O. check	VD2P	40	1.57
Stud nut	VD2P	10	0.40
Manifold	V-19	10	0.38
<b>Total length:</b>		<b>147</b>	<b>5.79</b>

## Product selection

Description	Model number	Stud Length	
		mm	in
Imperial stud kit (#10-24) *	BKD71	—	7.00
Metric stud kit (M5) *	BKD72	178	—
▼ Valve mounting bolt lengths using stud kits			
Stud Nut	BKD71, BKD72	10	0.40
Manifold	MB1, MB2, MB3	10	0.38
Solenoid valve	VAS/VSS/VST	41	1.63
Solenoid valve	VEW/VET/VEX	32	1.25
Solenoid valve	VP03	47	1.87
Manual valve	VMMD001/VMMD003	29	1.13
Pressure Reducing Valve	PRV6/PRV7	40	1.57
Check valve, on "P"	VD1P	40	1.57
Dual P.O. check valve	VD2P	40	1.57
Dual flow control	VFC-4	40	1.57

\* Note: Stud kit includes 4 studs and 4 stud nuts



# Solenoid modular valves *Application & selection*

Shown: VEC-15600D, VEC-15000B, VEK-15000B



## VE-series

Solenoid modular valves are especially well suited for workholding and production applications.

With 11 possible flowpaths and 2 manifolds, for either Enerpac's submerged pump or a remote NPT mount, you can "custom build" a valve for almost any application.

### Application

Ideal when mounted on remote manifold for applications where independent control of multiple cylinders is required.

## Unmatched combination of possibilities

- Relief valve and pilot-operated check accessory valves are stackable eliminating external plumbing
- Remote and pump mounting
- Mounting bolts included with each modular valve.



## Select the required valve flow path

Valve flow path	For cylinder	Valve code	Hydraulic symbol
<b>▼ 2-way, 2-position (2/2)</b>			
Normally closed	Unloading *	<b>VEH</b>	
Normally open	Unloading *	<b>VEK</b>	
<b>▼ 3-way, 2-position (3/2)</b>			
Normally open	Single-acting	<b>VEP</b>	
<b>▼ 3-way, 3-position (3/3)</b>			
Tandem center	Single-acting	<b>VEF</b>	
Closed center	Single-acting	<b>VEG</b>	
<b>▼ 4-way, 2-position (4/2)</b>			
Crossover offset	Double-acting	<b>VEE</b>	
Float offset	Double-acting	<b>VEM</b>	
<b>▼ 4-way, 3-position (4/3)</b>			
Open center	Double-acting	<b>VEA</b>	
Closed center	Double-acting	<b>VEB</b>	
Tandem center	Double-acting	<b>VEC</b>	
Float center	Double-acting	<b>VED</b>	

\* VEH and VEK valve models require the use of tank port for dump or unloading.



## Product specifications

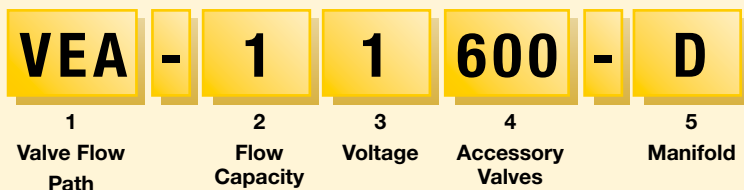
Pressure range	Maximum oil flow	Voltage @ Hz	Amperage draw	
bar	l/min		Amps inrush	Amps holding
0 - 700	15	24 VDC @ 50/60 Hz	—	2,5 A
0 - 700	15	115 VAC @ 60 Hz	3,6 A	1,0 A
0 - 700	15	220/240 VAC @ 50 Hz	1,3/1,4	0,45/0,53
0 - 700	15	230 VCA @ 60 Hz	1,8 A	0,50 A

**Note:** Seal material: Buna-N, Polyurethane.  
DIN43650 Valve plug included on remote mounted valves.



## Custom build your modular valves

▼ This is how a Solenoid Modular Valve Model Number is built up:



### 1 Modular valve code

- A = 4/3 Open center
- B = 4/3 Closed center
- C = 4/3 Tandem center
- D = 4/3 Float center
- E = 4/2 Crossover offset
- F = 3/3 Tandem center
- G = 3/3 Closed center
- H = 2/2 Normally closed
- K = 2/2 Normally open
- M = 4/2 Float offset
- P = 3/2 Normally open

### 2 Oil flow capacity

- 1 = 15 l/min

### 3 Solenoid voltage

- 1 = 24 VDC, 50 / 60 Hz
- 2 = 230 V, 1 ph, 50 Hz
- 5 = 115 V, 1 ph, 60 Hz
- 6 = 230 V, 1 ph, 60 Hz

### 4 Accessory valves

- 000 = No accessory valves
- 100 = VS-11 Relief valve only
- 150 = VS-11 Relief valve and VS-51 3-way pilot operated check valve VEF/VEG only
- 160 = VS-11 Relief valve and VS-61 4-way pilot operated check valve VEA/VEB/VEC/VED only
- 500 = VS-51 3-way pilot operated check valve VEF/VEG only
- 600 = VS-61 4-way pilot operated check valve VEA/VEB/VEC/VED only

### 5 Manifold

- A = No manifold
- B = Remote mounted manifold
- D = Pump mounted manifold VEA/VEC/VEF only

## Example

The **VEA-11600-D** is a modular valve with a 4-way, 3-position open center flowpath, 24 VDC, and an integrated pilot-operated check valve, for mounting on an Enerpac pump.

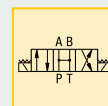
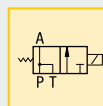
Bolt Kit **BK-2** is included.

Pressure: 0 - 700 bar

Flow: 15 l/min max.

Voltage: 24, 115, 230 V

- E** Válvulas de control
- F** Electro distributeurs
- D** Wegesitzventile



## Options

### Gauges and accessories

190 ▶



### Fittings

194 ▶



### Accessory Valves and Bolt Kits

Use **VS-11** relief valve to add system pressure control to VE-series valves.

Use **VS-51** 3-way pilot operated check valve to convert 3-way VE-valve into load-holding valve.

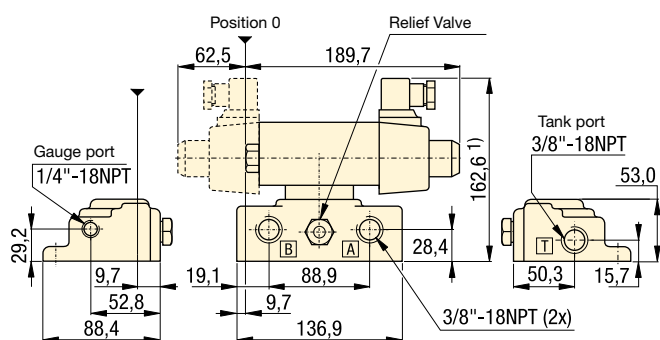
Use **VS-61** 4-way pilot operated check valve to convert 4-way VE-valve into load-holding valve.

To install accessory valves to stack build modular valves use bolt kits:

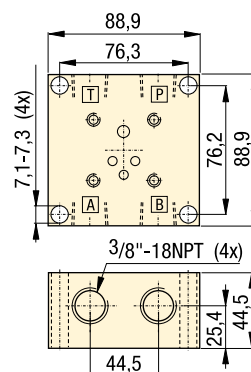
- BK-2** for 1 VS valve;
- BK-3** for 2 VS valves.

### VE series

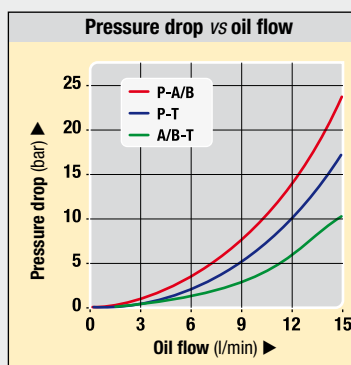
### Modular Valve Pump Mounted



### Modular Valve Remote Mounted



<sup>1)</sup> add 47 mm for each Accessory Valve.  
Note: BK-1 Bolt Kit is included with each modular valve.





# 3-way directional manual control valves *Application & selection*

Shown: VM-2, VM-3



## V-series

Manual operated 3-way, 2-position and 3-way, 3-position directional control valves for operation of single-acting cylinders. Remote mount valves include return line kit for connecting the valves to pump reservoir.

### Application

Pump mounted valves provide centralized control of pump output for cylinder cycling. Remote mounted at any convenient point along the system where control of cylinders is needed.

■ Four VC-15 Enerpac manual valves mounted on fixture to give independent control of several hydraulic circuits.



## Reliable control of single-acting cylinders

- Directional control valves provide advance/hold/retract operation for use with single-acting cylinders
- Remote or pump mounting on most Enerpac pumps
- Return line kit included with remote valves
- Available “locking” option on VC and VM-series valves for load-holding applications.

## Select the required center position

### Non-locking

- Use in simple clamping circuits. Has interflow between ports when shifted.

### Closed center

- For multiple valve and cylinder operation. All ports blocked in the center position.

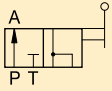
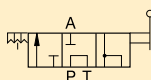
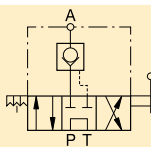
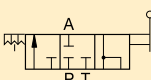
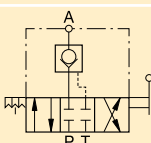
### Locking center

- For positive load holding without loss of pressure. Cylinder travel can only resume by shifting valve from hold position.

### Tandem center

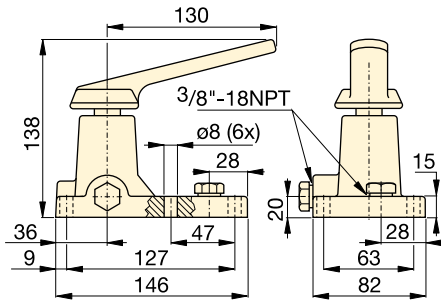
- For one or multiple cylinder operation. Pump flow is directed back to tank in the center position.

## Product selection

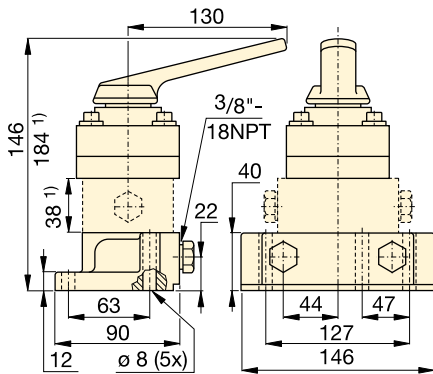
Valve type	Valve mounting location	Model number	Hydraulic symbol
▼ Manual 3-way, 2-position (3/2)			
–	Pump	VM-2	
▼ Manual 3-way, 3-position (3/3)			
Tandem center	Pump	VM-3	
Tandem center	Remote	VC-3	
▼ Manual 3-way, 3-position (3/3)			
Tandem center, locking	Pump	VM-3L	
Tandem center, locking	Remote	VC-3L	
Closed center	Remote	VC-15	
Closed center, locking	Remote	VC-15L	



### VM-2

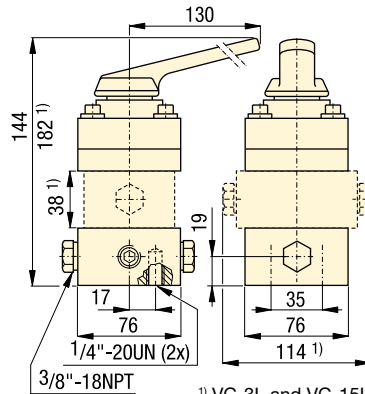


### VM-3, VM-3L



<sup>1)</sup> VM-3L only

### VC-3, VC-3L VC-15, VC-15L



<sup>1)</sup> VC-3L and VC-15L only

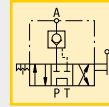
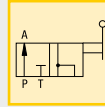
Pressure: 0 - 700 bar

Flow: 17 l/min max.

**E** Válvulas de control

**F** Distributeurs à 3 voies

**D** 3-Wege-Ventile



### Options

Gauges and accessories

190 ▶



Hoses and couplers

192 ▶



Fittings

194 ▶



### Important

#### Locking Valves


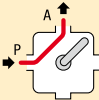
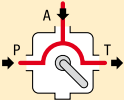
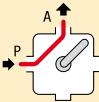
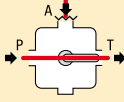
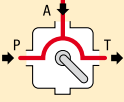
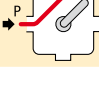
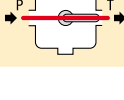

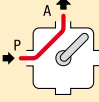
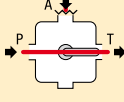
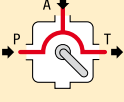
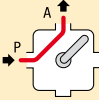
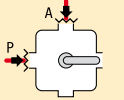
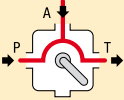
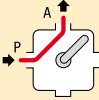
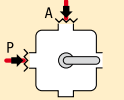
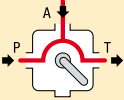
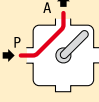
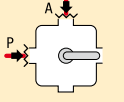
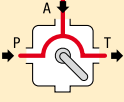
For applications that require positive load holding, most VM and VC valves are available with pilot operated check valve. This option provides hydraulic locking of the load until valve is shifted into retract position. To order this feature, place an "L" at the end of the model number.

#### Valving help

See Basic System Set-up and Valve information in our "Yellow Pages".

197 ▶

## Product specifications

Model number	Pressure range	Used for cylinder	Schematic flowpath			 kg
			bar	Advance	Hold	
▼ Manual 3-way, 2-position (3/2)						
VM-2	0-700	Single-acting		—		2,2
▼ Manual 3-way, 3-position (3/3)						
VM-3	0-700	Single-acting				2,1
VC-3	0-700	Single-acting				2,9
▼ Manual 3-way, 3-position (3/3)						
VM-3L	0-700	Single-acting				3,9
VC-3L	0-700	Single-acting				4,7
VC-15	0-700	Single-acting				2,9
VC-15L	0-700	Single-acting				4,7



# 4-way directional manual control valves *Application & selection*

Shown: VC-20, VM-4



## **V-series**

Manual operated 4-way, 3-position directional control valves for operation of double-acting or two single-acting cylinders. Remote mount valves include return line kit for connecting the valves to pump reservoir.

### **Application**

Pump mounted valves provide centralized control of pump output for cylinder cycling. Remote mounted at any convenient point along the system where control of cylinders is needed.

■ *Enerpac VC-4 manual valves mounted to control hydraulic circuit on pallet fixture*



## **Reliable control of double-acting cylinders**

- Directional control valves provide advance/hold/retract operation for use with double-acting or two single-acting cylinders
- Remote or pump mounting on most Enerpac pumps
- Return line kit included with remote valves
- Available “locking” option on VC and VM-series valves for load-holding applications

## **Select the required center position**

### **Non-locking**

- Use in simple clamping circuits. Has interflow between ports when shifted.

### **Closed center**

- For multiple valve and cylinder operation. All ports blocked in the center position.

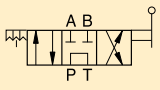
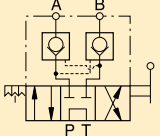
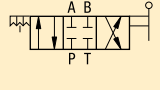
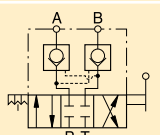
### **Locking center**

- For positive load holding without loss of pressure. Cylinder travel can only resume by shifting valve from hold position.

### **Tandem center**

- For one or multiple cylinder operation. Pump flow is directed back to tank in the center position.

## **Product selection**

Valve type	Valve mounting location	Model number	Hydraulic symbol
<b>▼ Manual 4-way, 3-position (4/3)</b>			
Tandem center	Pump	<b>VM-4</b>	
Tandem center	Remote	<b>VC-4</b>	
Tandem center, locking	Pump	<b>VM-4L</b>	
Tandem center, locking	Remote	<b>VC-4L</b>	
Closed center	Remote	<b>VC-20</b>	
Closed center, locking	Remote	<b>VC-20L</b>	
			



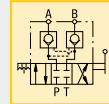
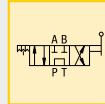
Pressure: 0 - 700 bar

Flow: 17 l/min max.

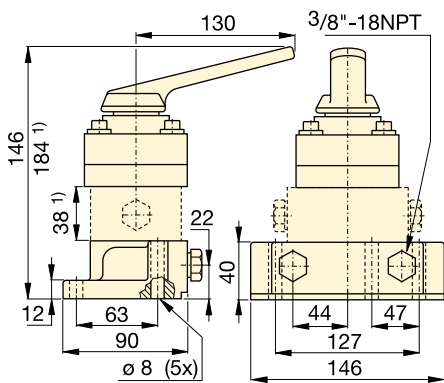
**E** Válvulas de control

**F** Distributeurs à 4 voies

**D** 4-Wege-Ventile

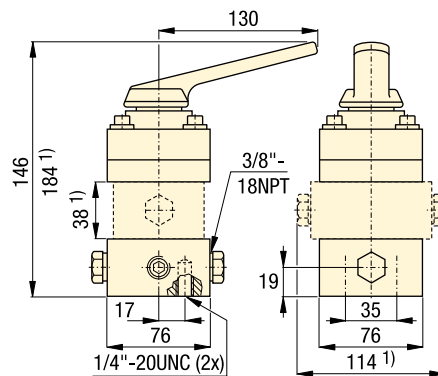


VM-4, VM-4L



<sup>1)</sup> VM-4L only

VC-4, VC-3L  
VC-20, VC-20L



<sup>1)</sup> VC-4L and VC-20L only

## Options

Gauges and accessories

190 ▶



Hoses and couplers

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Fittings

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## Important

### Locking Valves


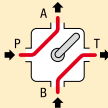
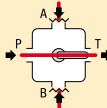
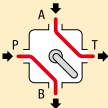
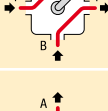
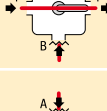
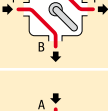
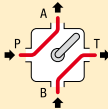
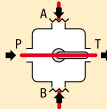
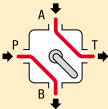
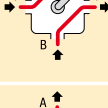
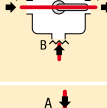
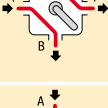
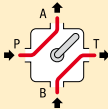
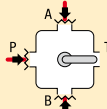
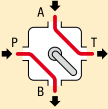
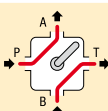
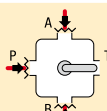
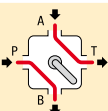
For applications that require positive load holding, most VM and VC valves are available with pilot operated check valve. This option provides hydraulic locking of the load until valve is shifted into retract position. To order this feature, place an "L" at the end of the model number.

### Valving help

See Basic System Set-up and Valve information in our "Yellow Pages".

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## Product specifications

Model number	Pressure range	Used for cylinder	Schematic flowpath			
	bar		Advance	Hold	Retract	kg
▼ Manual 4-way, 3-position (4/3)						
VM-4	0-700	Double-acting				2,1
VC-4	0-700	Double-acting				2,9
VM-4L	0-700	Double-acting				3,9
VC-4L	0-700	Double-acting				4,7
VC-20	0-700	Double-acting				2,9
VC-20L	0-700	Double-acting				4,7



Shown: WVP-5, MVPM-5



## Sequence valves

Sequence valves block the oil to a secondary hydraulic circuit until pressure in the primary circuit reaches a preset level.

The sequence valves have a built-in check system to allow the oil to flow back without external piping.

Pressure settings for the V-2000 can be adjusted by screwing the slotted pin in or out. The pressure settings for the other models is adjusted by loosening the jam nut and turn the set screw to reach your setting.

## Application

The sequence valves can be mounted in-line or fixture mounted using mounting bolts.

A typical application for the sequence valve would be to build pressure within work supports before the swing cylinders are applied to the supported part, to prevent deflection in the part.

■ Two WVP-5 sequence valves used in conjunction with Enerpac MCA-series Auto Coupler to provide system automation.



## Pressure dependent sequence control

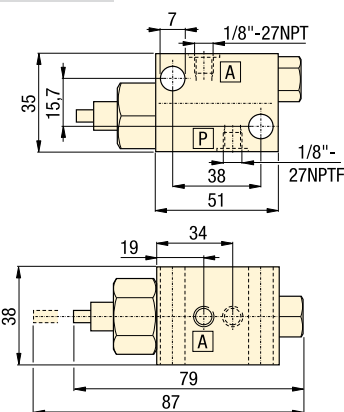
### MVPM-5, WVP-5, MVPC-5

- Direct accurate pressure setting
- Pressure setting between 35-350 bar for secondary circuit is secured with lock nut
- Mounting holes on WVP-5, manifold mounting ports on MVPM-5
- MVPC-5 features cartridge body

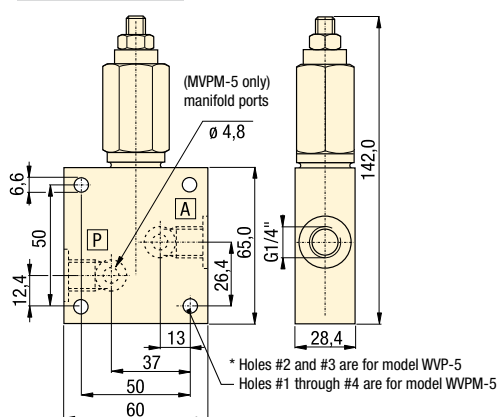
### V-2000

- Direct accurate pressure setting
- Pressure setting between 14-140 bar for secondary circuit
- Flag indicator appears everytime the valve is operated

### V-2000



### MVPM-5, WVP-5



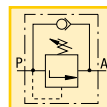
Pressure: 350 bar

Flow: 4 - 10 l/min

E Válvulas de secuencia

F Valve de séquence

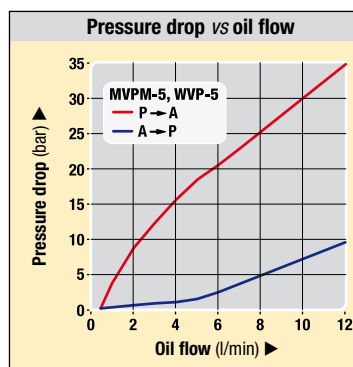
D Folgeventil



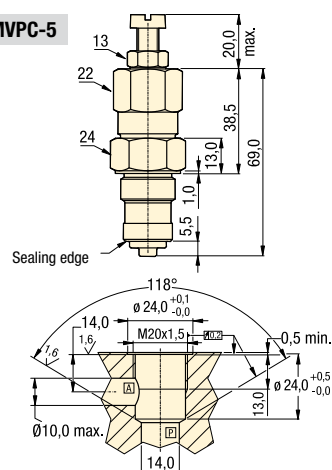
## Options

### Gauges and accessories

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### MVPC-5



## Product selection

Pressure adjustment range	Maximum pressure	Maximum oil flow	Model number	Oil ports	Opening pressure check valve	A	
bar	bar	l/min			bar	mm	kg
14 - 140	350	4,0	V-2000	1/8"-27 NPTF	—	—	0,9
35 - 350	350	10,0	MVPC-5	—	0,7	—	0,2
35 - 350	350	6,0	MVPM-5	G 1/4"	1,4	28,5	1,3
35 - 350	350	6,0	WVP-5	SAE #4	1,4	24,9	0,8

Seal material: Buna-N.

Manifold O-rings included with MVPM-5. For manifold mounting installation information consult Enerpac for surface preparation.



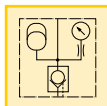
Pilot ratio: 7:1

Flow: 38 l/min max.

**E** Válvulas antiretorno pilotada

**F** Clapets antiretour piloté

**D** Rückschlagventile



## To hold cylinder load and ensure remote unlocking

- Fast check-off response
- Hardened seats ensure long life and positive pressure holding
- Built-in accumulator to maintain system pressure
- Mounting holes
- Manifold mount body MVM-72

Shown: MV-72

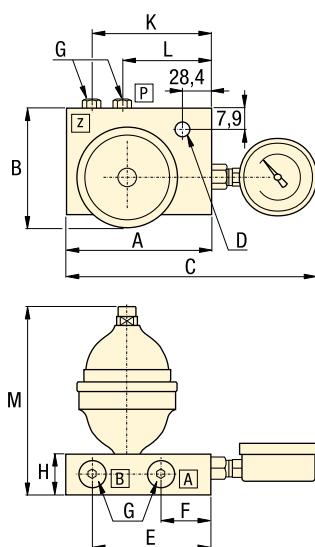


## Product selection

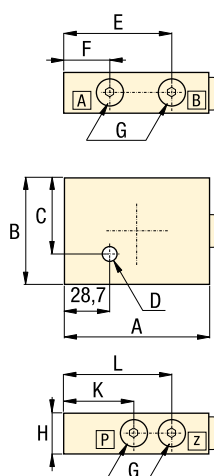
Pilot ratio	Accumulator included	Maximum oil flow l/min	Maximum pressure bar	Model number	Oil ports	Optional charging tool for ACL	kg
7 : 1	–	38	350	MV-72	G 1/4"	–	1,8
7 : 1	ACL-22	38	350	MV-722B	G 1/4"	WAT-2	2,7
7 : 1	ACL-202	38	350	MV-7202B	G 1/4"	WAT-2	3,4
7 : 1	–	38	350	MVM-72	G 1/4"	–	1,4

For more information on ACL-series Accumulators see page 124.

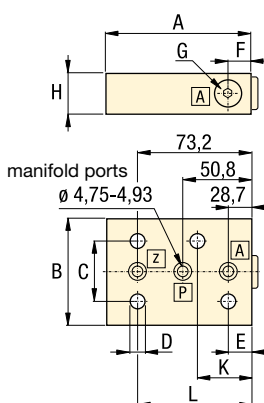
### MV-722B, -7202B



### MV-72



### MVM-72



**A** = Cylinder advance

**B** = Cylinder retract

**P** = Pressure

**Z** = Pilot

## Product dimensions in mm [ ]

Model number	A	B	C	D	E	F	G	H	K	L	M
MV-72	89,0	63,5	55,6	7,1	73,2	28,7	G1/4"	31,8	50,8	73,2	–
MV-722B	89,0	71,1	184,2	7,1	73,2	28,4	G1/4"	31,8	73,2	50,8	145
MV-7202B	89,0	92,4	181,1	7,1	73,2	28,4	G1/4"	31,8	73,2	50,8	185
MVM-72	89,0	63,5	38,1	7,1	28,7	28,4	G1/4"	31,8	44,5	73,2	–

Seal material: Buna-N.

Manifold O-rings included with MVM-72. For manifold mounting installation information consult Enerpac for surface preparation.



### MV-series

Pilot operated check valves check the oil flow with a built-in pilot circuit providing fast, automatic check-off for your workholding applications.

The pilot operated check valves with built-in accumulator help to maintain system pressure due to minor oil loss.

### Application

Added capability to open with pilot pressure to allow cylinders to retract. By using a pilot operated check valve, cylinder retraction can be accomplished automatically without operator activity.



### Options

#### Fittings

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Shown: PRV-3



## PRV series

These valves regulate system pressure for all subsequent valves, according to the adjusted pressure. Maintains a constant pressure in a secondary circuit. Includes a check valve that prevents pressure drop on secondary side.

### Application

Used when a hydraulic supply with a higher pressure (primary side) must also be used for another circuit with a lower pressure (secondary circuit).

The PRVM-2 manifold can be manifold mounted or plumbed with tubing. The PRV-8 and PRV-9 use this manifold to provide a pre-assembled valve. PRV-3 and 4 are for remote mounting. The cartridge from PRV-3 and 4 can be removed from manifold for direct integration into gundrilled fixture. Order the cartridge separately as PRV-3T or PRV-4T.

## Precise control of hydraulic pressure

- Tool adjustable knob can be locked
- Precise control of pressure
- G1/4" oil connection
- Remote mount
- PRVM-2 manifold has both 1/4" BSPP and manifold ports
  - Gauge port- 1/8" NPT

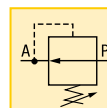
Pressure: 350 bar

Flow: 7 l/min

**E** Válv. reguladora de presión

**F** Valve de pression réglable

**D** Druckreduzierventil



## Options

### Gauges

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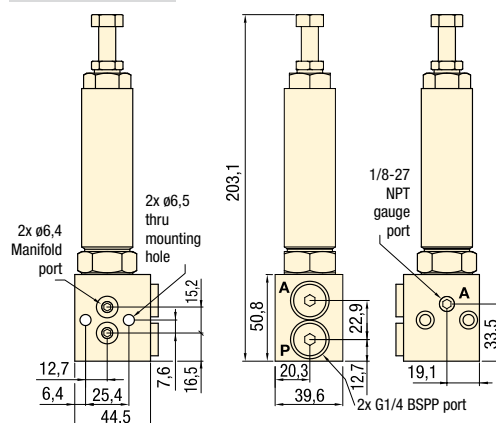


### Fittings

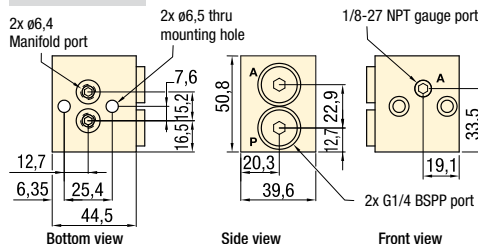
194 ▶



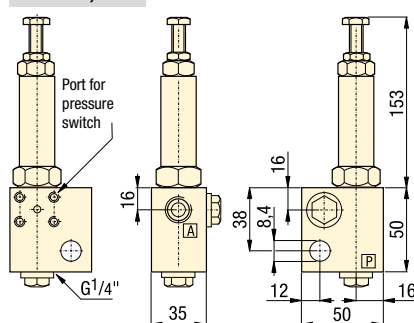
### PRV-8, 9



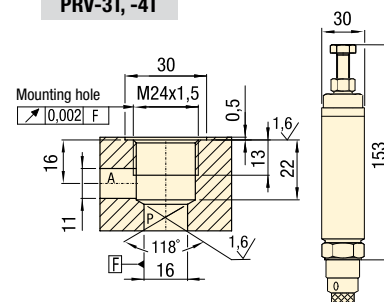
### PRVM-2



### PRV-3, -4



### PRV-3T, -4T



## Product selection

Mounting style	Adjustable pressure range	Maximum pressure	Model number	Oil ports	Maximum oil flow	
	bar	bar		BSPP	l/min	kg
Remote	30 - 300	350	PRV-3	G1/4"	7	1,3
Cartridge	30 - 300	350	PRV-3T	–	7	0,7
Remote	5 - 130	350	PRV-4	G1/4"	7	1,3
Cartridge	5 - 130	350	PRV-4T	–	7	0,7
Remote	30 - 300	350	PRV-8	G1/4"	7	1,1
Remote	5 - 138	350	PRV-9	G1/4"	7	1,1
Remote	–	350	PRVM-2	G1/4"	7	0,6



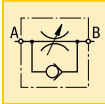
**Max. Flow: 38 l/min**

**Pressure: 0 - 350 bar**

**E** Válv. reguladoras de caudal

**F** Valves de control débit

**D** Stromregelventile



## Regulate the flow of oil

- Poppet valve design for zero leakage
- Color coded flow indicator
- Free flow return
- Fine metering capability
- Lockable
- Standard Viton seals

Shown: VFC-1



## Options

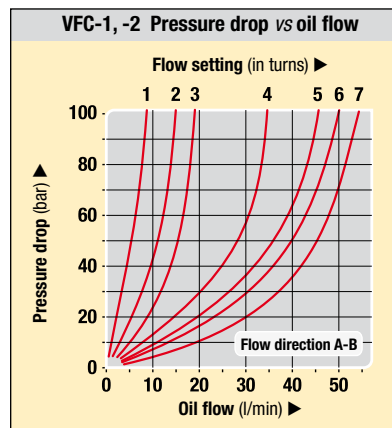
### Fittings

194 ▶

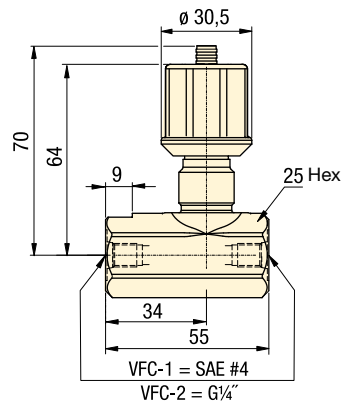


### High pressure filters

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### VFC-1, -2



## Product selection

Maximum oil flow	Pressure range	Oil ports	Model number	Flow path	Maximum pressure drop	
l/min	bar				bar	kg
▼ Flow control valves						
38	0-350	SAE#4	VFC-1		105	0,8
38	0-350	G 1/4"	VFC-2		105	0,8

Seal material: Viton



### VFC-series

Provide repeatable oil flow control. The internal check valve allows metered flow in one direction and free flow in the opposite direction. Precise control is achieved with a micro-meter style adjustment knob, which can be locked with the set screw.

### Application

Use VFC-series flow control valves in-line with the Enerpac WE-series workholding pump to protect your components from damage due to high flow rates.

■ In-line installation of a VFC-1 flow control valve.





# Accessory valves *Application & selection*

Shown: HV-1000A, V-17, V-10, V-12, V-152



## Accessory valves

Enerpac accessory valves are available in a wide variety and many configurations to control hydraulic pressure or oil flow. These valves are used in conjunction with other valves and system components to provide full automation and control.

### Application

Accessory valves are used to automate clamp cycles, prevent pressure loss and provide additional operator and component safety.

## Your hydraulic control solution

- Regulate oil flow or system pressure
- All valves feature NPT or SAE porting to insure against leakage at rated pressure
- Can easily be installed in any system
- All valves are painted, coated or plated for corrosion resistance.

## Product selection

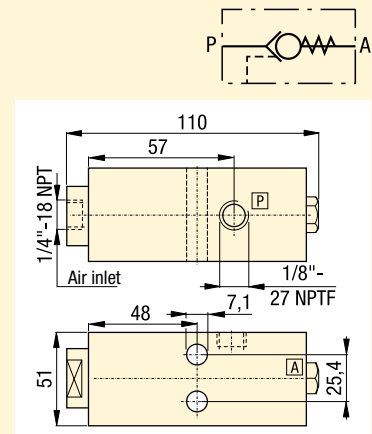
Valve type	Maximum pressure	Model number	Oil ports
	bar		
Holding valve, air pilot	200	<b>HV-1000A</b>	1/8" NPTF
Holding valve, modular	200	<b>MHV-1</b>	1/8" NPTF
Pressure limiting valve	200	<b>PLV-40013B</b>	1/8" NPTF
Manual shut-off valve	350	<b>V-12</b>	SAE #4
Auto-damper valve	700	<b>V-10</b>	1/2" NPTF
Safety check valve	700	<b>V-17</b>	3/8" NPTF
Pressure relief valve	700	<b>V-152</b>	3/8" NPTF

## Product specification

### HV-1000A

#### Air pilot holding valve

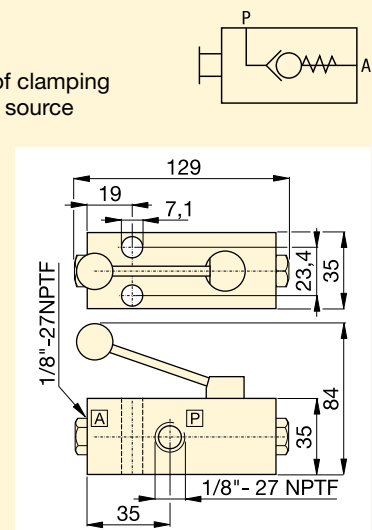
- Holds fluid under pressure offering independent control of different branches of the same fixture
- Valve can control the pilot air and the booster in sequence
- Max. oil flow 5 l/min
- Works with the VA-42 four-way air valve and a booster.



### MHV-1

#### Modular holding valve

- Allows separate operation of clamping fixtures with a single power source
- Ideal for applications when fluid feed lines are impractical. If system pressure is interrupted, the MHV-1 will hold the pressure beyond the valve.
- Max. oil flow 5 l/min
- To release system pressure, rotate valve handle in either direction 90° to release and retract system pressure.



■ V-17 Safety check valve installed on a fixture.

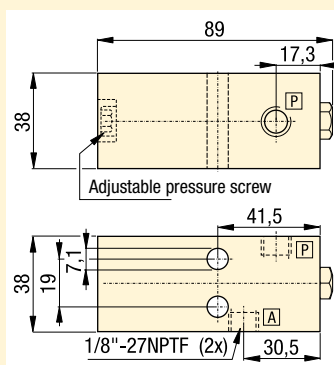
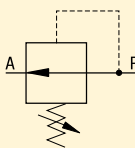




## PLV-40013B

### Pressure limiting valve

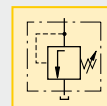
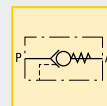
- Allows precise control of pressures reaching specific clamps
- When pressure build-up reaches a preset level, the valve closes, stabilizing pressure to that section of the fixture
- Pressure adjustment between 14-103 bar
- Max. oil flow 5 l/min.



Pressure: 0 - 700 bar

Flow: 5 - 30 l/min max.

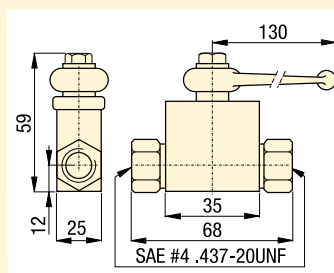
- E** Válvulas de control
- F** Valves de contrôle
- D** Regelventile



## V-12

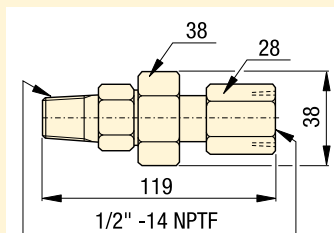
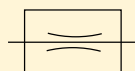
### Manual shut-off valve

- Ball type valve can be used for the master system shut-off or for isolating separate circuits on a fixture
- Viton seals standard
- Straight through design for easy system plumbing and installation
- Fully open allows high flow return of oil
- Max. oil flow 12 l/min.



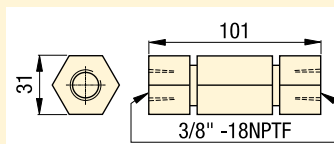
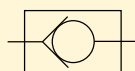
## V-10 Auto-damper valve

- To protect gauge during high cycle applications
- Creates a flow resistance when load is released suddenly
- No adjustments are necessary
- Fits directly into GA-series gauge adaptor.



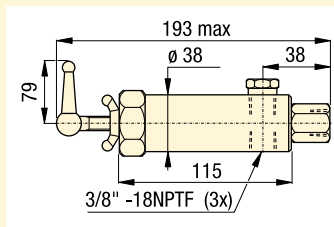
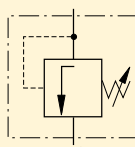
## V-17 Safety check valve

- Ruggedly built to resist shock and operate with low pressure drop
- Closes smoothly without pounding
- Max. oil flow 30 l/min.



## V-152 Pressure relief valve

- Limits pressure developed by the pump in hydraulic circuit, thus limiting the force imposed on other components
- 55-700 bar adjustment range;  $\pm 3\%$  repeatability
- Valve opens whenever preset pressure is reached. To increase pressure setting, turn handle clockwise
- Max. oil flow 30 l/min
- Includes 1 meter return line hose kit.



## Options

### VA-42 Air valve

158 ▶



### Gauges and adaptors

190 ▶



### Hoses and couplers

192 ▶



### Fittings

194 ▶



## Important

**Valving help**  
See Basic System Set-up and Valve information in our "Yellow Pages".

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Shown: VA-42, VAS-42



## Air valves

Enerpac's line of directional air valves and accessories complete your workholding system. Used to control air operated hydraulic units, they increase your productivity and efficiency.

## Application

VA-series directional air valves provide either manual or electric control to air operated hydraulic units. Accessories such as rapid exhaust, check valves, silencers and regulators complete the air control system.

- Accessory valves provide greater safety and more efficient clamping cycles
- Recommended for use with all air powered units
- Directional valves to control booster and pump air supply
- Remote air valve permits either hand or foot operation



## Important

**Valving help**  
See Basic System Set-up  
and Valve information in our  
"Yellow Pages".

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## To control and regulate air supply

### VA-42 Manual operated air valve 5-way, 2-position

- For control of boosters
- Viton seals standard

### VAS-42 Solenoid operated air valve 5-way, 2-position

- For control of pump and boosters air supply
- Viton seals standard
- Solenoid: 120 VAC, 50/60Hz  
Amperage: inrush .11 Amps, holding .07 Amps
- Maximum cycle rate: 600 cycles per minute

### VR-3 Rapid exhaust valve

- Enables booster to advance and retract faster
- Instantly exhausts air supply from booster to atmosphere

### V-19 Air check valve

- Prevent rapid drop of air pressure to the booster in the event of sudden loss of input air

### RFL-102 Regulator-Filter-Lubricator

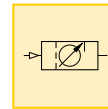
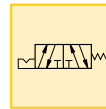
- Regulates air pressure
- Filter air input
- Lubricates air motors with a fine oil vapor mist
- Maximum air flow 1360 l/min

### QE-375 Muffler

- Use with VR-3 or VAS/VA-42
- Reduces noise level of exhaust air from pump.

Air Pressure: 0 - 10 bar

- E** Válvulas de aire
- F** Valves à air
- D** Luftventile



## Options

### Gauges and adaptors

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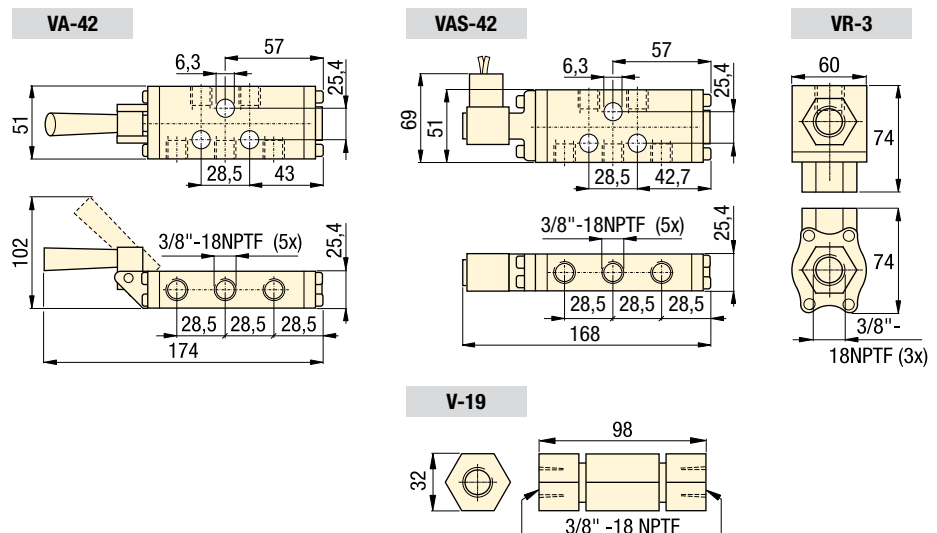
### Hoses and couplers

192 ▶



### Fittings

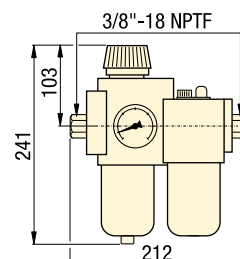
194 ▶



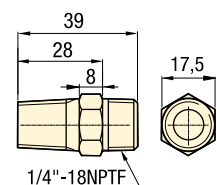
## Product selection

Maximum pressure bar	Model number
▼ Air valves	
2-10	VA-42
2-10	VAS-42
0-7	VR-3
0-7	V-19
▼ Accessories	
0-9	RFL-102
0-9	QE-375

### RFL-102



### QE-375

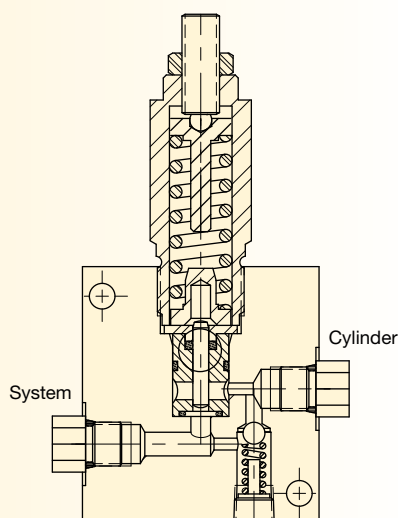




## Valve Cutaways

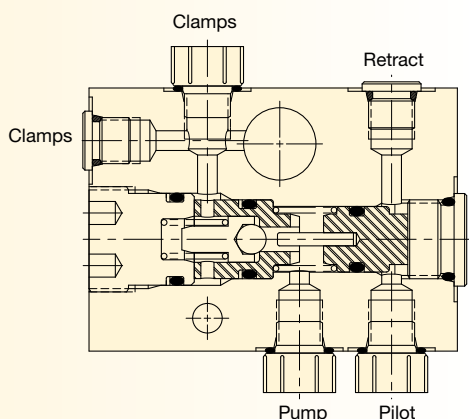
### MVPM-5

The opening point is set by the adjustment spring. Incoming pressure is blocked by the valve spindle in the orifice plate. When opening pressure is reached, the spindle is pushed up until fluid will pass. The system pressure level is maintained as pressure builds in the downstream circuit. Reverse flow is through a reverse check valve.



### V-72

System pressure enters through the "Pump" port, flows through the check seat and past the check valve into the cylinder circuit. When system pressure drops, the check ball closes off the seat, blocking flow. To release the cylinder pressure, the "Pilot" port is pressurized, and the pilot piston pushes the check ball off of the seat, allowing reverse flow.



### PRV-3

A check ball is held off of the check seat by a spring loaded spindle. The spring setting determines the closing point of the valve. As pressure builds in the cylinder side of the circuit, the spindle is lifted, and the check seats. Closing off further flow through the valve provides a reduced pressure to the cylinder.

