



# HAWE Products

Our current product range



Solutions for a World under Pressure

**HAWE**  
HYDRAULIK

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# Introduction

HAWE Hydraulik develops and produces hydraulic components and solutions for many sectors of the machine engineering and plant engineering industries. Fixed and variable displacement pumps, hydraulic power packs, hydraulic pumps, valves, hydraulic accessories and electronic components. The consistent modular system enables quick reaction to customer wishes and the assembly of tailor-made solutions from standard products. Due to a flexible production system, the manufacture and assembly of large quantities is just as possible as a batch size of 1.

The service range includes advice, project planning, comprehensive documentation, construction of prototypes, manufacture and assembly of various quantities, installation, maintenance and service.

All pressurised parts are made of steel. Pressures of up to 700 bar are possible, which above all makes application in mid-pressure ranges particularly safe and long lasting.

Sustainable solutions are a part of the corporate responsibility of HAWE Hydraulik. This is how the company has been operating for years with certified environmental and energy management, and has been systematically implementing occupational safety and health protection. Since 2011, HAWE Hydraulik has been a member of Global Compact, an initiative of the United Nations, thus clearly demonstrating its respect for human rights and labour standards and its commitment to environmental protection and the fight against corruption.

The family-run company HAWE Hydraulik was founded in 1949 and today is comprised of 2,200 employees in the headquarters in Munich, in seven production sites as well as five sales offices in Germany and 14 international subsidiaries. Approximately 30 sales partners in many countries around the globe support the worldwide sales.

In addition to this product overview, further technical information sheets on the individual components are available. To optimise the selection, configuration and specification of the products, HAWE sales staff will be glad to be of assistance (contact details in "Addresses of offices and representatives" attached or [info@hawe.de](mailto:info@hawe.de)).

Headquarters Munich



HAWE plant in Freising



HAWE plant in Dorfen



**HAWE plant in Kaufbeuren**

**HIGH VERTICAL RANGE OF  
MANUFACTURE ENSURES THE  
HIGHEST LEVEL OF QUALITY**



**HAWE plant in Sachsenkam**



All dimensions in mm, subject to change!

# Our vertical range of manufacture ensures superior quality!

## Efficiency:

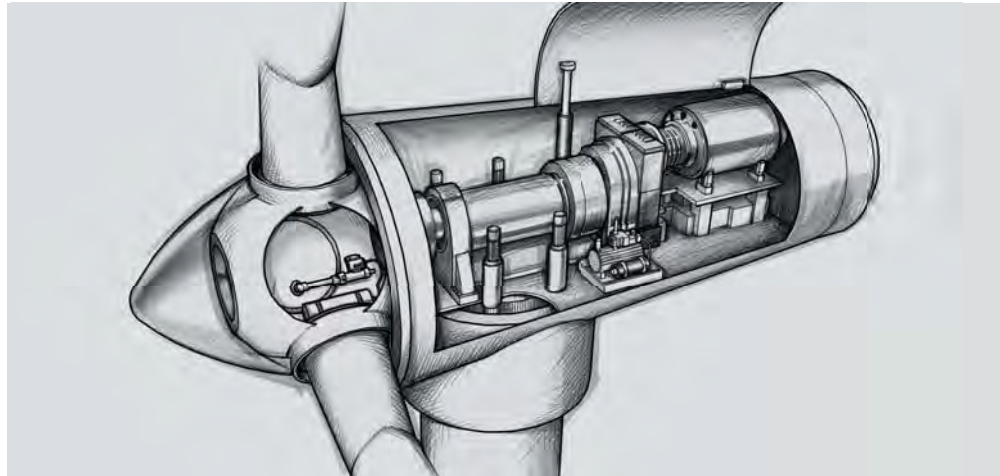
### Example: Machine tools

- Compact hydraulic power packs with small tank capacity
- Zero leakage directional seated valves instead of directional spool valves
- Accumulator charged operation with idle pump circulation

### Example: Truck mounted cranes

- Variable displacement axial piston pumps with clever controller technique
- Well-engineered Load-Sensing systems
- Quick response and directional spool valves with minimized leakage

HAWE Proportional directional spool valve:  
Sensible and powerful fine adjustability for all mobile application with a maximum of robustness. Also in harsh environments and up to 420 b



## Flexibility:

### Example: Tractors for logging and agriculture

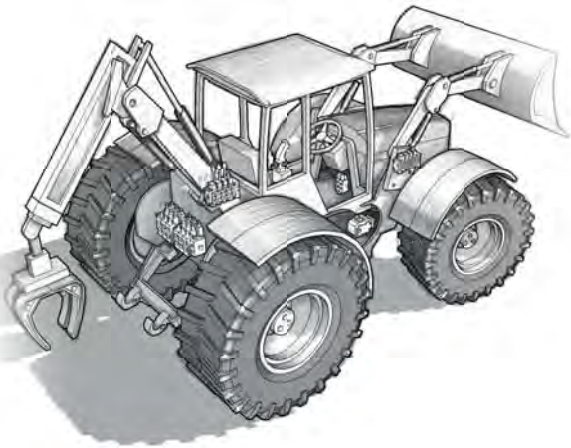
- Accurate controls that can be easily customized and extended
- One product covering all functions (boom, supports, steering etc.)
- Various sizes can be combined, additional function can be integrated

### Example: Food processing

- Versatile, compact hydraulic power packs
- AC or DC-drive for low and high pressure applications
- All required functions can be implemented via directly mounted modular valve banks

We offer a wide range of various directional seated valves to ensure a safe and powerful functionality of your machine.






## Reliability:

### Example: Wind energy plants

- Sturdy long-lived components ensure long service life
- Modular design eases maintenance
- Hydraulic controls also for severe ambient conditions (hot, cold, moist, etc.)

### Example: Construction machines

- Well proven systems consisting of pump, hydraulic controls, over-center valve and electronics
- Modular electronic controls perfectly fitting the hydraulics
- Various approved solutions for oscillation dampening



We provide with our compact hydraulic power packs energy efficient solutions for brake controls.

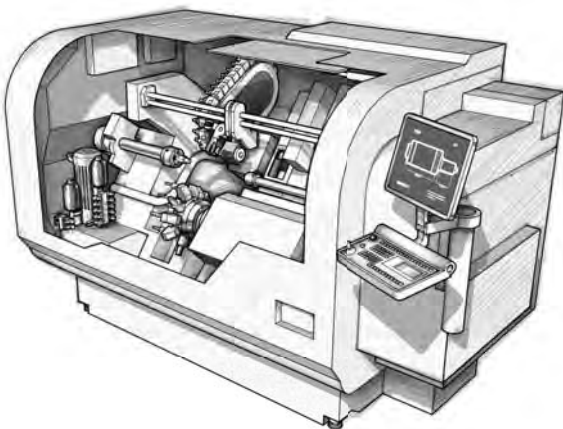
## Technology:

### Example: Tools with hydraulic drive

- High power density via compact design
- Wide range of modular high pressure components (max. 700 bar)
- Two-stage pumps efficiently generate the necessary working pressure

### Example: Hydraulic presses

- Hydraulic power controlled reliable and smooth
- Decentralized hydraulic controls via compact hydraulic power packs
- Various solutions for synchronous operation



# SOLUTIONS FOR A WORLD UNDER PRESSURE

## 1.1 Single pumps

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*Radial piston pump  
type R and RG*



*Variable displacement  
axial piston pump  
type V60N*



## Radial piston pumps

Type	Nomenclature/version	Features	$p_{\max}$ (bar)	$V_{\max}$ (cm <sup>3</sup> /rev.)
R, RG, RZ	<b>Radial piston pump / Dual-stage pump</b> <ul style="list-style-type: none"> <li>▪ Single pump</li> <li>▪ Motor pump</li> <li>▪ Hydraulic power pack</li> </ul>	<b>Features and benefits:</b> <ul style="list-style-type: none"> <li>▪ High level of efficiency</li> <li>▪ Compact design</li> <li>▪ Max. 14 separate pressure outlets</li> <li>▪ Available from the modular product range as a hydraulic power pack with valve banks</li> </ul>	R 7631: 700  R, RG 6010: 700 R, RG 6011: 700 R, RG 6012: 700 R, RG 6014: 700 R, RG 6016: 700  HP/LP RZ 7631: 700/200 RZ 6910: 700/200 RZ 6911: 700/200 RZ 6912: 700/200 RZ 6914: 700/200 RZ 6916: 700/200	R 7631: 1.59  R, RG 6010: 4.58 R, RG 6011: 10.7 R, RG 6012: 21.39 R, RG 6014: 42.78 R, RG 6016: 64.18  RZ 7631: 1.59/7.9 RZ 6910: 4.58/26 RZ 6911: 10.7/89.6 RZ 6912: 21.39/89.6 RZ 6914: 42.78/89.6 RZ 6916: 64.18/89.6

## Axial piston pumps

Type	Nomenclature/Design	Features	$P_{\max}$ (bar) (Operation/Peak)	$V_{\max}$ (cm <sup>3</sup> /rev.)
V30D	<b>Variable displacement axial piston pump</b> <ul style="list-style-type: none"> <li>Single pump</li> <li>Pump combination</li> </ul>	<b>Features and benefits:</b> <ul style="list-style-type: none"> <li>Low-noise emissions</li> <li>Wide controller options</li> <li>Full torque available at the second pump in tandem pump applications</li> </ul>	045: 350/420 075: 350/420 095: 350/420 115: 250/300 140: 350/420 160: 250/300 250: 350/420	045: 45 075: 75 095: 95 115: 115 140: 140 160: 160 250: 250
V30E	<b>Variable displacement axial piston pump</b> <ul style="list-style-type: none"> <li>Single pump</li> <li>Pump combination</li> </ul>	<b>Features and benefits:</b> <ul style="list-style-type: none"> <li>Low noise emissions</li> <li>Wide controller options</li> <li>Full torque available at the second pump in tandem pump applications</li> </ul>	095: 350/420 160: 350/420 270: 350/420	095: 95 160: 160 270: 270
V80M	<b>Variable displacement axial piston pump</b> <ul style="list-style-type: none"> <li>Single pump</li> <li>Pump combination</li> </ul>	<b>Features and benefits:</b> <ul style="list-style-type: none"> <li>High speed</li> <li>High nominal pressure</li> <li>Less installation space</li> <li>Full torque available at the second pump in tandem pump applications</li> </ul>	200: 400/450	200: 202
V60N	<b>Variable displacement axial piston pump</b> <ul style="list-style-type: none"> <li>Single pump</li> <li>Pump combination</li> </ul>	<b>Features and benefits:</b> <ul style="list-style-type: none"> <li>Optimized power-to-weight ratio</li> <li>High self-suction speed</li> <li>Wide controller options</li> </ul>	060: 350/400 090: 350/400 110: 350/400 130: 400/450	060: 60 090: 90 110: 110 130: 130
V40M	<b>Variable displacement axial piston pump</b> <ul style="list-style-type: none"> <li>Single pump</li> <li>Pump combination</li> </ul>	<b>Features and benefits:</b> <ul style="list-style-type: none"> <li>Optimized power-to-weight ratio</li> <li>High self-suction speed</li> <li>Different shaft and flange versions</li> </ul>	028: 250/320 045: 380/400	028: 28 045: 46
K60N	<b>Fixed displacement axial piston pump</b> <ul style="list-style-type: none"> <li>Single pump</li> </ul>	<b>Features and benefits:</b> <ul style="list-style-type: none"> <li>Good performance/weight ratio</li> <li>High self-suction speed</li> <li>Different shaft and flange versions</li> </ul>	012: 400 017: 400 025: 400 034: 400 047: 400 064: 400 084, 984: 400 108, 9108: 400	012: 12.6 017: 17.0 025: 25.4 034: 34.2 047: 47.1 064: 63.5 084, 984: 83.5 108, 9108: 108

### Air-driven hydraulic pumps

Type	Nomenclature/Design	Features	$p_{max}$ (bar)	$V_{max}$ (cm <sup>3</sup> /stroke)
LP	<b>Air-driven hydraulic pump</b> <ul style="list-style-type: none"> <li>▪ Single pump</li> <li>▪ Hydraulic power pack</li> </ul>	<b>Features and benefits:</b> <ul style="list-style-type: none"> <li>▪ High operating pressures</li> <li>▪ Suitable for explosion-proof systems and equipment</li> <li>▪ No electrical energy</li> <li>▪ Hydraulic power packs with direct valve mounting</li> </ul>	80: 700 125: 1500 160: 1500	80: 6.00 125: 28.30 160: 28.30

### Hand pumps

Type	Nomenclature/Design	Features	$p_{max}$ (bar)	$V_{max}$ (cm <sup>3</sup> /stroke)
H, HE, HD	<b>Hand pump</b> <ul style="list-style-type: none"> <li>▪ single-acting</li> <li>▪ double-acting</li> </ul>	<b>Features and benefits:</b> <ul style="list-style-type: none"> <li>▪ Sturdy design</li> <li>▪ Hand pumps with integrated tank</li> <li>▪ Safety and drain valve</li> </ul>	H - 16: 350 H - 20: 220 H - 25: 150  HE - 3: 800 HE - 4: 600  HD - 13: 350 HD - 20: 220 HD - 30: 150	H - 16: 6.00 H - 20: 9.40 H - 25: 14.70  HE - 3: 3.00 HE - 4: 4.00  HD - 13: 13.00 HD - 20: 20.00 HD - 30: 30.00

# Individual pumps

## 1.1 Radial piston pump type R, RG and RZ

Radial piston pumps are a type of hydraulic pump. They consist of valve-controlled pump cylinders that are arranged radially.

The radial piston pump type R, RG and RZ has a closed pump housing. Therefore, besides use as a motor pump outside an oil tank, installation in the container of a hydraulic power pack is also possible. The radial piston pump is available with several pressure outlets which enable the same or several different volumetric flows. Type RZ is a classic dual-stage pump consisting of a radial piston pump and a gear pump. The radial piston pump type RG has plain bearings which have a longer storage life. This type is therefore used in extreme operating conditions.

Extremely high volumetric flows can be achieved by arranging up to 6 radials in parallel. When the radial piston pump is used in the hydraulic power pack, it is suitable for use as a highly compact control system. Connection blocks and valve banks can be mounted on the cover plate of the hydraulic power packs.

### Features and benefits:

- High level of efficiency
- Compact design
- Max. 14 separate pressure outlets
- Available from the modular product range as a hydraulic power pack with valve banks

### Intended applications:

- Press construction
- Jig construction
- Testing and laboratory devices
- Lubricating systems



<b>Nomenclature:</b>	not possible Radial piston pump
<b>Design:</b>	Single pump; dual-stage pump
<b>p<sub>max</sub>:</b>	700 bar
<b>Q<sub>max</sub>:</b>	91.2 lpm (V <sub>g</sub> = 64.18 cm <sup>3</sup> /rev)

### Design and order coding example

RZ 0,9 / 2 - 16

Sizes Delivery flow gear pump [lpm]

Basic type, delivery flow [lpm]

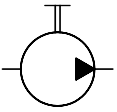
- Type R (version with roller bearing)
- Type RG (version with plain bearing)
- Type RZ (dual-stage pump)

### Additional versions:

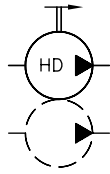
- With several pressure ports
- With separate ports for the flow of one or two pump elements (Q<sub>max</sub> = 4,4 lpm)  
e.g. as control oil supply

## Function

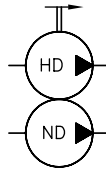
Single pump type R and RG



Single pump type RZ  
only high-pressure section,  
low-pressure section is  
installed by customer



Single pump type RZ  
High and low-pressure section

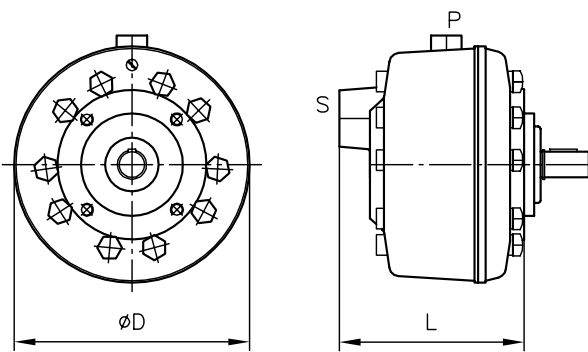


Pump with several pressure  
outlets (example for an Single  
pump)

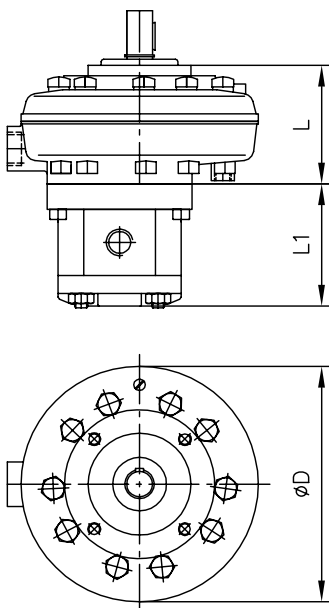


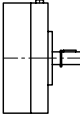
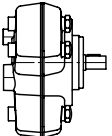
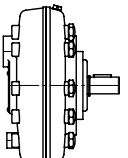
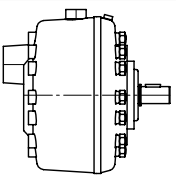
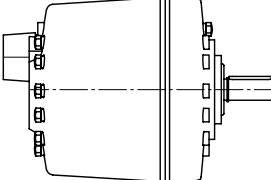
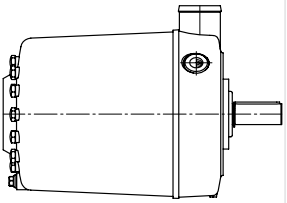
## General parameters and dimensions

Single pump type R and RG



Single pump type RZ



Design	Number of cylinders	Delivery flow $Q_{pu}$ (lpm) (approximate reference value at 1450 rpm) and max. pressure $p_{max}$ (bar)						$P_N$ [kW]	Dimensions [mm]		
		700 bar	550 bar	450 bar	250 bar	160 bar	D		L	m [kg]	
7631 	2	0.18	0.28	0.43	0.92	-	0.25...0.55	130	53/58	3.2	
	3	0.27	0.42	0.64	1.35	-					
	5	0.46	0.7	1.08	2.27	-					
6010/ 6910 	1	0.3	0.5	0.8	1.7	2.2	0.25...3	174	82.5/85.5	3.1	
	2	0.6	1.0	1.6	3.3	4.4					
	3	0.9	1.5	2.5	5.1	6.5					
6011/ 6911 	5	1.4	2.6	4.2	8.3	10.9	0.55...5.5	185	86/85	5.8	
	7	2.1	3.7	5.8	11.8	15.3					
6012/ 6912 	10	2.7	5.3	8.2	16.8	21.7	2.2...11	185	146/125	10.5	
	14	4.0	7.4	11.6	23.5	30.4					
6014/ 6914 	20	6.1	11.0	17.4	35.0	43.4	5.5...22	218	250/221	24.2	
	28	8.0	15.0	23.0	47.0	60.8					
6016/ 6916 	42	12.7	22.0	34.5	70.0	91.2	11...30	238	311/320	39.1	

- The data listed represent only a selection of the various different versions  
1) Standard motor, design IM B 35 for motor pumps or IM B 5 for hydraulic power packs

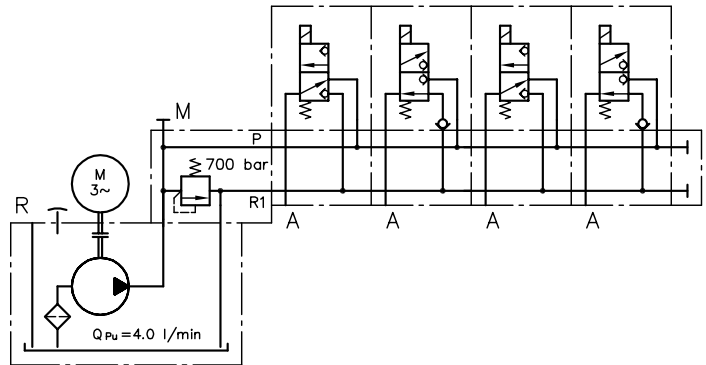
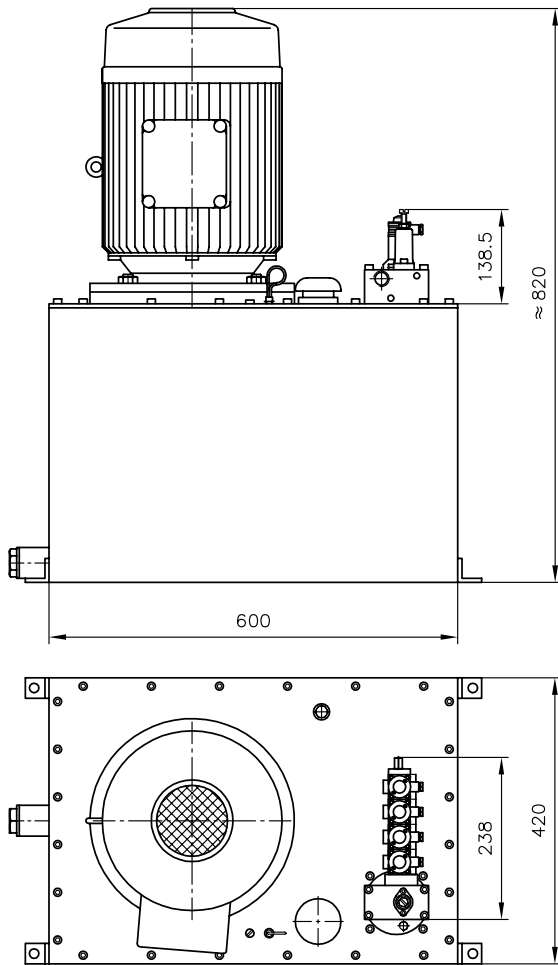
### Gear pump

Size	Delivery flow $Q_{pu}$ [lpm] and max. pressure $p_{max}$ [bar]			Dimensions [mm]	m [kg]
	120 bar	80 bar	40 ... 60 bar		
/1	5,2	8,8	11,3	70 ... 86	1,2
/2	12,3	16	37	96 ... 132	3,1
/3	24	110	135	140 ... 178	8,4

- The data listed represent only a selection of the various different versions

Circuit example:

R 4,0/B 50 A 700 - VB 11 DM - HRHR - 1 - G 24 - V 5,5



**Associated technical data sheets:**

- [Radial piston pump type R and RG: D 6010](#)
- [Motor pump and hydraulic power pack type R and RG: D 6010 H](#)
- [Radial piston pumps with several pressure connections type R, RG: D 6010 D, D 6010 DB](#)
- [Radial piston pump type R and RG with one main pressure connection and one or two ancillary pressure connections: D 6010 S](#)

**Directly mountable valve banks:**

- [Type VB: Page 130](#)
- [Type BWH\(N\): Page 136](#)
- [Type SWR: Page 92](#)

# Individual pumps

## 1.1 Variable displacement axial piston pump type V30E

Variable displacement axial piston pumps adjust the geometric delivery volume from maximum to zero. As a result they vary the volumetric flow that is provided to the loads. The axial piston pump type V30E is designed for open circuits in mobile hydraulics and works according to the swash plate principle. It is available with the option of a thru-shaft for operating additional hydraulic pumps in series.

The sturdy pump is particularly suitable for continuous operation in challenging applications. The range of pump controllers allows the axial piston pump to be used in a variety of applications.

### Features and benefits:

- Low noise emissions
- Wide controller options
- Full torque available at the second pump in tandem pump applications

### Intended applications:

- Machines for forestry and agricultural purposes
- Cranes and lifting equipment
- Construction machines



<b>Nomenclature:</b>	Variable displacement axial piston pump
<b>Design:</b>	Single pump Multiple pump
<b>p<sub>max</sub>:</b>	Nominal pressure 350 bar, peak pressure 420 bar
<b>V<sub>g max</sub>:</b>	95 ... 270 cm <sup>3</sup> /rev

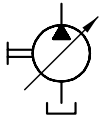
### Design and order coding example

V30E	- 095	R	S	F	N	- 1	- 1	- XX	/LSP	/120	- 200
Nominal size		Rotating direction		Shaft version		Flange version		Housing version		Seal material	
Basic type		Anti-clockwise (L), clockwise (R)		<ul style="list-style-type: none"> <li>▪ Spline shaft DIN 5480 (D)</li> <li>▪ Parallel key (K)</li> <li>▪ Spline shaft SAE J744 (S, U)</li> </ul>		<ul style="list-style-type: none"> <li>▪ Flange ISO 3019-2 (G)</li> <li>▪ Flange SAE J744 (F, W)</li> </ul>		With/without thru-shaft		<ul style="list-style-type: none"> <li>▪ NBR (N)</li> <li>▪ EPDM (E)</li> <li>▪ FKM (V, C)</li> </ul>	
				swash plate angle indicator		Release		Torque setting [Nm]		Pressure specification [bar]	
				With/without swash plate angle indicator		See section "Controller" <a href="#">Chapter , "Platzhalter"</a>					

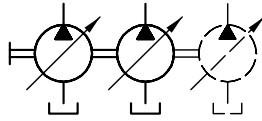


## Function

Single pump



Multiple pump



## Controller

### Pressure controller:

- Pressure controller (P, Pb)
- Electro-proportional pressure controller (P-PMVPS)

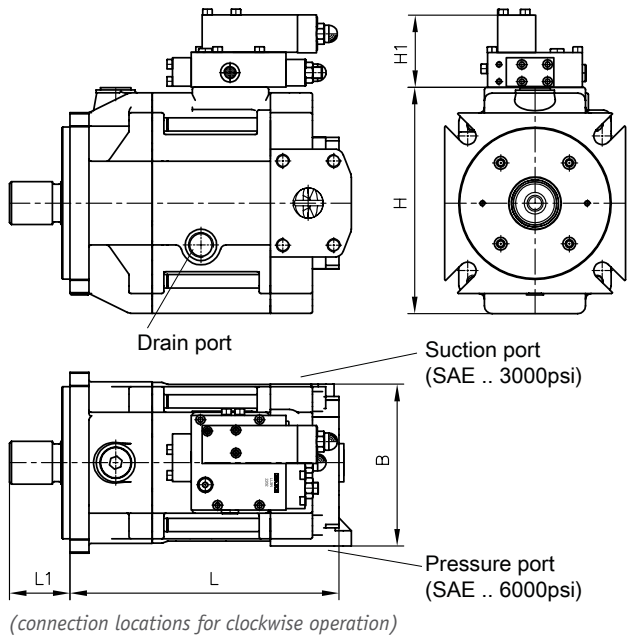
### Flow controller

- Load-sensing controller with integrated pressure limitation (LSP, LSPb)
- Load-sensing controller with integrated pressure limitation and electric pump direction switching (LSP-BVPM)
- Electro-hydraulic flow controller with integrated pivoting angle pick-up and control electronics for adjustment of setpoint and actual value (EM.CH)

### Power controller:

- Power controller (L)
- Power controller (Lf, Lf1)

## General parameters and dimensions



## Parameters

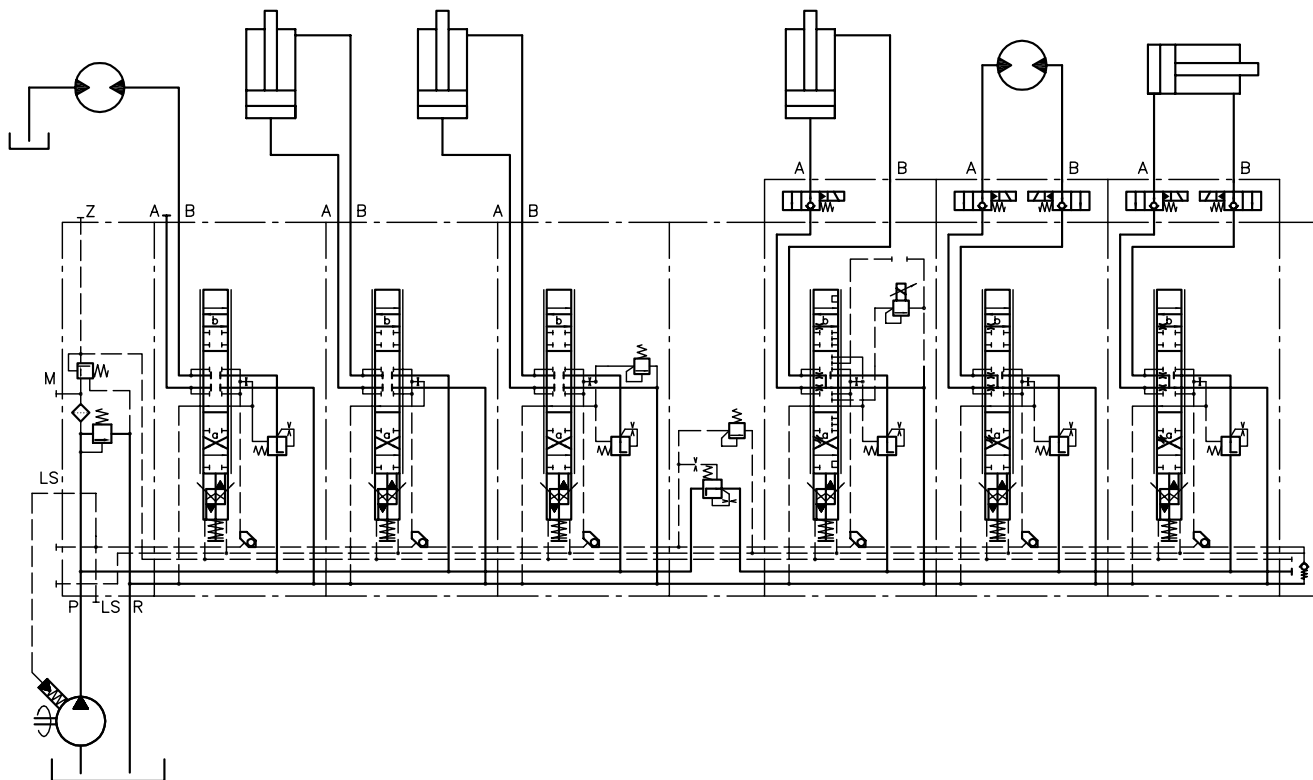
	Geom. output volume	Nom. pressure	Max. speed	Dimensions [mm] approx.					m [kg]
				$V_g$ [cm <sup>3</sup> /rev]	$p_{nom} (p_{max})$ [bar]	$n$ [rpm]	L	L1	
V30E - 095	95	350 (420)	2500	296	75	236	36	190	57
V30E - 160	160		2100	332	75	273	36	212	77
V30E - 270	270		1800	399	88	326	36	266	129

## Ports

	Pressure port	Suction port	Drain port
V30E - 095	1 1/4" SAE J518	2 1/2" SAE J518	G 3/4
V30E - 160	1 1/4" SAE J518	2 1/2" SAE J518	G 3/4
V30E - 270	1 1/2" SAE J518	3" SAE J518	G 1

**Example circuit:**

V30E-270-LSF N-2-1/03-LSN-320



**Associated technical data sheets:**

- [Variable displacement axial piston pump type V30E: D 7960 E](#)

**Similar products:**

- Variable displacement axial piston pump type V30D: [Page 20](#)
- Variable displacement axial piston pump type V40M: [Page 26](#)
- Variable displacement axial piston pump type V60N: [Page 28](#)
- Fixed displacement axial piston pump type K60N: [Page 32](#)
- Axial piston motor type M60N: [Page 262](#)
- Axial piston motor type V80M: [Page 24](#)

**Suitable proportional directional spool valve:**

- Type PSL/PSV size 2, 3 and 5: [Page 106](#)
- Type PSLF/PSVF sizes 3, 5 and 7: [Page 112](#)

**Suitable accessories:**

- Proportional amplifier type EV1M3: [Page 278](#)
- Programmable logic valve control type PLVC: [Page 280](#)

# Individual pumps

## 1.1 Variable displacement axial piston pump type V30D

Variable displacement axial piston pumps operate according to the bent axis principle. They adjust the geometric output volume from maximum to zero. As a result they vary the flow rate that is provided to the loads.

The axial piston pump type V30D is designed for open circuits in industrial hydraulics and works according to the swash plate principle. It is available with the option of a thru-shaft for operating additional hydraulic pumps in series.

The sturdy pump is particularly suitable for continuous operation in challenging applications. The range of pump controllers allows the axial piston pump to be used in a variety of applications.

### Features and benefits:

- Low-noise emissions
- Wide controller options
- Full torque available at the second pump in tandem pump applications

### Intended applications:

- Presses
- Industrial plants
- Marine cranes and winches
- Power pack assembly



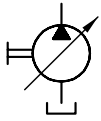
<b>Nomenclature:</b>	Variable displacement axial piston pump
<b>Design:</b>	Single pump Multiple pump
<b>p<sub>max</sub>:</b>	Nominal pressure 350 bar, peak pressure 420 bar
<b>V<sub>g max</sub>:</b>	45 ... 250 cm <sup>3</sup> /rev

### Design and order coding example

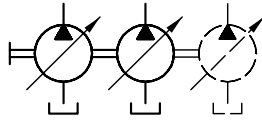
V30D	- 095	R	SF	N	- 1	- 1	- XX	/LN	-2	/120	- 200
<p><b>Basic type</b></p> <p><b>Nominal size</b></p> <p><b>Rotating direction</b> Anti-clockwise (L), clockwise (R)</p> <p><b>Shaft version/flange version</b> <ul style="list-style-type: none"> <li>▪ Spline shaft DIN 5480 (D)</li> <li>▪ Spline shaft SAE J744 (S)</li> <li>▪ Parallel key (K)</li> </ul> </p> <p><b>Seal material</b> <ul style="list-style-type: none"> <li>▪ NBR (N)</li> <li>▪ EPDM (E)</li> <li>▪ FKM (V)</li> </ul> </p> <p><b>Housing version</b> With/without thru-shaft</p> <p><b>swash plate angle indicator</b> With/without swash plate angle indicator</p> <p><b>Release</b></p> <p><b>Controller</b> See section "Controller" <a href="#">Chapter</a> , "Platzhalter"</p> <p><b>Additional versions</b> e.g. stroke limitation</p> <p><b>Torque setting [Nm]</b></p> <p><b>Pressure specification [bar]</b></p>											

## Function

Single pump



Multiple pump



## Controller

### Pressure controller:

- Pressure controller (N)
- Pressure controller with remote-control port (P, Pb)

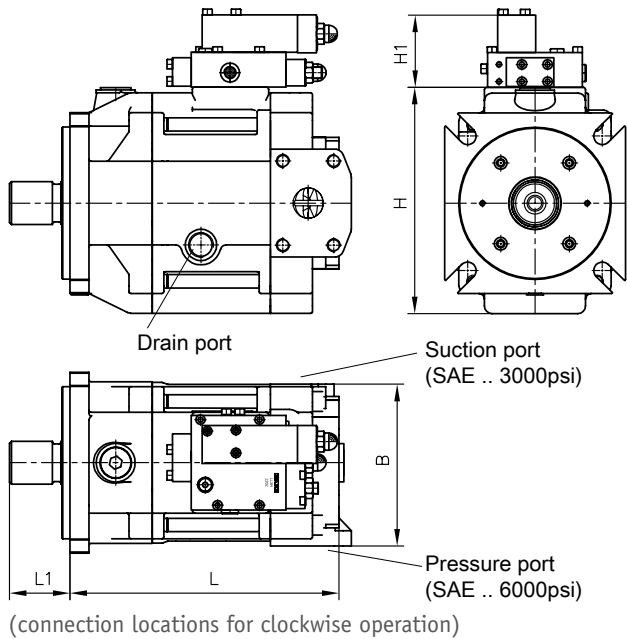
### flow controller

- Load-sensing controller (LS)
- Load-sensing controller with integrated pressure limitation (LSN)
- Flow controller for setting a constant, speed-independent volumetric flow (Q, Qb)
- Electro-proportional flow controller with rising characteristic (V)
- Hydraulic-proportional flow controller with rising characteristic (VH)

### Power controller:

- Power controller (L)
- Power controller, hydraulically adjustable (Lf1)

## General parameters and dimensions



## Parameters

	Geom. output volume	Nom. pressure	Max speed	Dimensions [mm]					m [kg]
	$V_g$ [cm <sup>3</sup> /rev]	$p_{nom}$ ( $p_{max}$ ) [bar]	$n$ [rpm]	L	L1	H	H1	B	(with controller)
V30D - 045	45	350 (420)	2600	268	68	150	82	160	40 (46)
V30D - 075	75		2400	310	80	170	86	178	60 (66)
V30D - 095	95		2200	341	93	196	87	196	70 (76)
V30D - 115	115	250 (300) <sup>1)</sup>	2000	341	93	196	87	196	70 (76)
V30D - 140	140	350 (420)	2200	363	90	212	85	212	85 (91)
V30D - 160	160	250 (300) <sup>1)</sup>	1900	363	90	212	85	212	85 (91)
V30D - 250	265	350 (420)	1800	432	115	224	97	272	130 (136)

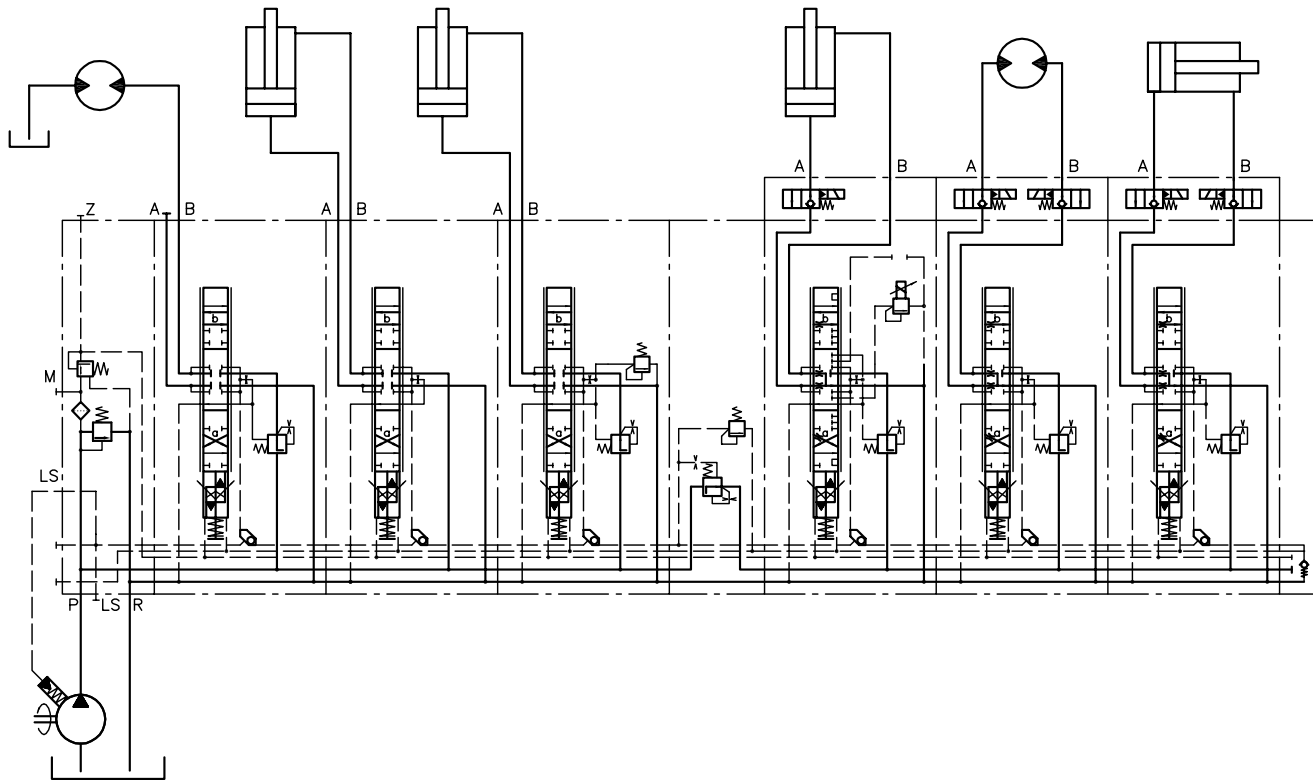
1) Higher pressure is possible with reduced geom. delivery flow

## Ports

	Pressure port	Suction port	Drain port
V30D - 045	3/4" SAE J518	1 1/2 " SAE J518	G 1/2
V30D - 075	1" SAE J518	2" SAE J518	G 3/4
V30D - 095	1 1/4" SAE J518	2" SAE J518	G 3/4
V30D - 115	1 1/4" SAE J518	2" SAE J518	G 3/4
V30D - 140	1 1/4" SAE J518	2 1/2 " SAE J518	G 3/4
V30D - 160	1 1/4" SAE J518	2 1/2 " SAE J518	G 3/4
V30D - 250	1 1/2" SAE J518	3" SAE J518	M 33x 2

**Example circuit:**

V30D-250-LSF N-2-1/03-LSN-320


**Associated technical data sheets:**

- Variable displacement axial piston pump type V30D: [D 7960](#),

**Similar products:**

- Variable displacement axial piston pump type V30E: [Page 16](#)
- Variable displacement axial piston pump type V40M: [Page 26](#)
- Variable displacement axial piston pump type V60N: [Page 28](#)
- Variable displacement axial piston pump type V60N: [Page 28](#)
- Variable displacement axial piston pump type V80M: [Page 24](#)

**Suitable proportional directional spool valve:**

- Type PSL/PSV 2, 3 and 5: [Page 106](#)
- Type PSLF/PSVF 3, 5 and 7: [Page 112](#)

**Additional electrical components:**

- Proportional amplifier: [Page 278](#)
- Programmable logic valve control type PLVC: [Page 280](#)
- CAN node type CAN-IO: [Page 282](#)
- Other electronic accessories [See "Electronics"](#)

# Individual pumps

## 1.1 Variable displacement axial piston pump type V80M

Variable displacement axial piston pumps adjust the geometric delivery volume from maximum to zero. As a result they vary the volumetric flow that is provided to the loads. The axial piston pump type V80M is designed for open circuits in mobile hydraulics and works according to the swash plate principle. It is available with the option of a thru-shaft for operating additional hydraulic pumps in series.

The sturdy pump is particularly suitable for continuous operation in challenging applications. The range of pump controllers allows the axial piston pump to be used in a variety of applications.

### Features and benefits:

- High speed
- High nominal pressure
- Less installation space
- Full torque available at the second pump in tandem pump applications

### Intended applications:

- Machines for forestry and agricultural purposes
- Cranes and lifting equipment
- Construction machines



<b>Nomenclature:</b>	Variable displacement axial piston pump
<b>Version:</b>	Single pump Multiple pump
<b><math>p_{max}</math>:</b>	Nominal pressure 400 bar, peak pressure 450 bar
<b><math>V_{g \max}</math>:</b>	202 cm <sup>3</sup> /rev

### Design and order coding example

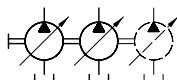
V80M	- 200	R	S	F	N	- 1	- 1	- XX	/LN	-2	/120	- 200
												Pressure specification [bar]
												Torque setting [Nm]
												Additional versions
												Controller See section "Controller"
												Release
												swash plate angle indicator With/without swash plate angle indicator
												Versions with housing With/without thru-shaft
												Seals
												▪ NBR (N)
												▪ FKM (V)
												Flange version
												▪ DIN (W)
												▪ SAE (F)
												Shaft version
												▪ Spline shaft (DIN 5480) (D)
												▪ Spline shaft and flange SAE (S)
												Rotating direction
												Counter clockwise (L), clockwise (R)
												Nominal size
												Basic type

### Function

Single pump



Multiple pump





**Controller**
**Pressure controller:**

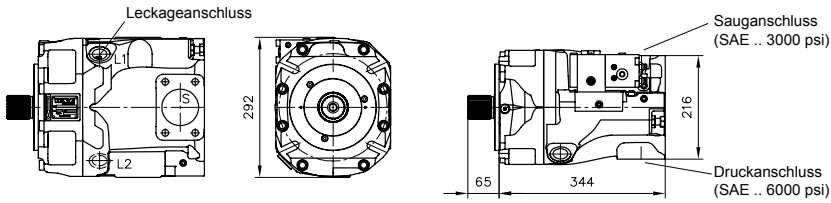
- Pressure controller (N)

**Flow controller:**

- Load-sensing controller (LSN)

**Power controller:**

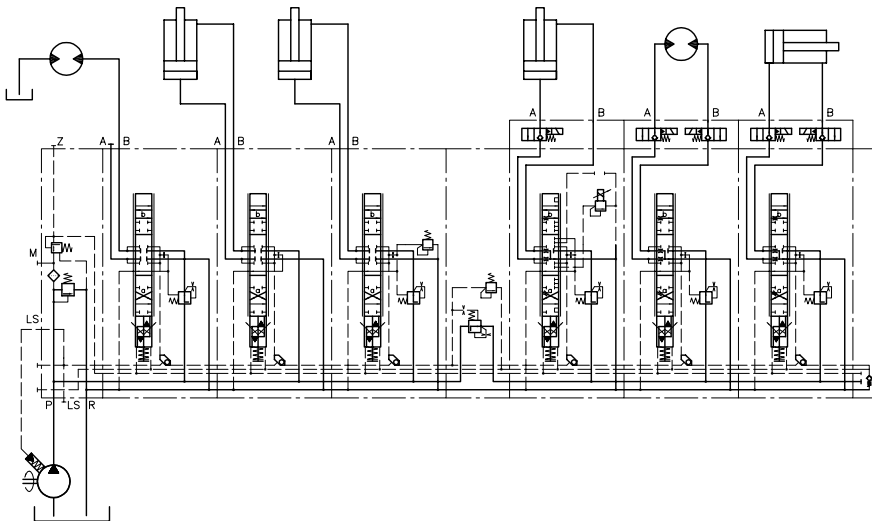
- Power controller (L)

**General parameters and dimensions**


(connection locations for clockwise operation)

**Parameters**

	Geom. output volume $V_g$ [cm <sup>3</sup> /rev]	Nominal pressure $p_{nom}$ ( $p_{max}$ ) [bar]	Self-suction speed $n$ [min <sup>-1</sup> ]	Ports			m [kg] (with controller)
				Drain port	Suction port	Pressure port	
V80M - 200	200	400 (450)	1800	G 1	3"	1 1/2"	130 (136)

**Circuit example:**

**Associated technical data sheets:**

- [Variable displacement axial piston pump V80M: D 7962 M](#)

**Similar products:**

- Variable displacement axial piston pump type V40M: [Page 26](#)
- Variable displacement axial piston pump type V60N: [Page 28](#)
- Fixed displacement axial piston pump type K60N: [Page 32](#)
- Axial piston motor type M60N: [Page 262](#)

**Suitable prop. directional spool valve:**

- Type PSL/PSV size 2, 3 and 5: [Page 106](#)
- Type PSLF/PSVF sizes 3, 5 and 7: [Page 112](#)

**Suitable accessories:**

- Proportional amplifier type EV1M3: "[Electronic accessory components](#)"
- Programmable logic valve control type PLVC: [Page 280](#)

# Individual pumps

## 1.1 Variable displacement axial piston pump type V40M

Variable displacement axial piston pumps operate according to the bent axis principle. They adjust the geometric output volume from maximum to zero. As a result they vary the flow rate that is provided to the loads.

The axial piston pump type V40M is designed for open circuits in mobile hydraulics and works according to the swash plate principle. It is available with the option of a thru-shaft for operating additional hydraulic pumps in series.

The pump is normally attached to the power take-off of diesel engines. The range of pump controllers allows the axial piston pump to be used in a variety of applications.

### Features and benefits:

- Optimized power-to-weight ratio
- High self-suction speed
- Different shaft and flange versions

### Intended applications:

- Machines for forestry and agricultural purposes
- Cranes and lifting equipment
- Truck-mounted concrete pumps
- Municipal trucks



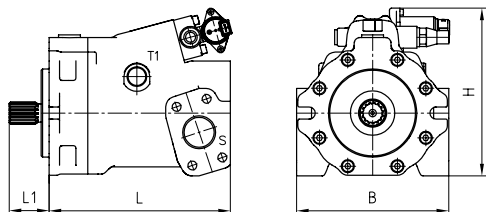
<b>Nomenclature:</b>	Variable displacement axial piston pump
<b>Version:</b>	Single pump Multiple pump
<b>p<sub>max</sub>:</b>	Nominal pressure 380 bar, peak pressure 400 bar
<b>V<sub>g max</sub>:</b>	28...45 cm <sup>3</sup> /rev

### Design and order coding example

V40M - 045 R T X V - 2 - 0 - 00 /LS-DA - C 23

<p><b>Basic type</b></p> <p>V40M</p> <p>Nominal size</p> <ul style="list-style-type: none"> <li>- 028: Medium pressure version (250 bar)</li> <li>- 028 H: High pressure version (380 bar)</li> <li>- 045: Medium pressure version (250 bar)</li> <li>- 045 H: High pressure version (380 bar)</li> </ul>	<p>- 045</p> <p>Rotating direction</p> <ul style="list-style-type: none"> <li>Anti-clockwise (L), clockwise (R)</li> </ul>	<p>R</p> <p>Shaft version</p> <ul style="list-style-type: none"> <li>Spline shaft SAE-B J 744 (H)</li> <li>Spline shaft SAE-BB J 744 (T)</li> </ul>	<p>T</p> <p>Flange version</p> <ul style="list-style-type: none"> <li>Flange SAE-B 2-hole J 744 (X)</li> </ul>	<p>X</p> <p>Seal material</p> <ul style="list-style-type: none"> <li>FKM (V)</li> </ul>	<p>V</p> <p>Housing version</p> <ul style="list-style-type: none"> <li>Axial ports</li> <li>Radial ports with thru-shaft</li> <li>Radial ports</li> </ul>	<p>- 2</p> <p>Additional function</p>	<p>- 0</p> <p>Release</p>	<p>- 00</p> <p>Controllers</p> <ul style="list-style-type: none"> <li><b>Load-sensing controller:</b> <ul style="list-style-type: none"> <li>Load-sensing controller with integrated pressure limitation (LS-DA)</li> </ul> </li> <li><b>Pressure controller:</b> <ul style="list-style-type: none"> <li>Electro-proportional pressure controller with falling characteristic (P1R1)</li> </ul> </li> </ul>	<p>/LS-DA</p> <p>Thru-shaft version</p>	<p>- C 23</p>
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**Function**

**General parameters and dimensions**

**Parameters**

	Geom. output volume $V_g$ [cm <sup>3</sup> /rev]	Nom. pressure $p_{nom}$ ( $p_{max}$ ) [bar]	Self-suction speed $n$ [rpm]	Dimensions [mm]				m [kg]
				L	L1	H	B	
V40M - 028	28,7	250 (320)	3200	182	41	170	172	16
V40M - 028 H		380 (400)						
V40M - 045	46,5	250 (320)	2900	212	46	186	175	21
V40M - 045 H		380 (400)						

**Ports**

	Drain port T.	LS connection	Suction port	Pressure port P
V40M - 028	3/4-16 UNF-2B	M12 x 1.5	1 1/4" SAE J518	3/4" SAE J518
V40M - 028 H				
V40M - 045	7/8-14 UNF-2B	M12 x 1.5	1 1/2" SAE J518	1" SAE J518
V40M - 045 H				

**Associated technical data sheets:**

- Variable displacement axial piston pump type V40M: [D 7961](#)

**Similar products:**

- Variable displacement axial piston pump type V60N: [Page 28](#)
- Variable displacement axial piston pump type V30D: [Page 20](#)
- Variable displacement axial piston pump type V30E: [Page 16](#)
- Fixed displacement axial piston pump type K60N: [Page 32](#)
- Axial piston motor type M60N: [Page 262](#)

**Prop. directional spool valve:**

- Type PSL/PSV size 2, 3 and 5: [Page 106](#)
- Type PSLF/PSVF sizes 3, 5 and 7: [Page 112](#)

**Load holding valves:**

- Type LHK, LHDV, LHT: [Page 204](#)

# Individual pumps

## 1.1 Variable displacement axial piston pump type V60N

Variable displacement axial piston pumps operate according to the bent axis principle. They adjust the geometric output volume from maximum to zero. As a result they vary the flow rate that is provided to the loads.

The axial piston pump type V60N is designed for open circuits in mobile hydraulics and works according to the swash plate principle. It is available with the option of a thru-shaft for operating additional hydraulic pumps in series.

The pump is fitted above all to the power take-off on commercial vehicle transmissions. The range of pump controllers allows the axial piston pump to be used in a variety of applications.

### Features and benefits:

- Optimized power-to-weight ratio
- High self-suction speed
- Wide controller options

### Intended applications:

- Municipal trucks
- Cranes and lifting equipment
- Machines for forestry and agricultural purposes
- Truck-mounted concrete pumps



<b>Nomenclature:</b>	Variable displacement axial piston pump
<b>Design:</b>	Single pump Multiple pump
<b>p<sub>max</sub>:</b>	Nominal pressure 400 bar, peak pressure 450 bar
<b>V<sub>g max</sub>:</b>	60 ... 130 cm <sup>3</sup> /rev

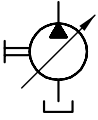
### Design and order coding example

V60N - 110 R S F N - 1 - 0 - 03 /LSNR -2 - 320

<p><b>Nominal size</b></p> <p><b>Rotating direction</b></p> <p><b>Shaft version</b></p> <p><b>Flange version</b></p> <p><b>Seal material</b></p> <p><b>Housing version</b></p> <p><b>Additional function</b></p> <p><b>Release</b></p> <p><b>Controller</b></p> <p><b>Stroke limitation</b></p> <p><b>Pressure specification [bar]</b></p>	<ul style="list-style-type: none"> <li>▪ ISO 14 parallel key splined shaft (D)</li> <li>▪ Spline shaft DIN 5480 (M)</li> <li>▪ Spline shaft SAE J744 (H, U, T, S, Q)</li> </ul> <ul style="list-style-type: none"> <li>▪ Flange ISO 7653-1985 (Y, P)</li> <li>▪ Flange ISO 3019-2 (G)</li> <li>▪ Flange SAE J744 (X, Z, F)</li> </ul> <ul style="list-style-type: none"> <li>▪ NBR (N), FKM (V)</li> </ul> <ul style="list-style-type: none"> <li>▪ Axial ports</li> <li>▪ Radial ports with thru-shaft</li> <li>▪ Radial ports</li> </ul> <ul style="list-style-type: none"> <li>▪ With/without max. stroke limitation</li> </ul> <p>See section "Controller" <a href="#">Chapter</a> , "<a href="#">Platzhalter</a>"</p>
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Basic type

## Function



## Controller

### Pressure controller

- Pressure controller (NR, NXR)
- Electro-proportional pressure controller with rising characteristic (PR)
- Electro-proportional pressure controller with falling characteristic (P1R)

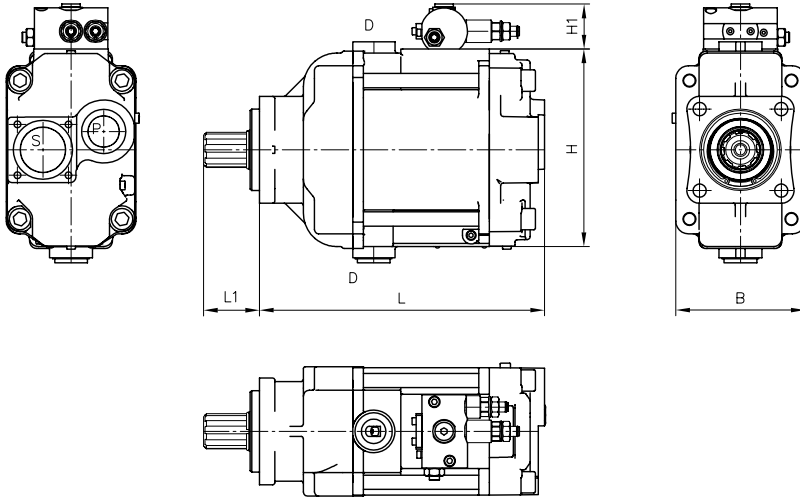
### Flow controller

- Load-sensing controller with integrated pressure limitation (LSNR, LSNRT)
- Flow controller for setting a constant, speed-independent volumetric flow (QNR)
- Electro-proportional flow controller with rising characteristic (V)
- Electro-proportional flow controller with falling characteristic (V1)

### Power controller

- Power controller (L, /ZL)

## General parameters and dimensions



## Parameters

	Geom. output volume	Nom. pressure	Max. speed	Dimensions [mm]					m [kg]
				$V_g$ [cm <sup>3</sup> /rev]	$p_{nom}$ ( $p_{max}$ ) [bar]	$n$ [rpm]	L	L1	
V60N - 060	60	350 (400)	2500	254	55	177	45	115	24
V60N - 090	90		2300	278	55	184	45	120	27
V60N - 110	110		2200	280	55	194	45	125	30
V60N - 130	130	400 (450)	2100	270	55	210	45	130	31

## Ports

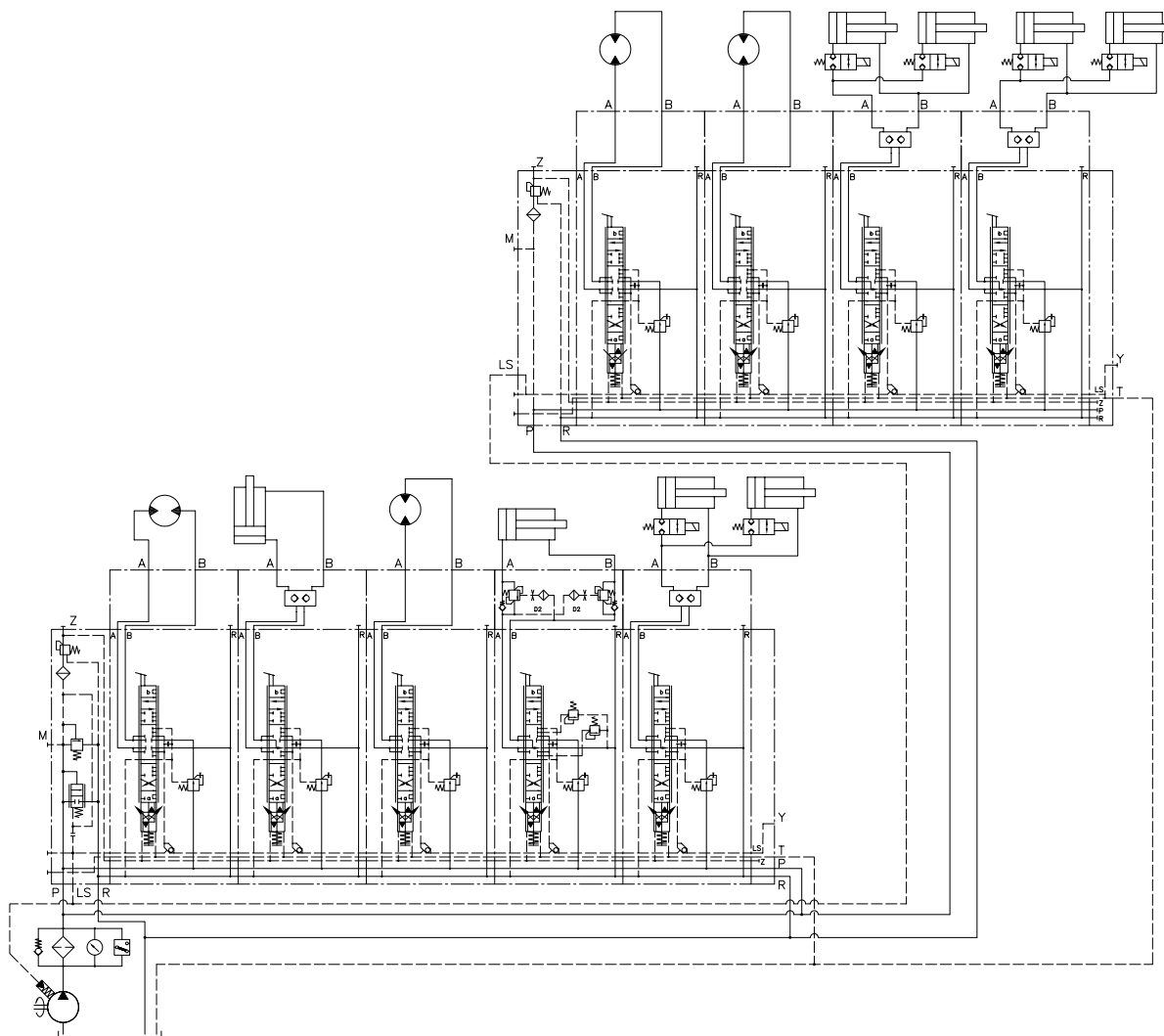
	Pressure port P	Suction port S	Drain port D	LS connection
V60N - 060	G 3/4	1 1/2" SAE J518	G 3/4	G 1/4
V60N - 090	G 1			
V60N - 110				
V60N - 130				

**Example circuit**
**V60N-130 RSNF-1-0-0.00/LSNR-2-250**
**PSV 31/D280-2**

- A 2 L 25/25/EA1/2
- A 2 H 40/40/EA1/2 DRH
- A 2 L 25/25/EA1/2
- A 2 H 3/3 A 100 B 100/EA1/2 AL-0-D 4/120-BL-0-D 4/120
- A 2 H 3/3/EA1/2 DRH
- E 18-G 24

**PSV 31-1**

- A2 L 25/25/EA1/2
- A2 L 25/25/EA1/2
- A2 H 3/3/EA1/2 DRH
- A2 H 3/3/EA1/2 DRH
- E 1 - G24


**Associated technical data sheets:**

- [Variable displacement axial piston pump type V60N: D 7960 N](#)

**Similar products:**

- Variable displacement axial piston pumps type V40M: [Page 26](#)
- Variable displacement axial piston pump type V30E: [Page 16](#)
- Variable displacement axial piston pump type V30D: [Page 20](#)
- Axial piston motor type M60N: [Page 262](#)
- Variable displacement axial piston pump type V80M: [Page 24](#)
- Fixed displacement axial piston pump type K60N: [Page 32](#)

**Suitable prop. directional spool valves:**

- Type PSL/PSV size 2, 3 and 5: [Page 106](#)
- Type PSLF/PSVF sizes 3, 5 and 7: [Page 112](#)

**Suitable load-holding valves:**

- Type LHK, LHDV, LHT: [Page 204](#)

# Individual pumps

## 1.1 Variable displacement axial piston pump type K60N

Fixed displacement axial piston pumps operate according to the bent axis principle. They have a constant output volume and therefore deliver a constant flow rate at a specific rotation speed.

The axial piston pump type K60N is designed for open circuits in mobile hydraulics and operates based on the bent axis principle.

The pump is fitted mainly to the power take-off on commercial vehicle transmissions.

### Features and benefits:

- Good performance/weight ratio
- High self-suction speed
- Different shaft and flange versions

### Intended applications:

- Machines for forestry and agricultural purposes
- Cranes and lifting equipment
- Truck-mounted concrete pumps
- Municipal trucks

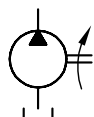


<b>Nomenclature:</b>	Fixed displacement axial piston pump
<b>Design:</b>	Single pump
<b><math>p_{max}</math>:</b>	400 bar
<b><math>V_{g max}</math>:</b>	12... 108 cm <sup>3</sup> /rev

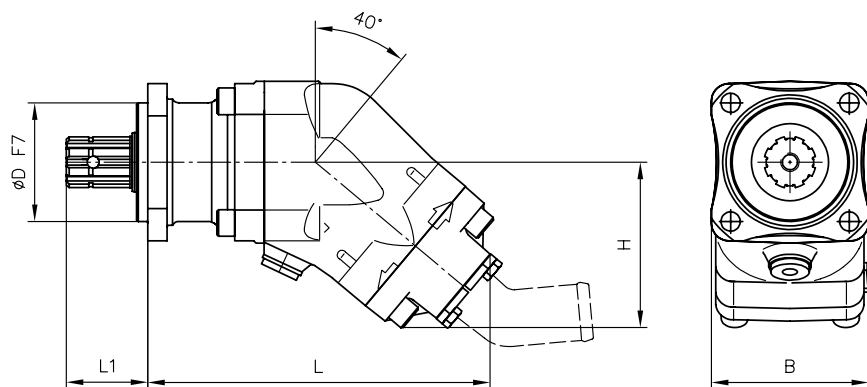
### Design and order coding example

K60N	- 064	R	S	F	N	- S - F12
Basic type	Nominal size	Rotating direction	Shaft version	Flange version	Seal material	Additional versions Bypass valve
			▪ ISO 14 parallel key splined shaft (D) ▪ SAE-C, SAE-B J 744 spline shaft (S)	▪ DIN ISO 7653 (Y) ▪ SAE-C, SAE-B J 744 (F)	▪ NBR (N), FKM (V)	

### Function





**General parameters and dimensions**

**Parameters**

	Geom. output volume $V_g$ [cm <sup>3</sup> /rev]	Nom. pressure $p_{nom}$ ( $p_{max}$ ) [bar]	Self-suction speed $n$ [rpm]	Dimensions [mm]					m [kg]
				L	L1	H	B	ØD	
K60N - 012	12,6	400	3300	207	48	145	95	80/101.6/--	7,5
K60N - 017	17,0	400	3200						
K60N - 025	25,4	400	2550	209	53	156	118	80/101.6/--	8,5
K60N - 034	34,2	400	2250						
K60N - 040	41,2	400	2200	246	67	185	143	80/101.6/127	15,5
K60N - 047	47,1	400	2200						
K60N - 056	56,0	400	2100						
K60N - 064	63,6	400	2050						
K60N - 084	83,6	400	1700	276	72	212	160	80/--/127	27,0
K60N - 090	90,7	400	1700						
K60N - 108	108,0	400	1700	276	85	231	180	80/--/127	29,5
K60N - 130	130,0	350	1600						

**Associated technical data sheets:**

- Fixed displacement axial piston pump type K60N: [D 7960 K](#)

**Similar products:**

- Variable displacement axial piston pump type V30D: [Page 20](#)
- Variable displacement axial piston pump type V30E: [Page 16](#)
- Variable displacement axial piston pump type V40M: [Page 26](#)
- Variable displacement axial piston pump type V60N: [Page 28](#)
- Variable displacement axial piston pump type V80M: [Page 24](#)
- Axial piston motor type M60N: [Page 262](#)

**Suitable prop. directional spool valves:**

- Type PSL/PSV size 2, 3 and 5: [Page 106](#)
- Type PSLF/PSVF sizes 3, 5 and 7: [Page 112](#)

**Suitable load-holding valves:**

- Type LHK, LHDV, LHT: [Page 204](#)

# Individual pumps

## 1.1 Air-driven hydraulic pump type LP

Air-driven hydraulic pumps are pneumatically driven, reciprocally acting plunger pumps. They operate as pneumatic pressure boosters with oscillating movement and automatic stroke reversal control.

The air-driven hydraulic pump type LP can generate up to 1500 bar. It is available as a single pump or as a hydraulic power pack with different tank sizes and valve banks. The delivery flow is dependent on the air pressure set and the flow resistance currently present. It can decay to standstill.

Applications are in laboratory presses, in fixture design, in lubrication systems or in potentially explosive atmospheres.

### Features and benefits:

- High operating pressures
- Suitable for explosion-proof systems and equipment  
No electrical energy
- Hydraulic power packs with direct valve mounting

### Intended applications:

- Construction and construction materials machinery
- fixture design
- Testing and laboratory equipment



<b>Nomenclature:</b>	Air driven hydraulic pumps
<b>Design:</b>	Single pump
<b><math>p_{\text{hydraulicmax}}</math>:</b>	160...1500 bar
<b><math>p_{\text{airmax}}</math>:</b>	10 bar
<b><math>Q_{\text{max}}</math>:</b>	0.9...12 lpm

### Design and order coding example

LP 125 - 16 E /S 81

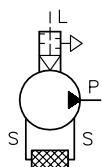
**Additional elements** ▪ Suction parts for hydraulic pumps

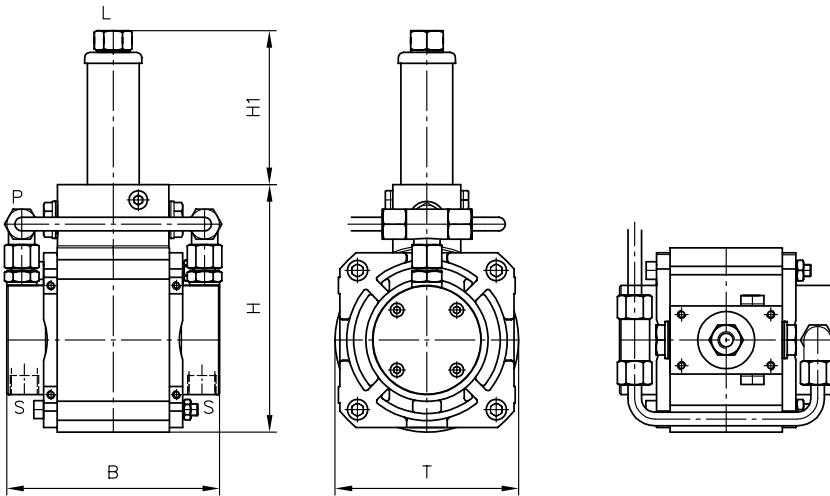
**Design** **Hydraulic pump**

- Ready-to-connect version
- Individual version for self-installation

**Basic type, size** Type LP, size 80, 125, 160

### Function



**General parameters and dimensions**


Basic type and size	p <sub>max</sub> [bar]	Pressure ratio	Geom. volume per double stroke V <sub>hydr</sub> [cm <sup>3</sup> ]	Tapped port (air) Pipe diameter for pressure connection (hydr)	Dimensions [mm]				m [kg]	
					H	H1	B	T		
LP80-	8	700	1 : 200	1.5	G 1/4 Æ6 mm	119	94	121	85	5
	...									
LP125-	16	240	1 : 24	6	G 3/8 Æ8 mm, Æ10 mm	159	114	156	135	8.5
	...									
LP160-	8	1500	1 : 243	2	G 1/2 Æ8 mm, Æ10 mm	228	136	156	175	11.5
	...									
LP160-	30	160	1 : 16	28.3	G 1/2 Æ8 mm, Æ10 mm	228	136	156	175	11.5
	...									
LP160-	30	265	1 : 24	28.3	G 1/2 Æ8 mm, Æ10 mm	228	136	156	175	11.5
	...									

**Associated technical data sheets:**

- [Air-driven hydraulic pump type LP: D 7280](#)
- [Hydraulic power pack type LP: D 7280 H](#)

**Valve banks :**

- Type VB: [Page 130](#)
- Type BWH(N): [Page 136](#)

# Individual pumps

## 1.1 Hand pump type H, HE and HD

Hand pumps are a type of hydraulic pump. They generate a flow rate manually.

The hand pump type H and HE is single-acting. It draws in oil in one direction and pumps it in the opposite direction. The hand pump type HD is double-acting. It pumps and draws in the same quantity of oil in the pressure line during the forward and backward movement of the hand lever. The hand pump type H, HE and HD is available for pipe connection and manifold mounting.

The hand pump is particularly suitable as an emergency pump or for test benches.

### Features and benefits:

- Sturdy design
- Hand pumps with integrated tank
- Safety and drain valve

### Intended applications:

- Shipbuilding
- Mining machinery
- fixture design
- Testing and laboratory equipment



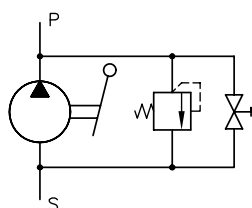
<b>Nomenclature:</b>	Piston pump
<b>Design:</b>	Single acting hand pump Double acting hand pump
<b>p<sub>max</sub>:</b>	150 ... 800 bar
<b>V<sub>max</sub>:</b>	4 ... 64 cm <sup>3</sup> /stroke

### Design and order coding example

<b>HD 13</b>	<b>AS</b>	<b>- K 0,5</b>	<b>- 110</b>
		<b>Pressure setting (bar)</b>	
		<b>With/without tank</b>	Usable volume $V_{use}$ , 0,35 l and 0,5 l
		<b>Additional elements</b>	<ul style="list-style-type: none"> <li>▪ Drain valve (A)</li> <li>▪ Pressure limiting valve (fixed or manually adjustable) (S)</li> </ul>
<b>Basic type, size</b>	Type H (single-acting, open design), Type HE (single-acting, encapsulated design) Type HD (double-acting, encapsulated design)		
	<ul style="list-style-type: none"> <li>▪ With/without pressure resistant suction port</li> <li>▪ Versions for manifold mounting</li> </ul>		

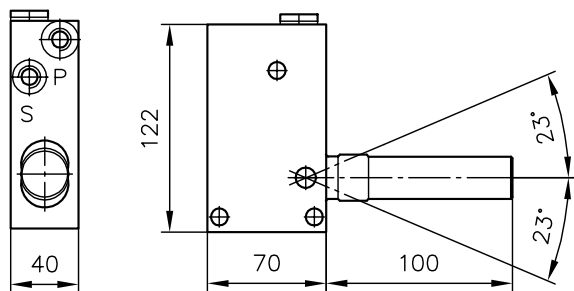
### Function

Design with pressure limiting valve and drain valve

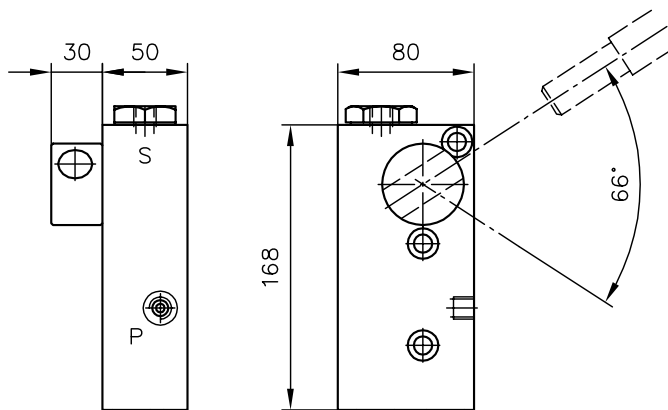


**General parameters and dimensions**

H..



HE.. and HD..



	p <sub>max</sub> [bar]	V <sub>max</sub> [cm <sup>3</sup> /stroke]	Tapped ports (BSPP)		m [kg]
			P	S	
H 16	350	6	G 1/4	G 1/4	3.1
H 20	220	9.4			
H 25	150	14.7			
HE 3	800	3	G 1/4	G 1/4 and G 3/8	4.8
HE 3	800	3			
HD 13	350	13			
HD 20	220	20			
HD 30	150	30			

**Associated technical data sheets::**

- Manual pump type H, HD and HE: [D 7147/1](#)

## 1.2 Hydraulic power packs

Compact hydraulic power pack type NPC	44
Compact hydraulic power pack type HC and HCW	46
Compact hydraulic power pack type KA and KAW	50
Compact hydraulic power pack type MP and MPN	54
Compact hydraulic power pack type HK, HKF and HKL	58
Radial piston pump type R, RG and RZ	62
Air-driven hydraulic pump type LP	66
Connection block type A, B and C	68
Valve bank (nominal size 6) type BA	70
Valve bank (directional seated valve) type BVH	76



*Compact hydraulic power packs  
type KA and KAW*



*Compact hydraulic power packs  
type HK, HKF and HKL*



*Valve bank  
type BVH*



*Air-driven hydraulic pump  
type LP*

**Compact hydraulic power pack**

Type	Nomenclature/Design	Tank volume (l)	$p_{max}$ (bar)	$V_{max}$ (cm <sup>3</sup> /rev.)
NPC	<b>Radial piston pump</b> <ul style="list-style-type: none"> <li>With integrated electric motor</li> <li>Direct current supply</li> </ul> <b>Version</b> <ul style="list-style-type: none"> <li>Oil immersed compact hydraulic power pack for short period operation</li> </ul>	Fill volume 1.0  Usable volume 0.65	11: 750 12: 750	11: 0.46 12: 0.46
HC, HCW	<b>Radial piston or gear pump</b> <ul style="list-style-type: none"> <li>With integrated electric motor</li> <li>3-phase or AC version</li> </ul> <b>Version</b> <ul style="list-style-type: none"> <li>Oil immersed compact hydraulic power pack for intermittent operation</li> </ul>	Fill volume - vertical approx. 1.16-2.5 - horizontal approx. 0.95-2.3  Usable volume - vertical approx. 0.50-1.5 - horizontal approx. 0.50-1.1	HP/LP: 1: 700/180 2: 700/180	1: 0.76 2: 1.59
KA, KAW	<b>Radial piston or gear pump</b> <ul style="list-style-type: none"> <li>With integrated electric motor</li> <li>3-phase or AC version</li> </ul> <b>Version</b> <ul style="list-style-type: none"> <li>Oil immersed compact hydraulic power pack for intermittent operation</li> </ul>	<b>KA 2</b> Fill volume approx. 3.9-11.1  Usable volume - vertical approx. 1.85-8.95 - horizontal approx. 1.5-4.8  <b>KA 4</b> Fill volume approx. 13-31  Usable volume - vertical approx. 5-25 - horizontal approx. 6-16	HP/LP: 2: 700/180 4: 700/180	HP/LP: 2: 3.61/7.9 4: 9.17/30.2
MP, MPN	<b>Radial piston pump and/or gear pump</b> <ul style="list-style-type: none"> <li>With integrated motor</li> <li>Single- or dual-circuit pump</li> </ul> <b>Version</b> <ul style="list-style-type: none"> <li>Oil immersed compact hydraulic power pack for intermittent or load/no load operation</li> </ul>	Fill volume approx. 17-100  Usable volume approx. 10-75	HP/LP: MP - 1: 700/220 MP - 2: 700/200  MP - 4: 700/220	HP/LP: MP - 1: 0.95/4.76 MP - 2: 1.59/26  MP - 4: 9.17/60
HK, HKF, HKL	<b>Radial piston pump and/or gear pump</b> <ul style="list-style-type: none"> <li>With integrated motor</li> <li>3-phase version</li> </ul> <b>Version</b> <ul style="list-style-type: none"> <li>Oil immersed compact hydraulic power pack for continuous and intermittent operation</li> </ul>	<b>HK 2</b> Fill volume approx. 2.77 Usable volume approx. 0.85  <b>HK 3</b> Fill volume approx. 4.65-6.1 Usable volume approx. 1.45-2.90  <b>HK 4, HKF 4</b> Fill volume approx. 5.8-15.4 Usable volume approx. 1.9-11.1  <b>HKL 3</b> Fill volume approx. 3.7-13 Usable volume approx. 1.7-9.1	HP/LP: HK - 2: 700 HK - 3: 700/180 HK - 4: 700/180  HKF - 4: 700/180  HKL - 3: 700/180	HP/LP: HK - 2: 1.59 HK - 3: 4.58/4.8 HK - 4: 9.17/17.0  HKF - 4: 9.17/17.0  HKL - 3: 6.11/14.5

## Hydraulic power packs

Type	Nomenclature/Design	Tank volume (l)	$p_{\max}$ (bar)	$V_{\max}$ (cm <sup>3</sup> /rev.)
R, RG, RZ	Radial piston pump	Fill volume approx. 9-470	HP/LP: R 7631: 700	R 7631: 1.59
		Usable volume approx. 6-450	R, RG 6010: 700 R, RG 6011: 700 R, RG 6012: 700 R, RG 6014: 700 R, RG 6016: 700  RZ 7631: 700/220 RZ 6010: 700/200 RZ 6011: 700/200 RZ 6012: 700/200 RZ 6014: 700/200 RZ 6016: 700/200	R, RG 6010: 4.58 R, RG 6011: 10.7 R, RG 6012: 21.39 R, RG 6014: 42.78 R, RG 6016: 64.18  RZ 7631: 1.59/7.9 RZ 6010: 4.58/26 RZ 6011: 10.7/89.6 RZ 6012: 21.39/89.6 RZ 6014: 42.78/89.6 RZ 6016: 64.18/89.6
LP	Air-driven hydraulic pump	Fill volume approx. 5.8-33	80: 700 125: 700 160: 700	80: 6.00 125: 28.30 160: 28.30



### Connection blocks/mounted valves

Type	Nomenclature/Design	$p_{max}$ (bar)	$Q_{max}$ (lpm)
A, B, C	<p><b>Connection blocks</b></p> <ul style="list-style-type: none"> <li>For completion of hydraulic power packs</li> </ul> <p><b>Version</b></p> <ul style="list-style-type: none"> <li>Add-on valve enabling pipe connection or mounting of valves</li> </ul>	700	20
BA	<p><b>Valve bank</b></p> <ul style="list-style-type: none"> <li>Directional spool valve</li> <li>Directional seated valve</li> </ul> <p><b>Version</b></p> <ul style="list-style-type: none"> <li>Valve bank enabling pipe connection</li> </ul> <p><b>Actuation</b></p> <ul style="list-style-type: none"> <li>solenoid, pressure-actuated or manual, mechanical</li> </ul>	2: 500	2: 50
BVH	<p><b>Valve bank</b></p> <ul style="list-style-type: none"> <li>Directional seated valve</li> <li>Zero leakage</li> </ul> <p><b>Version</b></p> <ul style="list-style-type: none"> <li>Valve bank enabling pipe connection</li> </ul>	11: 400	11: 20

# Efficiency from the modular system

Hydraulics are based on a simple principle: using fluid pressure media, power is transmitted and motion generated. This principle can be transferred to a broad range of applications. The product range in the modular system – the result of the consistent development philosophy of HAWE Hydraulik – enables the creation of tailor-made solutions and systems.

Standardised components and individual combination options ensure increased efficiency at the optimum cost-benefit ratio.

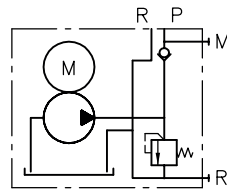
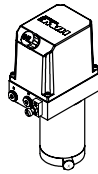
- Various components complement each other to form a complete product range
- Enables solutions tailor-made to the customer



## Compact hydraulic power packs

### Type NPC

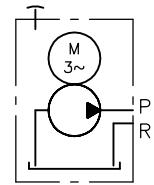
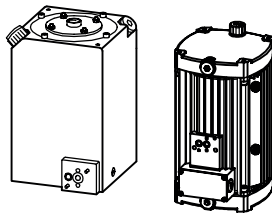
for compact controllers  
with 5...10% operating time  
( $P_{max} = 700 \text{ bar}$ ,  $Q_{max} = 2.1 \text{ lpm}$ )



e.g.  
NPC 11 K/0,31

### Type HC, HCW, KA, KAW

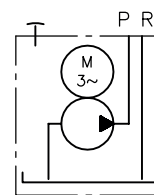
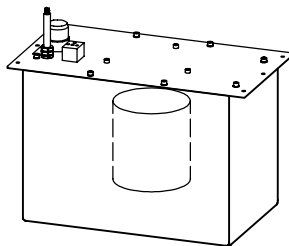
for compact controllers  
with 10...30% operating time  
( $P_{max} = 700 \text{ bar}$ ,  $Q_{max} = 20.1 \text{ lpm}$ )  
in 4 sizes, also as dual-circuit pump



e.g.  
HC 14/2,0  
KA 24 SKS/0,36

### Type MP, MPN, MPW, MPNW

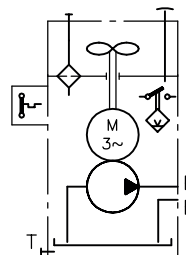
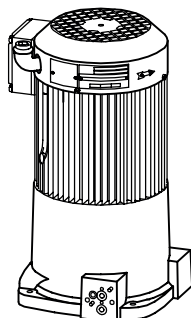
for controls in standby mode or  
load/no load operation  
( $P_{max} = 700 \text{ bar}$ ,  $Q_{max} = 15 \text{ lpm}$ )  
in 5 sizes, also as dual-circuit pump,  
tank size can be selected



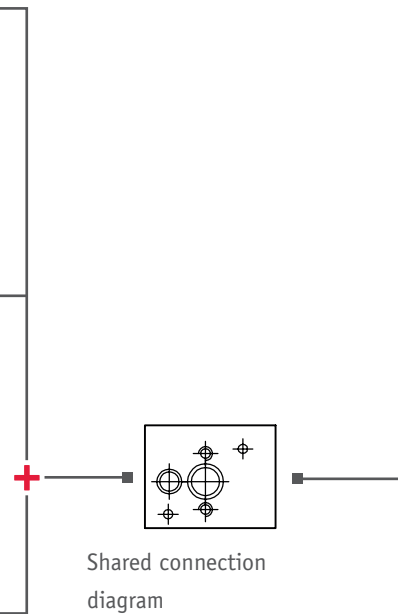
e.g.  
MP 24-H 1,77/B 10  
MPN 44 - H 5,6 - B 25.20

### Type HK, HKF, HKL

for compact controls also in conti-  
nuous operation ( $P_{max} = 700 \text{ bar}$ ,  
 $Q_{max} = 16 \text{ lpm}$ ) in 3 sizes, also as dual  
and triple-circuit pump



e.g.  
HK 449 ST/1-H 5,0



**Order examples**

NPC 11 K/0,31 - 1/320 - R - 24  
KA 44 LFK/H 2,5  
MPN 44 - HZ 0,9/12,3 - B 25.20  
HK 449 ST/1 - H 5,0 -  
C 16 -

Compact hydraulic power packs

B31/450 - EM11 V - 13 - G 24  
NE 21 - 320/25 -  
AS 1 F 2/300 -  
AP 34 - 43/24 -

Connection blocks

BWH 1 - NW - 33 - G 24

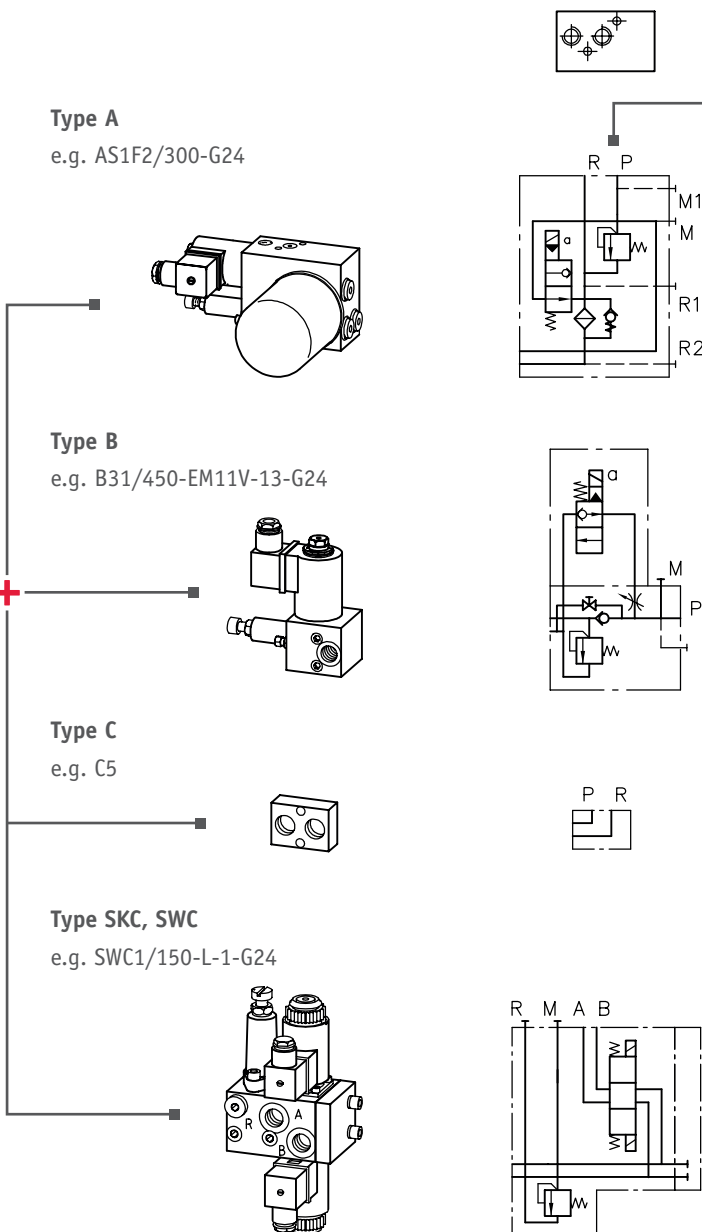
VB 21 GM - RH - 3 - G 24  
BVZP 1 F 23 - G 52/22 - H 14 N 15/0 - 1 - 1 - G 24  
BWN 1 F - HJ 5 - 1 - 1 - G 24

Directly mounted valve banks

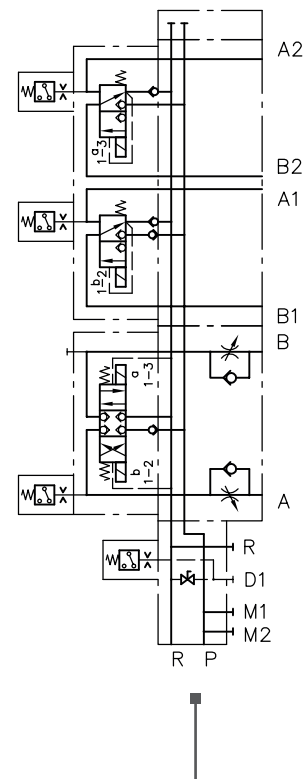
**The practical modular system enables completely individual combinations.**

**Connection blocks**

**Directly mounted valve bank**



Connection diagram for pipe connection or fitting of a directional control valve bank e.g. BVZP1F23-G52/22-N14H15/0-1-1G24



# Compact hydraulic power packs

## 1.2 Compact hydraulic power pack type NPC

Compact hydraulic power packs are a type of hydraulic power pack. They are characterised by a highly compact design, since the motor shaft of the electric motor also acts as the pump shaft.

The ready-for-connection compact hydraulic power pack type NPC is suitable for hydraulic systems with operating mode S2. Type NPC includes a DC motor. The power pack is available in a horizontal or vertical version. Either single-circuit systems or dual-circuit systems can be selected. A radial piston pump or an external gear pump can be used as a hydraulic pump.

The compact hydraulic power pack type NPC is suitable for use as a highly compact control system, since the pressure-limiting valve is integrated and valve banks can be directly mounted.

### Features and benefits:

- Very low space requirements and easy to transport
- Supplied with direct current at 12V DC or 24V DC
- Particularly suited to mobile applications and construction site operation
- Long lifetime and excellent reliability achieved by using radial piston pumps
- Environmentally sound thanks to low oil fill volumes and minimum cost of disposal
- Low costs for hydraulic fluid
- Co-ordinated range of valves and accessories from the modular system

### Intended applications:

- Riveting
- Brakes for wind power plants
- Hydraulic jigs
- Crimping
- Embossing



<b>Nomenclature:</b>	Radial piston pump with integrated electric motor (DC)
<b>Design:</b>	Oil immersed compact hydraulic power pack for short period operation
<b>p<sub>max</sub>:</b>	750 bar
<b>Q<sub>max</sub>:</b>	approx. 1.36 lpm (V <sub>g</sub> = 0.09 - 0.76 cm <sup>3</sup> /rev)

### Design and order coding example

NPC 11 / 0,87 - 1/170 - R - G12 BWN 1 - NN - 35 - 1 - G12

**Valve assembly**

- BWN1, BWH1, VB01
- Can be directly assembled without connection blocks acc. to [D 7470 B/1](#), [D 7302](#)

**Motor voltage** 12V DC or 24V DC

**Check valve** With/without check valve

**Pressure limiting valve and setting**

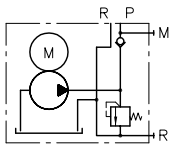
- 1 = Fixed
- 2 = Manually adjustable

**Delivery flow [lpm]**

**Basic type, size** Type NPC, size 11 and 12

**Function**

Symbol:



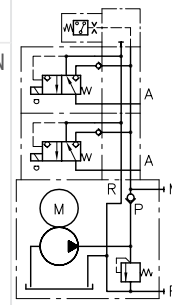
Example circuitry:

**NPC 11 / 0,87 - 1/170 - R - G 12**

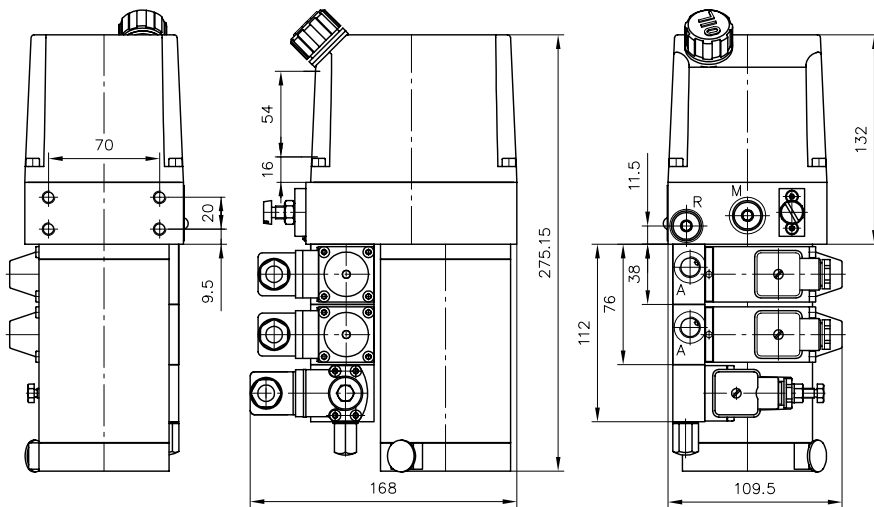
Compact hydraulic power pack type NPC, pump delivery flow approx. 0.87 lpm

**BWN 1 - NN - 35 - 1 - G 12**

Directly mounted valve bank type BWN with two valve sections and pressure switch for gallery P, solenoid voltage 12V DC



**General parameters and dimensions**



	Delivery flow						Max. pressure		
	$Q_{pu}$ [lpm]						$p_{max}$ [bar]	$P_N$ [kW]	$m$ [kg]
NPC 11 (24 V)	0.2	0.31	0.44	0.61	0.87	1.05	750	0.1/0.3	6
NPC 11 (12 V)								0.1/0.25	6
NPC 12 (24 V)	0.4	0.65	0.94	1.28	1.71	2.14	750	0.6	8
NPC 12 (12 V)								0.6	8

**Associated technical data sheets:**

- [Direct current compact hydraulic power pack type NPC: D 7940](#)

**Directly mountable valve banks:**

- Type VB: [Page 130](#)
- Type BWH, BWN: [Page 136](#)
- Pressure switches type DG: [Page 270](#)
- Electronic pressure transducer type DT: [D 5440 T/1](#), [D 5440 T/2](#)

# Compact hydraulic power packs

## 1.2 Compact hydraulic power pack type HC and HCW

Compact hydraulic power packs are a type of hydraulic power pack. They are characterised by a highly compact design, since the motor shaft of the electric motor also acts as the pump shaft.

The ready-for-connection compact hydraulic power pack type HC and HCW includes an electric motor which runs in oil. The stator is securely attached to the housing (tank). The compact hydraulic power pack is suitable for hydraulic systems with operating mode S2 or S3. The heat is dissipated via surface convection so that no external cooler is usually necessary.

Either single-circuit systems or dual-circuit systems can be selected. A radial piston pump or external gear pump can be used as a hydraulic pump.

The compact hydraulic power pack type type HC and HCW is suitable as a highly compact control system, since connection blocks and valve banks can be directly mounted.

### Features and benefits:

- Long lifetime and excellent reliability achieved by using radial piston pumps
- Low oil fill volumes make it environmentally sound thanks to small amount of oil to be disposed of and low costs for hydraulic fluid
- Co-ordinated range of valves and accessories from modular system
- Suitable for vertical and horizontal installation

### Intended applications:

- Clamping systems on machine tools and jigs
- Rivets and clinching equipment
- Welding robots
- Lubrication systems



<b>Nomenclature:</b>	Radial piston pump with integrated electric motor (3-phase or 1-phase version)
<b>Design:</b>	Oil immersed hydraulic power pack for intermittent service (S3-service)
<b>p<sub>max</sub>:</b>	Radial piston pump 700 bar Gear pump 180 bar
<b>Q<sub>max</sub>:</b>	Radial piston pump approx. 4.4 lpm (V <sub>g</sub> = 1.6 cm <sup>3</sup> /rev) Gear pump approx. 3.4 lpm (V <sub>g</sub> = 1.3 cm <sup>3</sup> /rev)
<b>V<sub>usable max</sub>:</b>	8 l

### Design and order coding example

HC24 /0,6 - A1/400 - BWH1F-HH-1-1-G24 - 400V 50 Hz

**Motor voltage** 3 ~ 400V 50 Hz, 3 ~ 460V 60 Hz  
1 ~ 230V 50 Hz, 1 ~ 110V 60 Hz (3~phase motor)

**Optional directly mounted directional valve bank**

**Connection block**

**Pump version**

**Single circuit pump**

- Radial piston pump H (3-, 5- or 6-cylinders) or gear pump Z

**Dual circuit pump**

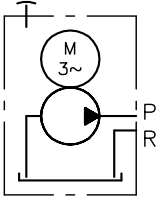
- Combinations:
  - Radial piston pump - gear pump
  - Radial piston pump - radial piston pump

**Basic type, size**

Type HC (3-phase motor) and type HCW (single-phase-motor, power reduction of 30 ... 50% depending on size), size 1 to 2, type HCG (direct current motor), size 1

- Horizontal version with low profile (type HC..L) or vertical version
- Usable volume V<sub>usable</sub> 0.5 l to 1.1 l
- With/without fluid level gauge
- With DC-motor (Type HCG) for short time operation

## Function



## Example circuit:

### HC 24/0.64 -

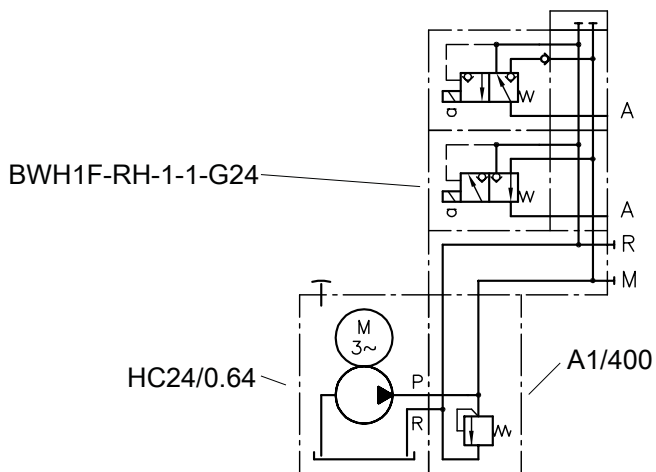
Hydraulic power pack type HC, size 24, pump delivery flow approx. 0.64 lpm

### - A1/400

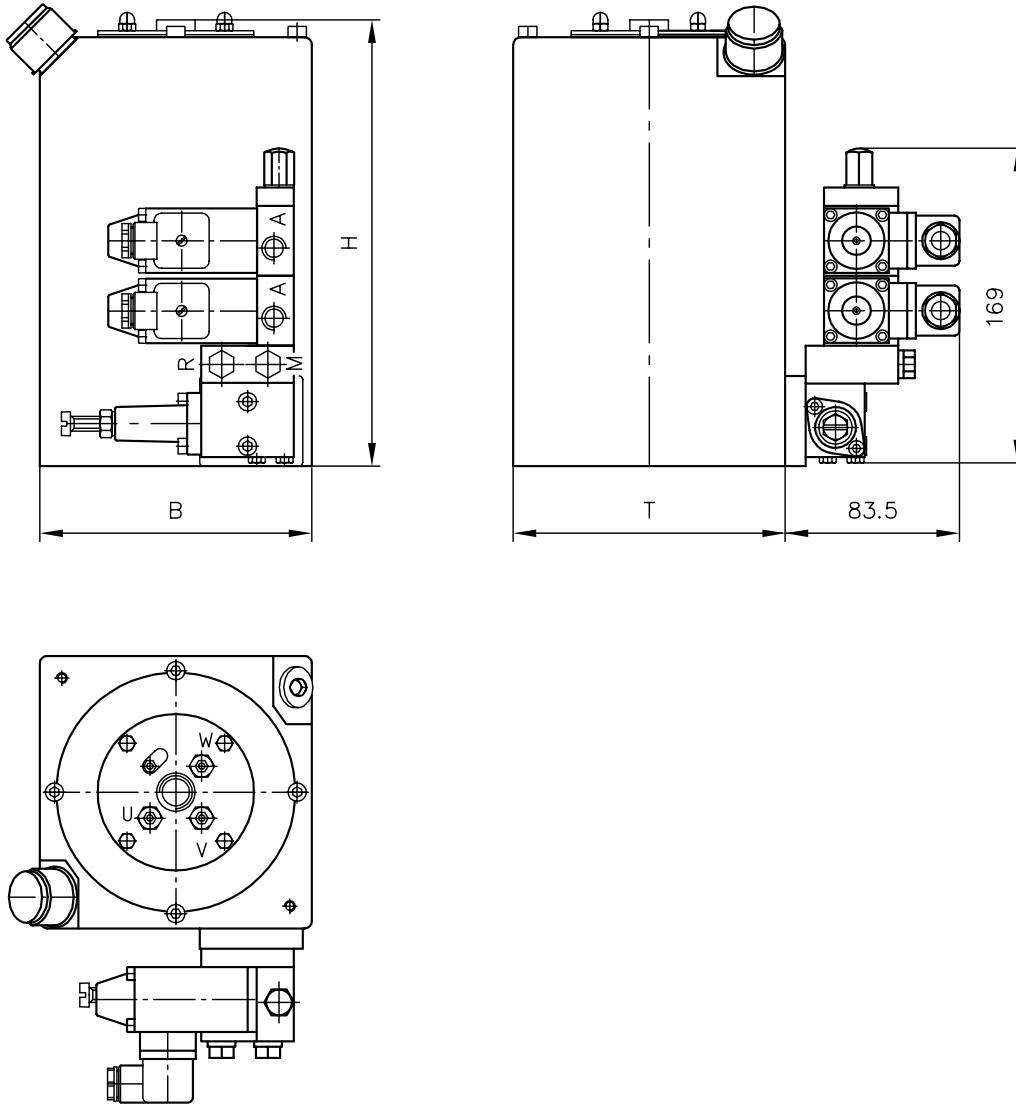
Connection block type A and pressure-limiting valve (400 bar)

### - BWH1F - RH1 - 1 - 1 - G 24

Directly mounted valve bank type BWH1



## General parameters and dimensions



	Radial piston pump (3 cyl.)			Gear pump			$P_N$ [kW] <sup>1)</sup>	m [kg] <sup>2)</sup>	Dimensions [mm]		
	Max. pressure	Delivery flow		Max. pressure	Delivery flow				H	B	T
	$p_{max}$ [bar]	$Q_{pu}$ [lpm] 50 Hz	$Q_{pu}$ [lpm] 60 Hz	$p_{max}$ [bar]	$Q_{pu}$ [lpm] 50 Hz	$Q_{pu}$ [lpm] 60 Hz					
HC 14	700 - 160	0.2 - 1.05	0.2 - 1.2	-	-	-	0.18	6.3	197	120	120
HC 12	600 - 120	0.4 - 2.15	0.5 - 2.5	-	-	-	0.25				
HC 24	700 - 185	0.27 - 2.27	0.3 - 2.7	150	0.4 - 1.6	0.5 - 1.9	0.55	10.1	243	148	148
HC 22	700 - 140	0.52 - 4.41	0.6 - 5.3	150	0.9 - 3.4	1.1 - 4	0.55				

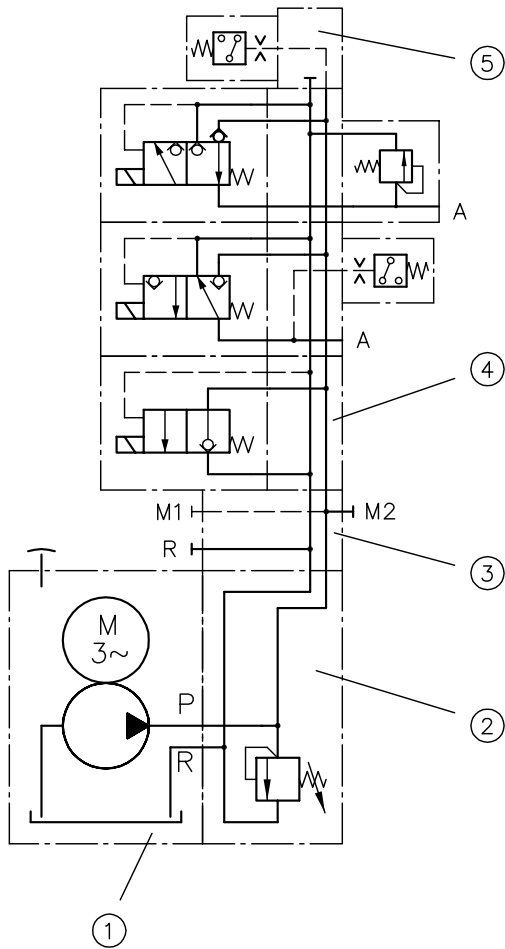
1) The actual power consumption depends on the respective operation pressure and can be up to  $1.5 \times P_N$

2) Without oil filling



**Example circuit:**

HC 24/0.64 - A2/400  
- BWH 1 F 1-DH3 R/230-33-G24  
- 3x400V 50Hz



- 1 Compact hydraulic power pack
- 2 Connection block
- 3 Adapter plate
- 4 Valve section
- 5 End plate

**Associated technical data sheets:**

- [Compact hydraulic power pack type HC and HCW: D 7900](#)
- [Compact hydraulic power pack type HCG: D 7900 G](#)

**Connection blocks:**

- Types A, B and C: [Page 68](#)

**Directly mountable valve banks:**

- Type VB: [Page 130](#)
- Type BWH, BWN: [Page 136](#)

**Directly mountable valve banks:**

- Type SWR, SWS: [Page 92](#)
- Type BA: [Page 70](#)
- Type BVH: [Page 76](#)

# Compact hydraulic power packs

## 1.2 Compact hydraulic power pack type KA and KAW

Compact hydraulic power packs are a type of hydraulic power pack. They are characterised by a highly compact design, since the motor shaft of the electric motor also acts as the pump shaft.

The ready-for-connection compact hydraulic power pack type KA and KAW includes an electric motor which runs in oil. The stator is securely attached to the housing (tank). The compact hydraulic power pack is suitable for hydraulic systems with operating mode S2, S3 or S6. The heat is dissipated via surface convection so that no external cooler is usually necessary.

For systems with high loads, an external fan that enables additional heat dissipation can be optionally mounted on the housing. The fan is powered by a separate motor independently of the pump motor. Type KA includes a 3-phase motor, while type KAW includes a single-phase-motor. The compact hydraulic power pack type KA and KAW is available in horizontal and vertical versions. Modules can be added to the tank so that different usable oil volumes are possible. Either single-circuit systems or dual-circuit systems can be selected. A radial piston pump or external gear pump can be used as a hydraulic pump. The compact hydraulic power pack type KA and KAW is suitable as a highly compact control system, since connection blocks and valve banks can be directly mounted.

### Features and benefits:

- Additional separately driven fan for maximum utilisation of power
- Fill/usable volumes can be flexibly extended by modular tank extensions
- Long lifetime and excellent reliability achieved by using radial piston pumps
- Low oil fill volumes make it environmentally sound thanks to small cost of disposal and low costs for hydraulic fluid
- Co-ordinated range of valves and accessories from modular system
- Suitable for vertical and horizontal installation
- Optimum efficiency thanks to suboil motor cooling, direct transmission of force and cleverly designed heat dissipation

### Intended applications:

- Brake and rotor adjustment modules on wind turbines
- Clamping systems on machine tools and appliances
- Torque wrenches
- Rivets and clinching equipment
- Presses
- Handling systems

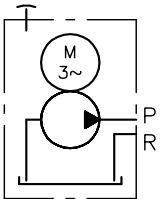


<b>Nomenclature:</b>	Radial piston or gear pump with integrated motor single or dual circuit pump
<b>Design:</b>	Oil immersed hydraulic power pack for intermittent or load/no load operation (S3-service)
<b>p<sub>max</sub>:</b>	Radial piston pump 700 bar Gear pump 180 bar
<b>Q<sub>max</sub>:</b>	Radial piston pump approx. 7 lpm (V <sub>g</sub> = 2.29 cm <sup>3</sup> /rev) Gear pump approx. 24.1 lpm (V <sub>g</sub> = 7.9 cm <sup>3</sup> /rev)
<b>V<sub>tank max</sub>:</b>	2 ... 10 l

## Design and order coding example

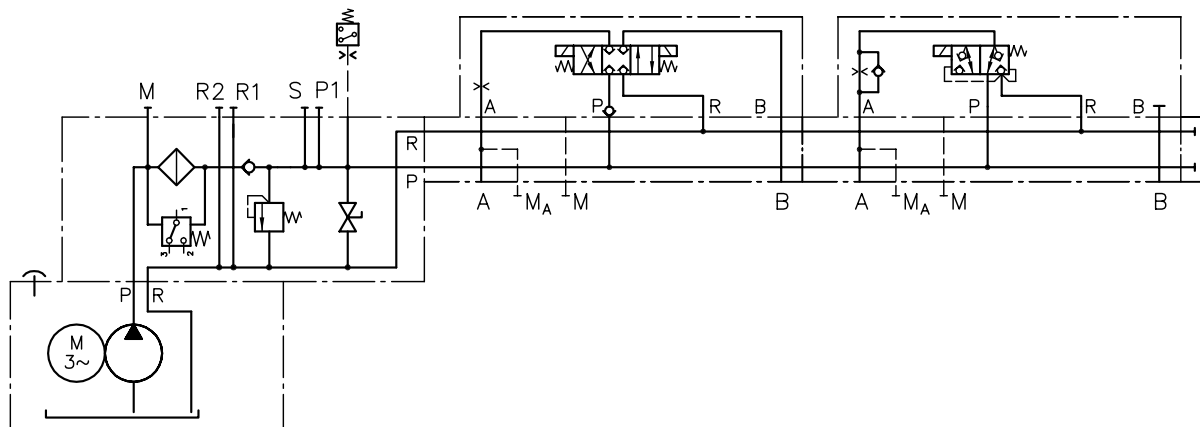
KA28	22	L1	KFTP	/HZ0,59/8,8	- ...	- 3x400V	- G1/2x300
							Oil drain hose
							Motor voltage 3 ~ 400V 50 Hz, 3 ~ 460V 60 Hz, 3 ~ 690V 50 Hz, 1 ~ 230V 50 Hz, 1 ~ 110V 60 Hz (1~phase motor)
							Valve design
			Pump version				<b>Single circuit pump</b>
							▪ Radial piston pump H or gear pump Z
							<b>Dual circuit pump</b>
							▪ with joint connection pedestal for pressure connections P1 and P3
							▪ Combinations: Radial piston pump - radial piston pump (HH) and radial piston pump - gear pump (HZ)
			Additional function				▪ Oil sight glass
							▪ Level gauge with level switch
							▪ Temperature switch
							▪ Silica gel filter (instead of breather filter)
							▪ Additional fans
							▪ Various electrical connection variants (type KA...S)
			Installation position				Horizontal version with low installation heights (type KA..L) or vertical version (type KA..S)
			Tank size [L]				
Basic type, size	Type KA (3~phase motor) and KAW (1~phase motor, power reduction 30 ... 50% dep. on size), size 2 and 4						

## Function

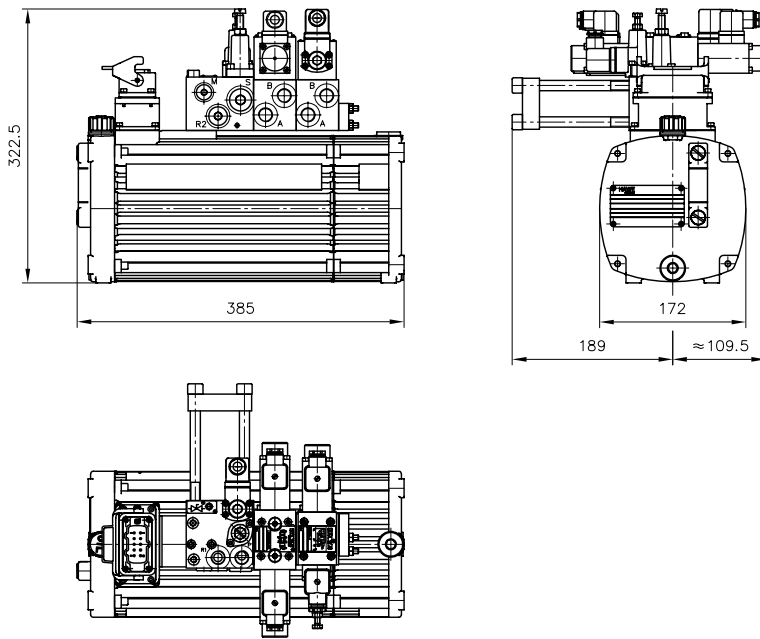


KA 231 LKP/H 0.59 - AX 34 D101VE1B/400 - BA 2

- NBVP 16 G/R/AB 2.0 - M/O  
- NBVP 16 Y/ABR 1.5/4 - M/O  
- 1 - G 24



## General parameters and dimensions

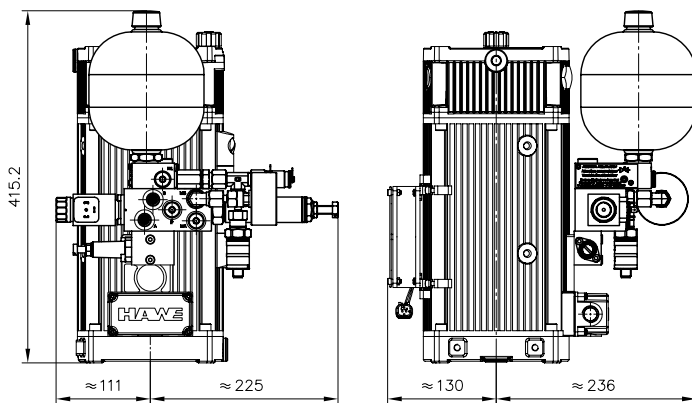
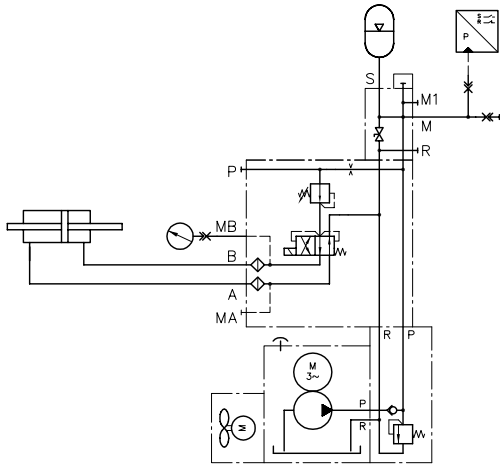


	3-cylinder radial piston pump			6-cylinder radial piston pump			Gear pump			P <sub>N</sub> [kW]
	p <sub>max</sub> [bar]	Q <sub>max</sub> [lpm] 50 Hz	Q <sub>max</sub> [lpm] 60 Hz	p <sub>max</sub> [bar]	Q <sub>max</sub> [lpm] 50 Hz	Q <sub>max</sub> [lpm] 60 Hz	p <sub>max</sub> [bar]	Q <sub>max</sub> [lpm] 50 Hz	Q <sub>max</sub> [lpm] 60 Hz	
KA 21	700 - 45	0,63 - 10,02	0,76 - 12,05	360 - 55	1,26 - 7,84	1,52 - 9,42	170 - 60	2,23 - 6,7	2,68 - 8,04	0,55
KA 22	700 - 140	0,63 - 0,02	0,76 - 12,05	700 - 180	1,26 - 7,84	1,52 - 9,42	170 - 55	2,23 - 22,04	2,68 - 26,47	1,1
KA 23	700 - 60	0,31 - 4,89	0,37 - 5,93	485 - 30	0,62 - 9,79	0,75 - 11,85	170 - 50	1,09 - 4,90	1,32 - 5,94	0,37
KA 24	700 - 160	0,31 - 4,89	0,37 - 5,93	700 - 80	0,62 - 9,79	0,75 - 11,85	170 - 65	1,09 - 10,74	1,32 - 13,04	0,75
KA 26	700 - 160	0,63 - 10,02	0,76 - 12,05	700 - 205	1,26 - 7,84	1,52 - 9,42	170 - 65	2,23 - 22,04	2,68 - 26,47	1,4
KA 28	700 - 185	0,31 - 4,89	0,37 - 5,93	700 - 90	0,62 - 9,79	0,75 - 11,85	170 - 75	1,09 - 10,74	1,32 - 13,04	1,0

	3-cylinder radial piston pump			6-cylinder radial piston pump			Gear pump			P <sub>N</sub> [kW]
	p <sub>max</sub> [bar]	Q <sub>max</sub> [lpm] 50 Hz	Q <sub>max</sub> [lpm] 60 Hz	p <sub>max</sub> [bar]	Q <sub>max</sub> [lpm] 50 Hz	Q <sub>max</sub> [lpm] 60 Hz	p <sub>max</sub> [bar]	Q <sub>max</sub> [lpm] 50 Hz	Q <sub>max</sub> [lpm] 60 Hz	
KA 42	700 - 220	0.84 - 11.8	2.0 - 14.4	700 - 110	3.3 - 23.8	4.0 - 28.9	200 - 130	1.6 - 18.0	2.0 - 22.0	- 2.6 - 3.9
KA 44	700 - 220	1.6 - 5.98	1,01 - 7,25	700 - 110	1,68 - 11,97	2,04 - 14,53	200 - 130	0,84 - 9,1	1,01 - 11,1	- 1,5 - 2,2 - 3,0

**Example circuit:**

KA 281 S16K/H3.61-FSHS-24VDC    -A 14/230  
 -BVH 11 W/CZ52/117GM/B3,5H  
 -82 - AC1002/130/3A  
 -XM 24  
 3x400V 50Hz



**Associated technical data sheets:**

- Compact hydraulic power packs type KA: [D 8010](#), [D 8010-4](#)

**Similar products:**

- Type HC, HCG: [Page 46](#)

**Suitable connection blocks:**

- Types A, B and C: [Page 68](#)

**Directly mountable valve banks:**

- Type VB: [Page 130](#)
- Type BWH, BWN: [Page 136](#)
- Type SWR, SWS: [Page 92](#)
- Type BA: [Page 70](#)
- Type BVH: [Page 76](#)

# Compact hydraulic power packs

## 1.2 Compact hydraulic power pack type MP and MPN

Compact hydraulic power packs are a type of hydraulic power pack. They are characterised by a highly compact design, since the motor shaft of the electric motor also acts as the pump shaft.

The ready-for-connection compact hydraulic power pack type MP, MPW, MPN and MPNW includes an electric motor which runs in oil. The stator is securely attached to the housing (tank). The compact hydraulic power pack is suitable for hydraulic systems with operating mode S2, S3 or S6. The heat is dissipated via surface convection so that no external cooler is usually necessary. Type MP and MPN includes a 3-phase motor, while type MPW and MPNW includes a single-phase-motor. Different tank sizes enable different usable oil quantities. Either single-circuit systems or dual-circuit systems can be selected. A radial piston pump, external gear pump or internal gear pump can be used as a hydraulic pump. The compact hydraulic power pack type MP, MPW, MPN and MPNW is suitable as a highly compact control system, since connection blocks and valve banks can be directly mounted.

### Features and benefits:

- Intermittent or load/no load operation (S2-/S3-/S6-service)
- Long lifetime and excellent reliability achieved by using radial piston pumps
- Low oil fill volumes make it environmentally sound thanks to small cost of disposal and low costs for hydraulic fluid
- Two-stage valves and switch units for press control systems can be directly flange mounted
- Co-ordinated range of valves and accessories from modular system
- Dual-circuit pumps available

### Intended applications:

- Brake and rotor adjustment modules on wind turbines
- Counterbalance as well as machine tools
- Presses and other shaping machines
- Handling and clamping systems on machine tools and fixtures
- Lubrication systems



<b>Nomenclature:</b>	Radial piston and/or gear pump with integrated motor single or dual circuit pump
<b>Design:</b>	Oil immersed hydraulic power pack for intermittent or load/no load operation (S2-/S3-/S6-service)
<b><math>p_{max}</math>:</b>	Radial piston pump 700 bar (high pressure) Gear pump 220 bar (low pressure)
<b><math>Q_{max}</math>:</b>	13.1 lpm (high pressure) ( $V_g = 10.7 \text{ cm}^3/\text{rev}$ ) 83 lpm (low pressure) ( $V_g = 61 \text{ cm}^3/\text{rev}$ )
<b><math>V_{t,max}</math>:</b>	approx. 100 lpm

## Design and order coding example

MPN 44 - H 1,5 - B10.20 D - ... - 3 ~ 230V 50 Hz

**Motor voltage** 3 ~ 230/400V Δγ 50 Hz, 3 ~ 500V γ 50 Hz,  
1 ~ 230V 50 Hz, 1 ~ 110V 60 Hz (single-phase-motor)

### Valve mounting

- Additional options**
- Level gauge
  - Level switch
  - Temperature switch
  - Various means of electrical connection

- Design**
- For installation in self-made oil tanks: as single pump or cover plate version
  - With tank, usable volume  $V_{usable}$  10 l to 75 l

### Pump version

#### Single-circuit pump

- Radial piston pump H or gear pump Z
- Internal gear pump IZ

#### Dual-circuit pump

- Combinations:
  - Radial piston pump - radial piston pump (HH, only MPN)
  - Radial piston pump - gear pump (HZ)

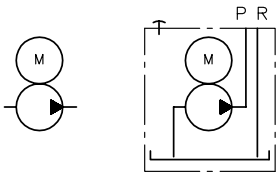
### Basic type, size

Type MP (3-phase motor) and MPW (single-phase-motor), sizes 1 and 2  
Type MPN (3-phase motor) and MPNW (single-phase-motor), size 4  
single-phase-motor, power reduction by 30 ... 50% depending on size

## Function

### Single stage pump

(radial piston pump, gear pump)

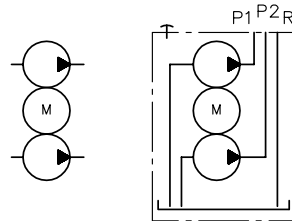


Installation pump

Hydraulic power pack (incl. tank)

### Dual stage pump

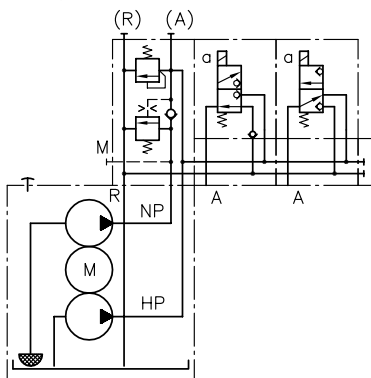
(radial piston/gear pump, gear pump/gear pump)



Installation pump

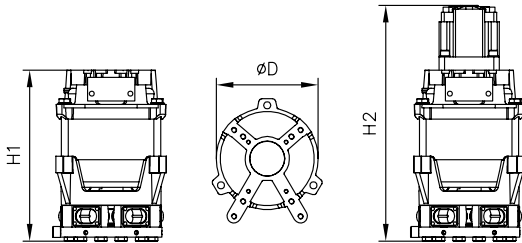
Hydraulic power pack (incl. tank)

### Example circuit:

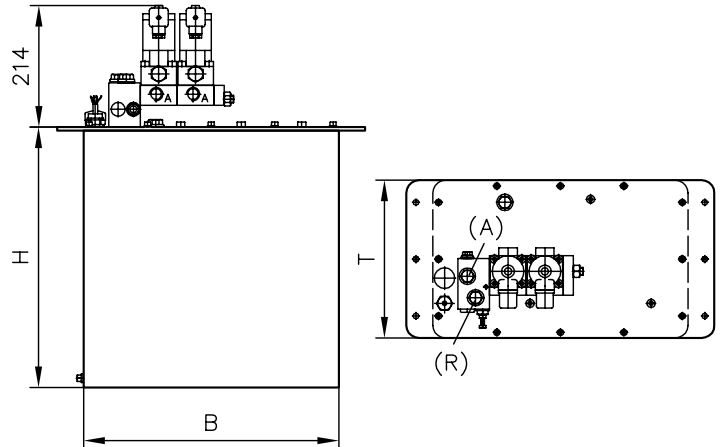


## General parameters and dimensions

### Single-circuit pump, dual-circuit pump (without tank)



### Compact hydraulic power pack (tank with mounted valves)



	Radial piston pump (3 cyl.)			Gear pump			$P_N$ [kW] <sup>1)</sup>	m [kg] <sup>2)</sup>	Dimensions [mm]		
	Max. pressure $p_{max}$ [bar]	Delivery flow		Max. pressure $p_{max}$ [bar]	Delivery flow				H1 <sup>2)</sup>	H2 <sub>max</sub>	ÆD
		$Q_{pu}$ [lpm] 50 Hz	$Q_{pu}$ [lpm] 60 Hz		$Q_{pu}$ [lpm] 50 Hz	$Q_{pu}$ [lpm] 60 Hz					
MP 14	700 - 220	0,27 - 1,07	0,32 - 1,28	150 - 15	0,5 - 6,9	0,6 - 8,29	0,25	5,2/5,0	183/228	249	124
MP 12	700 - 250	0,53 - 2,1	0,64 - 2,52	150 - 60	2 - 6,9	2,4 - 8,28	0,37				
MP 24	700 - 310	0,46 - 1,73	0,55 - 2,08	150 - 35	2 - 12,3	2,4 - 14,76	0,75		195/291	322,5	140
MP 22	700 - 260	0,88 - 3,51	1,06 - 4,21	150 - 18	4 - 41,4	4,8 - 49,68	0,55	9,1/7,7			
MPN 42	700 - 250	2,39 - 7,33	2,87 - 8,8	200 - 60	8,46 - 30,02	10,2 - 36,02	2,1		251/258	431	
MPN 44	700 - 250	1,53 - 5,37	1,84 - 6,44	200 - 55	5,37 - 25,99	6,4 - 31,19	2,1				
MPN 46	700 - 250	3,16 - 11,12	3,8 - 13,34	200 - 40	12,41 - 71,73	14,89 - 86,08	3,0	18,5	274/281	454	165
MPN 48	700 - 330	2,36 - 4,06	2,83 - 4,87	220 - 60	4,16 - 34,91	4,99 - 41,89	3,0				
MPN 404	700 - 340	3,1 - 3,49	3,7 - 4,19	220 - 45	2,7 - 68,16	2,25 - 81,79	4,2		298/313	486	

1) The actual power consumption is dependent on the respective operation pressure and can be up to  $1.5 \times P_N$

2) Values apply to radial piston pump/gear pump versions

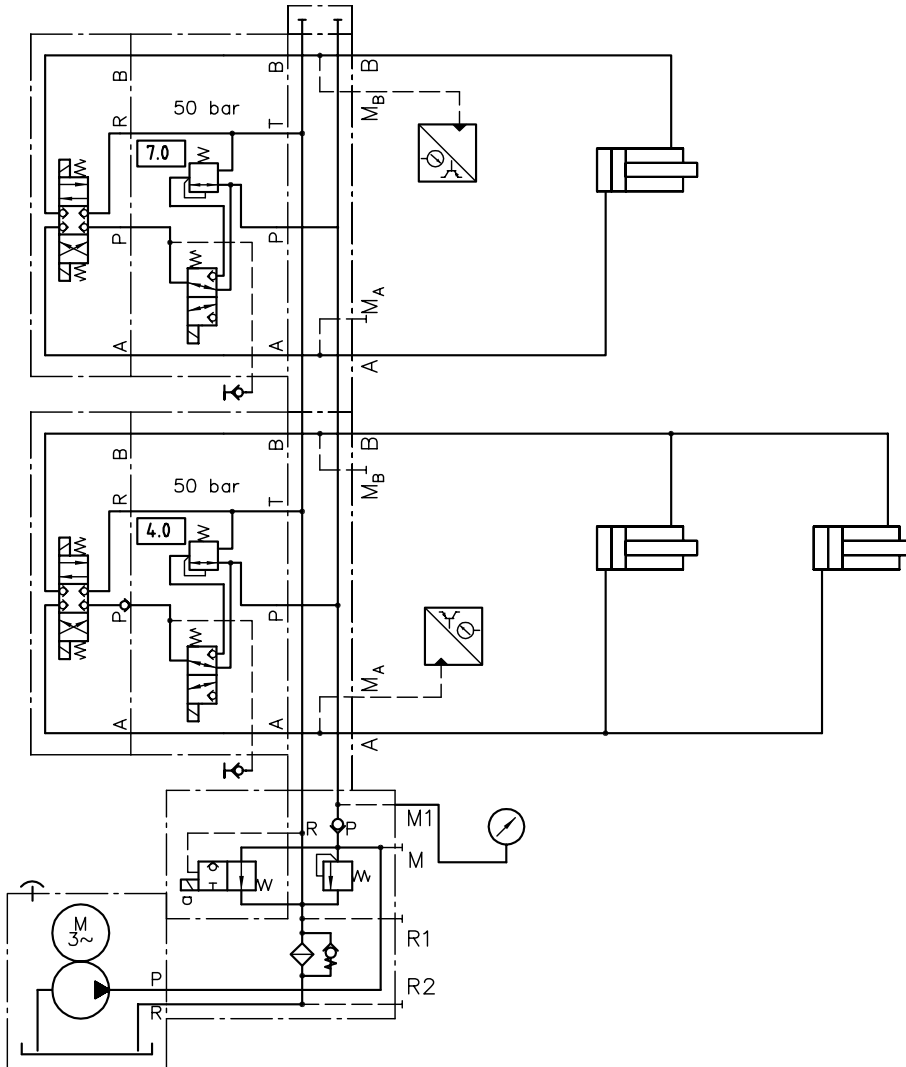
### Version with tank:

Size	Tank size	H [mm]	W [mm]	D [mm]
MP 1.	B 3	225	216	136
MP 1., MP 2.	B 5	265	258	160
MP 2., MPN 4.	B 10	358	324	200
MPN 4.	B 25	458	402	250
	B 55	470	560	350
	B 110	495	560	350
	B 25 L	283	623	250
	B 55 L	305	560	350



**Example circuit:**

MPN 44-Z 8.8-B 10 KT      -AS 1 F 3/160  
 -BA 2  
 -NBVP 16 G/R-GM/NZP 16 LZ 5/50-G 8 MA/GM/3-X 84 V-DG 5E-250-1/4  
 -NBVP 16 G-GM/NZP 16 LZ 5/50-G 8 MA/GM/3-X 84 V-DG 62  
 -1-G 24  
 -X 84 V-9/250  
 -3 x 400/230 V 50 Hz



**Associated technical data sheets:**

- Compact hydraulic power packs type MP, MPW: [D 7200](#), [D 7200 H](#)
- Compact hydraulic power pack type MPN and MPNW: [D 7207](#)
- Type SWR, SWS: [Page 92](#)
- Type BA: [Page 70](#)
- Type BVH: [Page 76](#)

**Connection blocks:**

- Types A, B and C: [Page 68](#)

**Directly mountable valve banks:**

- Type VB: [Page 130](#)
- Type BWH, BWN: [Page 136](#)

# Compact hydraulic power packs

## 1.2 Compact hydraulic power pack type HK, HKF and HKL

Compact hydraulic power packs are a type of hydraulic power pack. They are characterised by a highly compact design, since the motor shaft of the electric motor also acts as the pump shaft.

The ready-for-connection compact hydraulic power pack type HK, HKF, HKL and HKLW includes an electric motor which runs in oil. The stator is securely attached to the housing (tank). The compact hydraulic power pack is suitable for hydraulic systems with operating mode S2, S3 or S6. A fan, which effectively dissipates the heat from the hydraulic system, is mounted on the housing. In the case of type HKF, the fan is powered by a separate motor independently of the pump motor. For type HK, HKL and HKLW, the fan is securely attached to the motor shaft. An external cooler is not generally required. Type HK, HKF and HKL includes a 3-phase motor, while type HKLW includes a single-phase-motor. The compact hydraulic power pack type HK and HKF has a vertical housing, while type HKL and HKLW has a horizontal housing. Single-circuit, dual-circuit or triple-circuit systems can be selected. A radial piston pump, an external gear pump or an internal gear pump can be used as a hydraulic pump.

The compact hydraulic power pack type HK, HKF, HKL and HKLW is suitable as a highly compact control system, since connection blocks and valve banks can be directly mounted.

### Features and benefits:

- Suited for permanent and intermittent operation (S1/S6 service)
- Additional separately driven fan for maximum utilisation of power
- 3 sizes enable wide field of application
- Radial piston pumps ensure long lifetime and high reliability
- Small filling volume minimize costs for fluid and fluid disposal
- Matching valve and accessories from a modular system
- Available as single to triple circuit pump

### Intended applications:

- Clamping systems on machine tools and turning centres
- Welding machines, roboter
- Endurance test benches
- Endurance test bench construction
- Torque wrench



<b>Nomenclature:</b>	Radial piston pump and/or gear pump with integrated motor (version for 3-phase mains)
<b>Design:</b>	Oil immersed compact hydraulic power pack for permanent and intermittent operation (S1/S6 service)
<b>p<sub>max</sub>:</b>	700 bar (radial piston pump) 180 bar (gear pump)
<b>Q<sub>max</sub>:</b>	Radial piston pump (high pressure) approx. 13 lpm ( $V_g = 9.15 \text{ cm}^3/\text{rev}$ ) Gear pump (low pressure) 24 lpm ( $V_g = 17.0 \text{ cm}^3/\text{rev}$ )
<b>V<sub>usable max</sub>:</b>	approx. 11.1 l

## Design and order coding example

HK 34 8 LST - H 3,6 3 x 400V 50Hz

**Motor voltage** 3 ~ 230/400V  $\Delta$ y 50 Hz, 3 ~ 265/460V  $\Delta$ y 60 Hz  
1 ~ 230V 50 Hz, 1 ~ 115V 60 Hz (1~phase motor)

**Pump version** **Single circuit pump**

- Radial piston pump H, gear pump Z, internal gear pump IZ

**Dual circuit pump with joint connection pedestal for pressure ports P1 and P3**

- Combinations:
  - Radial piston pump - radial piston pump (HH)
  - Radial piston pump - gear pump (HZ)

**Dual circuit pump with separate connection pedestals**

- Radial piston pump H or gear pump Z

**Additional functions**

- Temperature and level switch, single or double version
- Additional leakage port (Type HK 4.L)

**Tank size** Type HK: Usable volume  $V_{usable}$  0.85 l to 15.4 l, Type HKL: Usable volume  $V_{usable}$  1.7 l to 9.1 l

- Various filler neck designs

**Basic type, size**

Type HK, size 2 to 4, type HKF (with auxiliary blower for increased cooling), size 4  
Type HKL (3~phase motor) and HKLW (1~phase motor), size 3

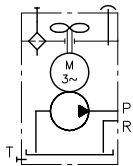
**Additional versions:**

- With molded motor
- With frequency-controlled drive

## Function

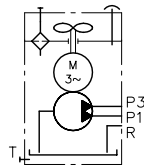
### Single stage pump

(radial piston pump, or gear pump)

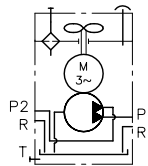


### Dual stage pump

(radial piston/radial piston pump, or gear pump/gear pump, or radial piston pump/gear pump)



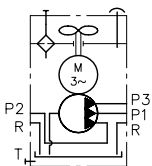
Joint pump pedestal



Separate pump pedestals

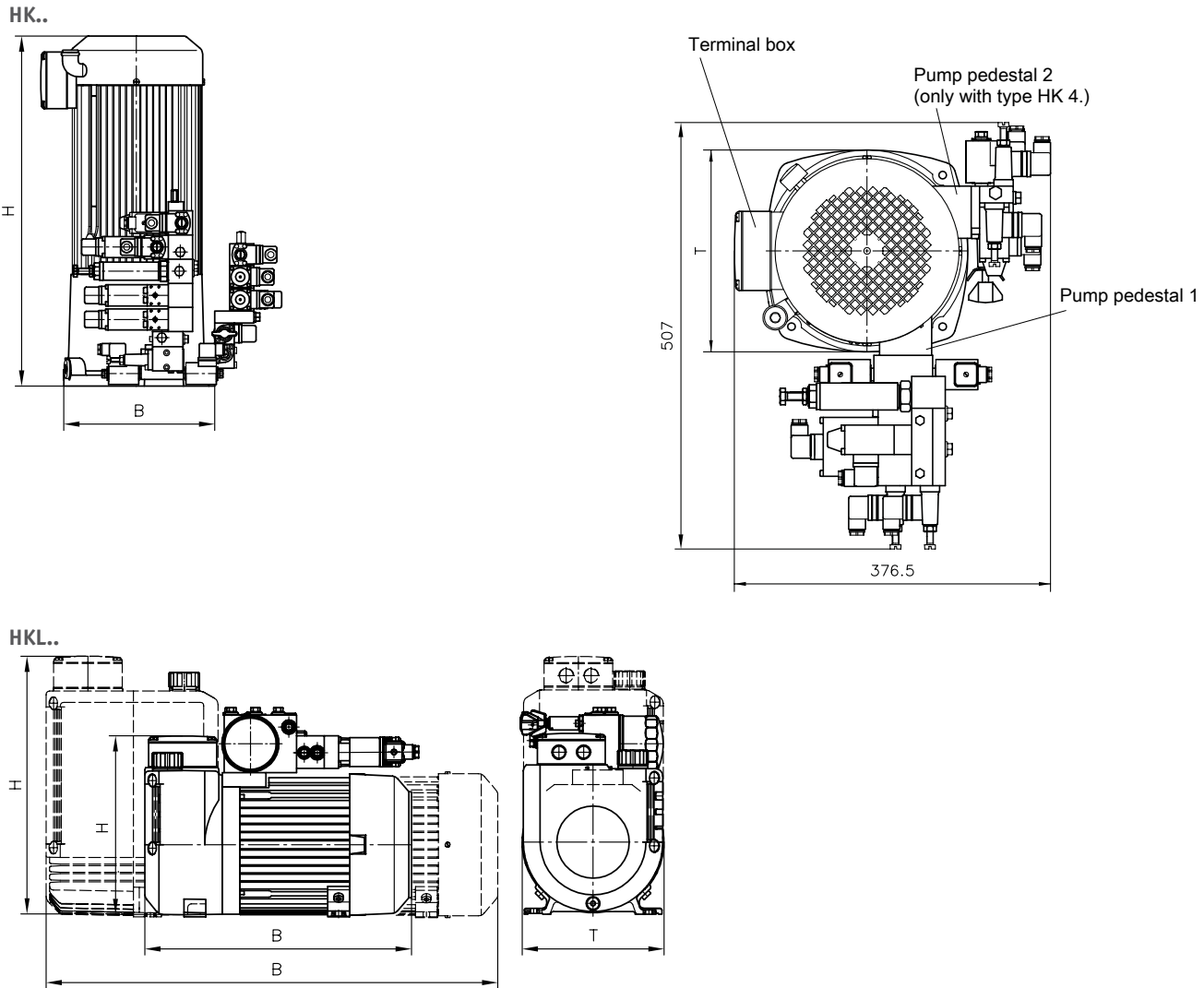
### Triple-circuit pump

(only radial piston pump)



Separate pump pedestals

## General parameters and dimensions



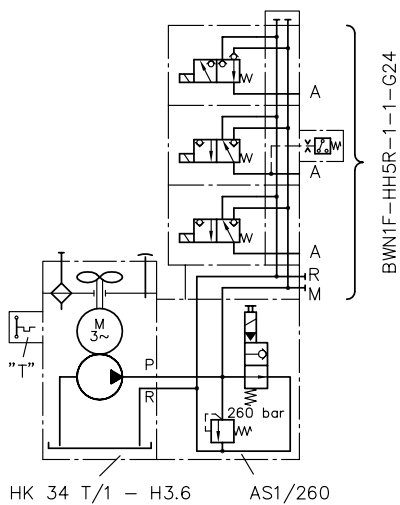
	Radial piston pump			Gear pump			Dimensions [mm]				
	Max. pressure	Delivery flow		Max. pressure	Delivery flow						
	$p_{max}$ [bar]	$Q_{pu}$ [lpm] 50 Hz	$Q_{pu}$ [lpm] 60 Hz	$p_{max}$ [bar]	$Q_{pu}$ [lpm] 50 Hz	$Q_{pu}$ [lpm] 60 Hz	$P_N$ [kW] <sup>1)</sup>	$H_{max}$	B	T	m [kg]
HK 24	700 - 220	0.46 - 1.77	0.55 - 2.12	-	-	-	0.55	340	196	196	13
HK 33	560 - 100	1.25 - 6.5	1.5 - 7.8	170 - 100	2.7 - 6.9	3.24 - 8.28	0.8	405	212	212	20.5
HK 34	700 - 170	1.25 - 6.5	1.5 - 7.8	170 - 160	2.7 - 6.9	3.24 - 8.28	1.1	405	212	212	20.5
HK(F) 43	610 - 90	2.08 - 13.1	3.36 - 15.72	170 - 80	4.5 - 16	3.29 - 19.2	1.5	460	240	240	29
HK(F) 44	700 - 130	2.08 - 13.1	2.5 - 15.72	170 - 110	4.5 - 24	3.29 - 28.8	2.2	460	240	240	29
HK(F) 48							3	833	240	240	40
HKL(W) 32	700 - 220	1.65 - 8.7	1.98 - 10.44	170 - 130	2.7 - 11.3	3.24 - 13.56	1.8	358	617	196	19.2
HKL(W) 34											
HKL 38	700 - 220	1.65 - 8.7	1.98 - 10.44	170 - 130	2.7 - 11.3	3.24 - 13.56	2.2	358	617	196	22.2

1) The actual power consumption is dependent on the respective operation pressure and can be up to  $1.5 \times P_N$

**Example circuits:**

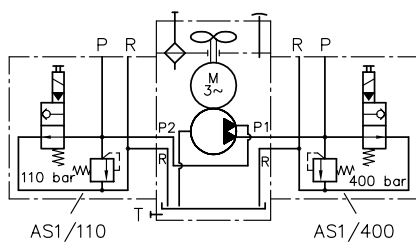
**HKF 489 LD-DT55T65/1P11M-Z11,3**

Compact hydraulic power pack HKF 489 with drain port (coding L) level switch with two switch points (coding D-D); temperature switch with two switch points (coding T55 T65) with Harting plugs coding P1 and oil filler (coding P11).



**HK44 /1-H 2.5-Z 6.9-AS1/400-AS1/110-G24**

Compact hydraulic power pack type HK 44 with radial piston pump H 2.5 and gear pump Z 6.9 on separate pump pedestals, each with connection block (type AS1/..) with pressure-limiting valve (400 bar and 110 bar) and idle circulation valve (connection of valve banks possible)



**Associated technical data sheets:**

- [Compact hydraulic power pack type HK 4: D 7600-4](#)
- [Compact hydraulic power pack type HK 3: D 7600-3](#)
- [Compact hydraulic power pack type HK 2: D 7600-2](#)
- [Compact hydraulic power pack type HKL and HKLW: D 7600-3L](#)

**Connection blocks:**

- Types A, B and C: [Page 68](#)

**Directly mountable valve banks:**

- Type VB: [Page 130](#)
- Type BWH, BWN: [Page 136](#)
- Type SWR, SWS: [Page 92](#)
- Type BA: [Page 70](#)
- Type BVH: [Page 76](#)

# Standard power packs

## 1.2 Radial piston pump type R, RG and RZ

Radial piston pumps are a type of hydraulic pump. They consist of valve-controlled pump cylinders that are arranged radially.

The radial piston pump type R, RG and RZ has a closed pump housing. Therefore, besides use as a motor pump outside an oil tank, installation in the container of a hydraulic power pack is also possible. The radial piston pump is available with several pressure outlets which enable the same or several different flows. Type RZ is a classic dual-stage pump consisting of a radial piston pump and a gear pump. The radial piston pump type RG has plain bearings which have a longer storage life. This type is therefore used in extreme operating conditions.

Extremely high volumetric flows can be achieved by arranging up to 6 radials in parallel. When the radial piston pump is used in the hydraulic power pack, it is suitable for use as a highly compact control system. Connection blocks and valve banks can be mounted on the cover plate of the hydraulic power packs.

### Features and benefits:

- High level of efficiency
- Compact design
- Max. 14 separate pressure outlets
- Available from the modular product range as a hydraulic power pack with valve banks

### Intended applications:

- Press construction
- Jig construction
- Testing and laboratory devices
- Lubricating systems



<b>Nomenclature:</b>	Radial piston pump
<b>Design:</b>	Motor pump Hydraulic power pack
<b>p<sub>max</sub>:</b>	700 bar
<b>Q<sub>max</sub>:</b>	91.2 lpm (V <sub>g</sub> = 64.18 cm <sup>3</sup> /rev)
<b>V<sub>tank max</sub>:</b>	approx. 470 l

### Design and order coding example

R 11,6 / M 7,5 K

- Options**
- Fluid level gauge, level switch
  - Temperature switch

- Function, drive**
- Motor pump**
- With/without industrial standard motor (output P<sub>N</sub> in kW)

### Hydraulic power packs

- Tank version, with/without standard motor
- Cover plate version (for installation on customer furnished tanks), with/without industrial standard motor

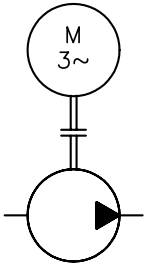
- Basic type, delivery flow [lpm]**
- Type R (version with roller bearing)
  - Type RG (version with plain bearing)
  - Type RZ (dual-stage pump)

### Additional versions:

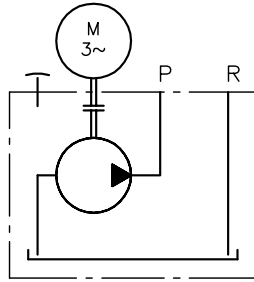
- With several pressure ports

## Function

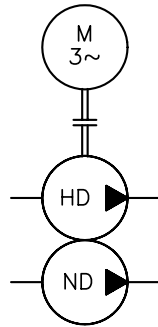
Motor pump type R and RG



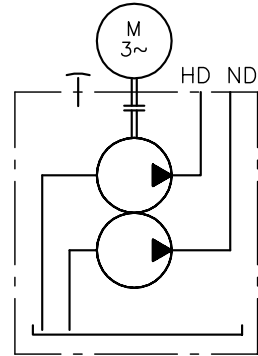
Hydraulic power pack type R and RG



Motor pump type RZ

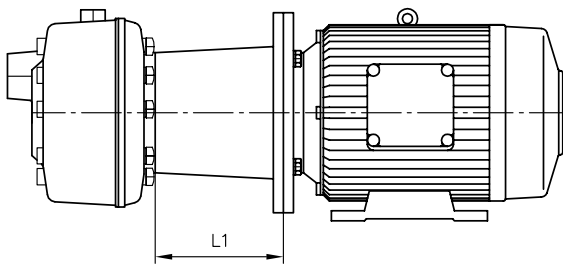


Hydraulic power pack type RZ

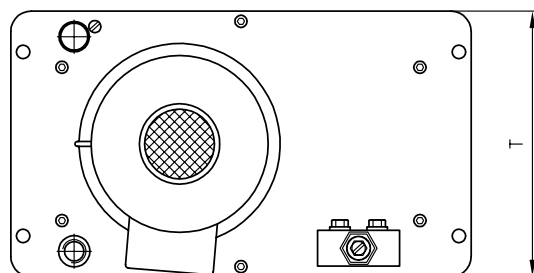
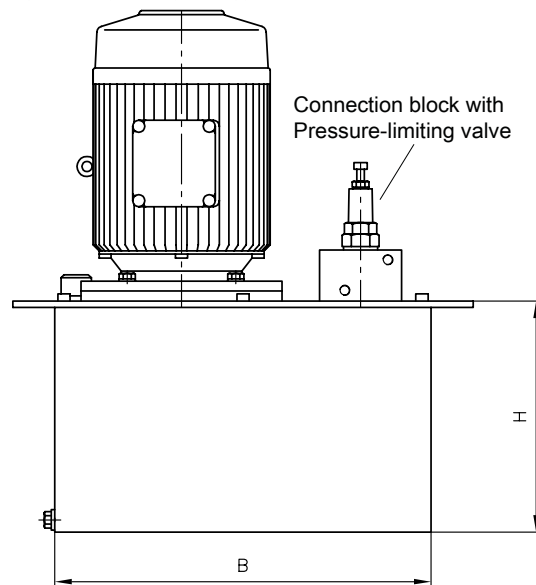


## General parameters and dimensions

Motor pump type R and RG



Hydraulic power pack type R, RG and RZ



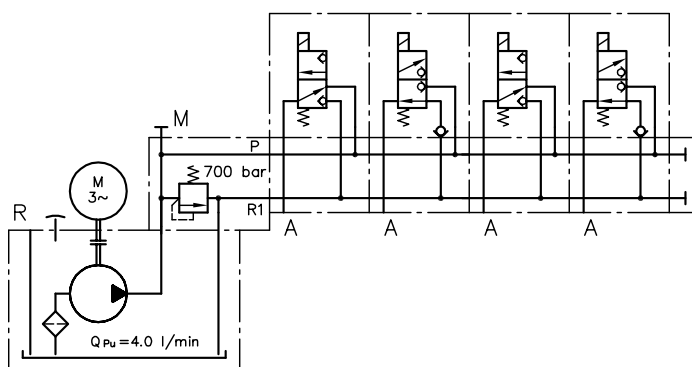
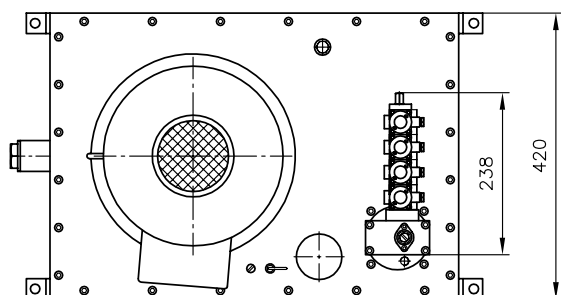
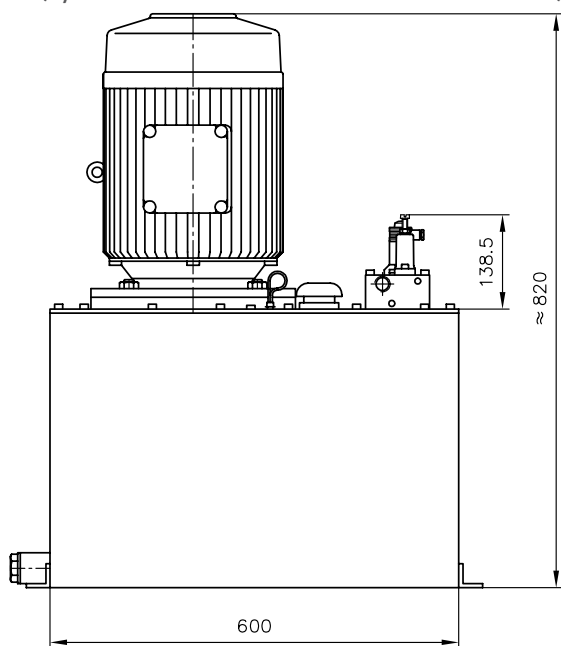
For dimensions of motor pumps and hydraulic power packs, see [Page 62](#)

## Hydraulic power pack:

Tank size	H [mm]	B [mm]	T [mm]	V <sub>max</sub> tank [L]
B 6	230	253	315	9.3
B 13	230	368	260	17
B 20	320	368	260	25
B 30	320	448	320	39
B 40	320	448	440	55
B 50	403	600	420	85
B 75	478	600	420	107
B 100	536	650	500	152
B 160	666	650	500	193
B 250	575	1000	600	309
B 400	825	1000	600	469

### Circuit example 1:

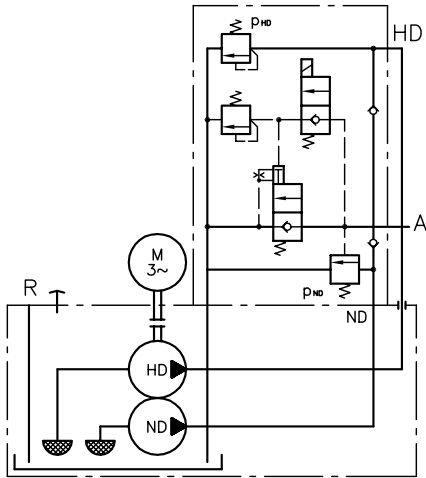
R 4,0/B 50 A 700 - VB 11 DM - HRHR - 1 - G 24 - V 5,5





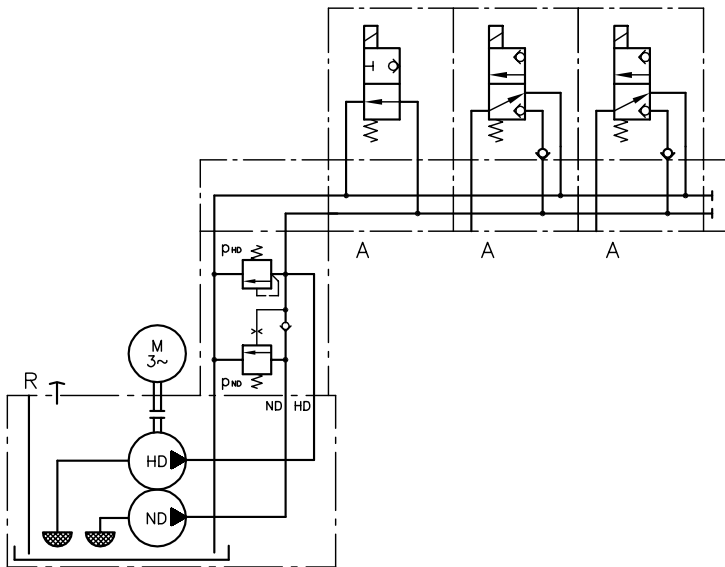
**Circuit example 2:**

RZ 6,0/2-24/B50-V3 - CR4M-280/30



**Circuit example 3:**

RZ 1,4/2-16/B100-V3 - NE21-700/55 - VB 21 GM - FNN - 2 - G24



**Associated technical data sheets:**

- [Radial piston pump type R and RG: D 6010](#)
- [Motor pump and hydraulic power pack type R and RG: D 6010 H](#)
- [Radial piston pumps with several pressure connections type R, RG: D 6010 D, D 6010 DB](#)
- [Radial piston pump type R and RG with one main pressure connection and one or two ancillary pressure connections: D 6010 S](#)

**Directly mountable valve banks:**

- [Type VB: Page 130](#)
- [Type BWH\(N\): Page 136](#)
- [Type SWR: Page 92](#)

# Standard power packs

## 1.2 Air-driven hydraulic pump type LP

Air-driven hydraulic pumps are pneumatically driven, reciprocally acting plunger pumps. They operate as pneumatic pressure boosters with oscillating movement and automatic stroke reversal control.

The air-driven hydraulic pump type LP can generate up to 1500 bar. It is available as a single pump or as a hydraulic power pack with different tank sizes and valve banks. The delivery flow is dependent on the air pressure set and the flow resistance currently present. It can decay to standstill.

Applications are in laboratory presses, in fixture design, in lubrication systems or in potentially explosive atmospheres.

### Features and benefits:

- High operating pressures
- Suitable for explosion-proof systems and equipment  
No electrical energy
- Hydraulic power packs with direct valve mounting

### Intended applications:

- Construction and construction materials machinery
- fixture design
- Testing and laboratory equipment



<b>Nomenclature:</b>	Air driven hydraulic pumps
<b>Design:</b>	Hydraulic power pack
<b><math>P_{\text{hydraulicmax}}</math>:</b>	160...1500 bar
<b><math>P_{\text{airmax}}</math>:</b>	10 bar
<b><math>Q_{\text{max}}</math>:</b>	0.9...12 lpm

### Design and order coding example

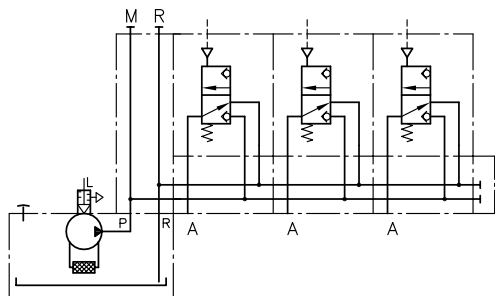
LP 125 - 16 /B4 VB 11 LP - HHH - 1

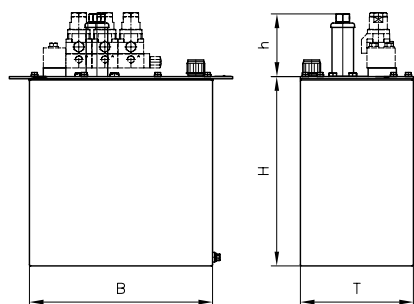
- Valve mounting**
- Valve bank type VB
  - Valve bank type BWN and BWH

- Design** **Hydraulic power pack**
- Tank version, usable volume  $V_{\text{usable}}$  5 l to 28 l
  - Cover plate version (for installation in self-manufactured oil tanks)

**Basic type, size** Type LP, size 80, 125, 160

### Function

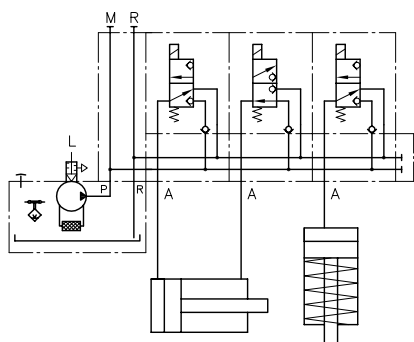


**General parameters and dimensions**


Basic type and size	B	H	T	h	V <sub>max</sub> tank (l)	m (kg)
LP 80-..B4	200	242,5	200	94	7	5,7
LP 125-..B4	200	242,5	200	110	5,8	5,7
LP 125-..B10	324	332,5	200	132	16,6	8,5
LP 125-..B25	402	410	250	130	34	15,1
LP 160-..B10	324	332,5	200	132	13,5	8,5
LP 160-..B25	402	410	250	130	33	15,1

**Example circuit:**

LP 125-10/B 10 D  
 -VB 11 LM-NRN-1-G 24



Hydraulic power pack in tank, version with air-driven hydraulic pump type LP125-10, tank size B10 as well as float switch D (normally closed) and valve bank type VB11 attached.

**Associated technical data sheets:**

- [Air-driven hydraulic pump type LP: D 7280](#)
- [Hydraulic power pack type LP: D 7280 H](#)

**Valve banks :**

- Type VB: [Page 130](#)
- Type BWH(N): [Page 136](#)

# Mounted valves

## 1.2 Connection block type A, B and C

A mounted valve represents the connecting link between the hydraulic power pack and the hydraulic control. Mounted valves can be combined with compact hydraulic power packs, for example.

A valve bank can be directly attached to the connection block type A such that a compact hydraulic control unit is produced. As standard the type A contains a pressure-limiting valve that can be supplemented with a pressure or return line filter, or an idle circulation valve, among other items. The connection block type B controls single-acting cylinders, e.g. in pallet lifting equipment. The integrated pressure-limiting valve limits the maximum lifting force. The lowering speed is adjusted using the integrated throttle. The connection block type C has only a pump and return port and is used in hydraulic systems with decentral valve blocks.

The connection blocks type A, B and C can be combined, e.g. with the compact hydraulic power packs type KA, HK and MPN.

### Features and benefits:

- Enables compact and sturdy direct mounting of ongoing components at the compact power packs of HAWE Hydraulik
- Intermediate plates enable versatile addition of other components
- Efficient and space saving solution for mounting individual valves or valve banks to single and dual circuit pumps
- Pressure and return line filter, pressure limiting valves, switches etc. can be integrated

### Intended applications:

- Lifting devices
- Machine tools
- Modules for braking or rotor blade adjustment at wind power systems
- Tracking systems for solar panels and parabolic antennas

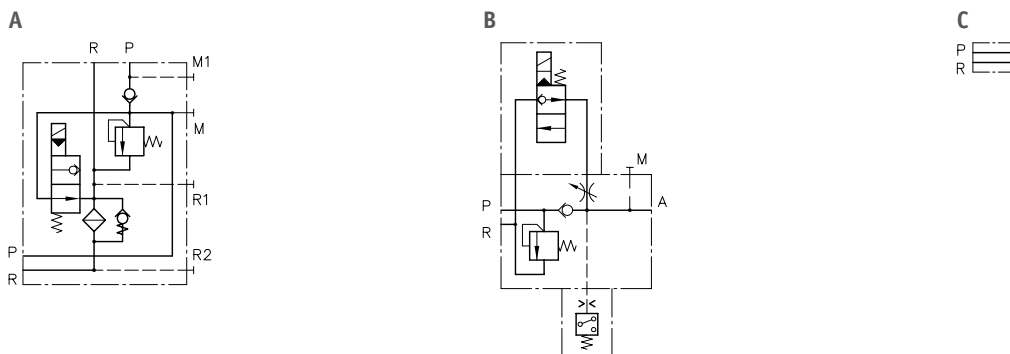


<b>Nomenclature:</b>	Connection blocks to the completion of hydraulic power packs
<b>Design:</b>	Add-on valve enabling pipe connection or direct mounting of valve banks
<b>p<sub>max</sub>:</b>	700 bar
<b>Q<sub>max</sub>:</b>	approx. 20 lpm

### Design and order coding example

AS3F2	/420	- G24
		<b>Solenoid voltage</b> 12V DC, 24V DC, 230V AC
		<b>Pressure setting (bar)</b>
<b>Basic type</b>	<b>Type A, B, C</b> see table	

### Function



### Options, type A, B, C

**Type A** with pressure-limiting valve (pre-set or manually adjustable, also with unit approval)

- For direct pipe connection
- To attach valve banks

#### Options:

- Check valve in P gallery
- Prop. pressure-limiting valve
- Return line filter, Pressure filter
- Idle circulation valve (solenoid-actuated)
- Shut-off valve, accumulator charging valve

**Type C** without additional elements

- For direct pipe connection

#### Options:

- For pipe connection (pump side) of all type A, B connection blocks (Type C15, C16 - connection block with hole pattern of the pump, type C36)

**Type B** with pressure-limiting valve to actuate single- and double-acting cylinders

- For direct pipe connection

#### Options:

- Check valve in P gallery
- Throttle for regulating the drain speed
- Idle circulation valve open or closed in neutral position
- Pressure switch in P gallery
- Automatic clamping and releasing via the pressure switch (type B..DW)

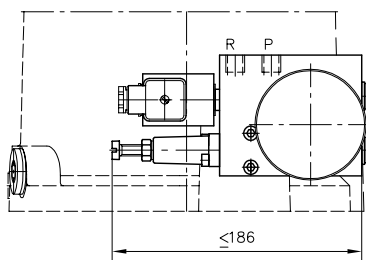
#### Additional versions

- Connection blocks for dual-stage pumps
- Intermediate blocks for dual-stage pumps type S, V, C30
- Spacer plates for single and dual-circuit pumps type U.
- Additional intermediate block for second pressure stage type V, S

### General parameters and dimensions

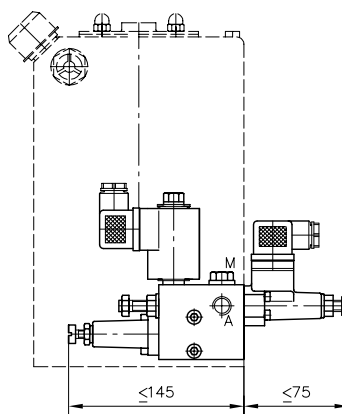
#### AS ..

Example: HK 44/1 - H 2.08 - ASX 3 F2/400 - G 24



#### B..

Example: HC 14/1.95 - B 31/180 - EM 11V - 13/3 - G 24



#### Associated technical data sheets:

- [Connection blocks type A for hydraulic power packs: D 6905 A/1](#)
- [Connection block type AX, with unit approval: D 6905 TUV](#)
- [Connection blocks type B for hydraulic power packs: D 6905 B](#)
- [Connection block type C 5 and C 6: D 6905 C](#)

#### Suitable compact hydraulic power packs:

- See "Compact hydraulic power packs" section

#### Products with shared connection pattern:

- Two-stage valves type NE 21: [Page 198](#)
- Switch units type CR: [Page 154](#)

#### Suited valve banks for combination:

- Type VB: [Page 130](#)
- Type BWH, BWN: [Page 136](#)
- Type SWR, SWP, SWS: [Page 92](#)
- Type BA: [Page 70](#)
- Type BVH: [Page 76](#)

# Mounted valves

## 1.2 Valve bank (nominal size 6) type BA

A valve bank combines different valves for operating independent consumers. The directional valve bank type BA consists of several valve sections that are fitted to sub-plates with NG 6. Using these items compact control blocks can be assembled flexibly. The intermediate plates type NZP make possible additional functions and contain, e.g., pressure-reducing valves, shock valves, load-holding valves etc. An intermediate plate can be inserted between the sub-plate and the valve. The valve bank type BA can be flange-mounted directly on the compact hydraulic power pack.

### Features and benefits:

- Sub-plates for flexible combination of directional valve types with NG 6 (CETOP) standard connection pattern
- Valve bank can be flange mounted directly on the connection block of a compact hydraulic power pack or connected as a separately arranged valve bank for pipe connection
- Pressure switches and/or any other monitoring elements can be connected directly
- Additional elements, such as orifices, throttles and check valves for connections P, R, A and B can be integrated
- Hydraulic accumulator can be mounted directly

### Intended applications:

- Clamping systems on machine tools and equipment
- Process control on deforming machine tools
- Brake and rotor adjustment modules on wind turbines



<b>Nomenclature:</b>	Sub-plates/directional seated valve, zero leakage
<b>Version:</b>	Valve section with sub-plates for pipe connection
<b>Actuation:</b>	Solenoid Pressure-operated <ul style="list-style-type: none"><li>▪ Hydraulic</li><li>▪ Pneumatic</li></ul> Manual Mechanical <ul style="list-style-type: none"><li>▪ Pin</li><li>▪ Roller</li></ul>
<b>p<sub>max</sub>:</b>	500 bar
<b>Q<sub>max</sub>:</b>	50 lpm

## Design and order coding example

BA2 A5	NBVP16 NBVP16 NSWP2	S G G	B0,8 R B0,6 R	/ABR2,0/BBR1,5 /ABR1,0/BBR1,5	/A3B9/400 /50	/S /S	/0 /3 /0	- 1	- G24
--------	---------------------------	-------------	------------------	----------------------------------	------------------	----------	----------------	-----	-------

**Solenoid voltage** 12V DC, 24V DC, 230V AC, 110V AC

**End plate**

- Drain valve with/without pressure switches
- with one or two accumulator ports with/without release valve and/or with/without drain valve

**Sub-plate**

- Check valves with release
- Throttle
- Additional pressure gauge connections

**Additional elements in R** Return pressure stop

**Pressure switch/pressure gauge** in A and/or B

**Additional elements in A, B** Throttle check valve in A and/or B  
Throttle valve in A and/or B

**Additional elements in P** Check valve  
Orifice

**Circuit symbol of the directional valve**

- Valve sections**
- Directional valves**
- Type NSMD2, NSWP2, NBVP16, NBMD16, NG...-1, NZP16
- Intermediate plates for series connection**
- Type CZ: with pressure-reducing valve in P gallery
- Intermediate plates for parallel connection type NZP**
- with throttle and/or throttle check valves
  - with pressure-reducing valves
  - with short-circuit and by-pass valves
  - for random switching of a 2nd speed

- Connection block**
- Direct mounting onto type A, AF etc. connection blocks (for type KA, MP, MPN, HC, HK(F), HKL compact hydraulic power packs)
  - Variant for pipe connection with/without pressure-limiting valve (A5)

## Function

### Connection blocks/adapter plates:

#### BA2 ..

Direct mounting onto type A, AF etc. connection blocks at type KA, MP, MPN, HC, HK(F), HKL compact hydraulic power packs

#### BA2 A5

Version for pipe connection without pressure-limiting valve



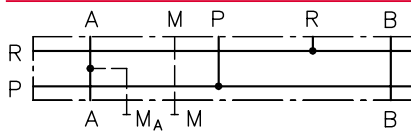
#### BA2 A8

Like version BA2 A5 but with check valve in R

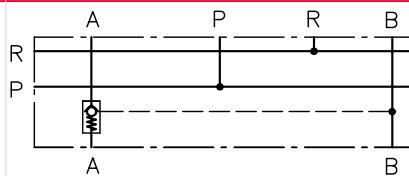


### Sub-plates for plate assembly valve

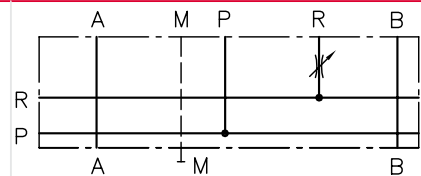
#### BA2.../0



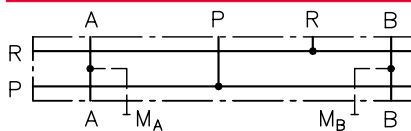
#### BA2../1



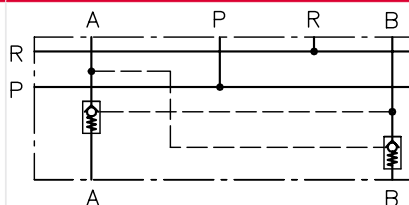
#### BA2../2



#### BA2../3



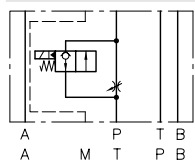
#### BA2../5



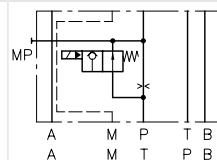
### Valve section additional options

Intermediate plates for 2nd speed with orifice/throttle in P and T gallery

/NZP16(T)V/P(T)Q20...

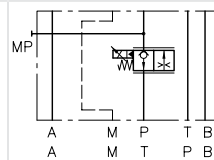


/NZP16(T)S/P(T)B...

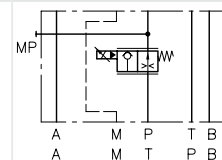


Intermediate plate for variable speed adaptation via proportional throttle in P and T gallery

/NZP16(T)VP



/NZP16(T)SP



Example: .../NZP16TV/TB1.0/...

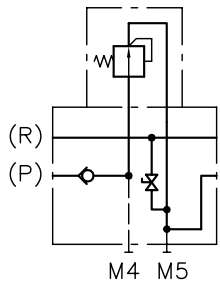
Type B1.0 orifice and type EM21V by-pass valve in T gallery

Example: .../NZP16VP/...

Type EMP21V proportional throttle valve in P gallery

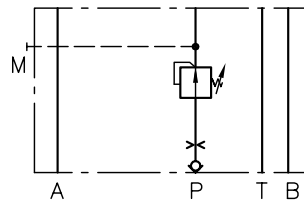


**Intermediate plate (series connection) with pressure-reducing valve for pressure reduction of the subsequent P gallery  
.../CZ...**



Example: BAZ-CZ2/180/5R  
Type CDK3 pressure-reducing valve set to 180 bar with check valve

**Intermediate plates (parallel connection) with pressure-reducing valve in P gallery  
.../NZP16(26)CZ...**



Example: .../NZP16CZ08/350/B0.8R/...  
Type CDK0.8 pressure-reducing valve set to 350 bar with orifice and check valve in P gallery

**Actuations:**

M: Solenoid actuation ( $p_{max}= 400$  bar)  
GM: Solenoid actuation ( $p_{max}= 250$  bar)  
H: Hydraulic actuation

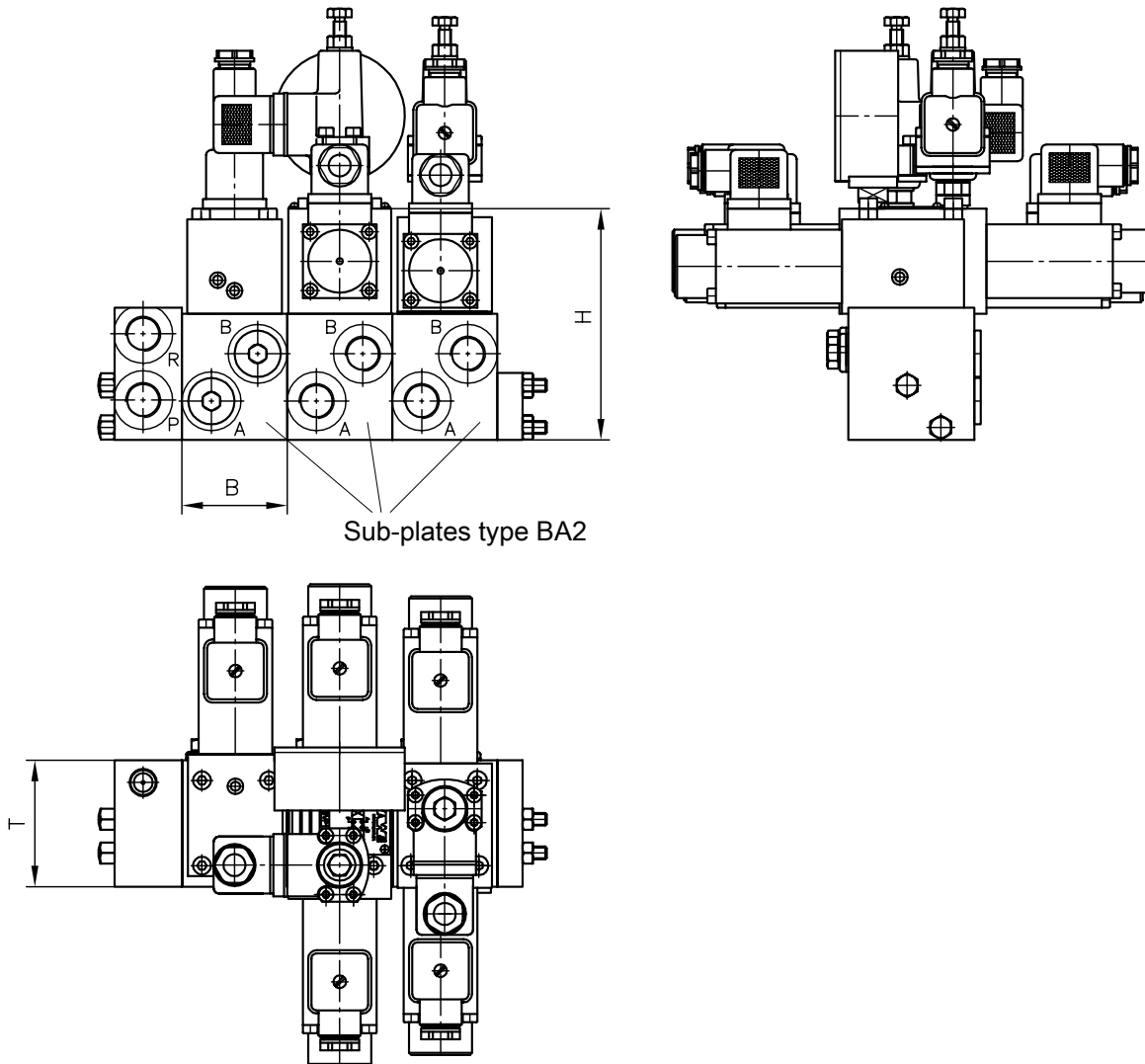
P: Pneumatic  
A: Manual actuation  
T: Pin  
K: Roller

**End plates**

-1	-6	-422	-8	-80/-8W	-880(88W)/...
Series	with drain valve	with drain valve and pressure switches	with accumulator port and drain valve	with accumulator port and release valve	with two accumulator ports and release valve

## General parameters and dimensions

### Mounted valve type BA



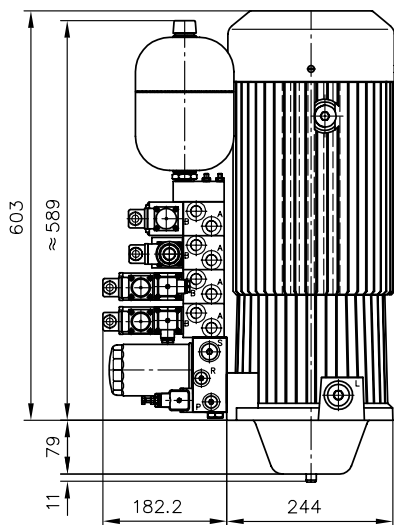
	$Q_{max}$ [lpm]	$p_{max}$ [bar]	Ports (BSPP)	Dimensions [mm]			m [kg]
				H	B	T	
BA2	20	400	A, B, P, R, M G 1/4, G 3/8	139	50	60	0,8

HK 449 LDT/1 - Z16  
- AL21R F2 - F/50/60 - 7/45

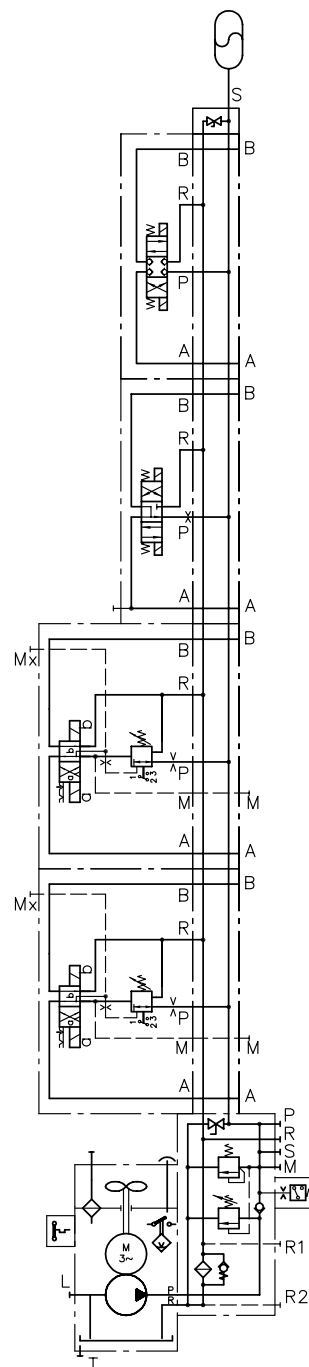
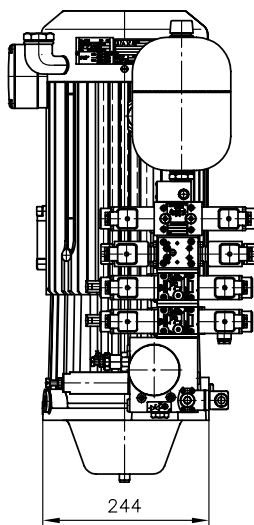
Type HK compact hydraulic power pack size 4;  
connection block with accumulator charging valve, setting: 50 bar, pressure-limiting valve, setting: 60 bar, filter and pressure switch, setting: 45 bar

**Parameters of the example circuit:**

- $Q_{Pu} = 16 \text{ lpm}$  (at 1450 rpm)
- $p_{\max Pu} = 110 \text{ bar}$
- $p_{\text{System}} = 60 \text{ bar}$   
(pressure-limiting valve setting)
- $p_{\text{switch-off feature}} = 50 \text{ bar}$
- $V_{\text{load}} = \text{approximately } 5 \text{ l}$



- BA2  
- NSMD2W/GRK/B2.0/0  
- NSMD2W/GRK/B2.0/0  
- NSWP2D/B2.0/20/1  
- NBVP16G/0  
- 8 - AC2001/35 - L24  
Type BA2 valve bank with four industrial standard valves mounted on sub-plates, two clamping functions for work piece clamping with combined option to adjust pressure and pressure switches, two additional functions for indexing and tool clamping



**Associated technical data sheets:**

- Valve bank (nominal size 6) type BA: [D 7788](#)
- Intermediate plate type NZP: [D 7788 Z](#)

**Suitable compact hydraulic power packs:**

- See chapter on hydraulic power packs

**Suitable connection block:**

- Type A: [Page 68](#)

**Products suitable for combination:**

- Clamping module type NSMD: [D 7787](#)
- Directional spool valve type NSWP: [Page 88](#)
- Directional spool valve type SWPN: [D 7451 AT](#)
- Directional seated valves type NBVP: [Page 144](#)

**Suitable accessories:**

- Pressure switches type DG: [Page 270](#)
- Hydraulic accumulator type AC: [Page 266](#)

**Suitable plugs:**

- Line connector type MSD and others: [D 7163](#)

# Mounted valves

## 1.2 Valve bank (directional seated valve) type BVH

A valve bank combines different valves for operating independent consumers.

The valve bank type BVH comprises several directional seated valves that are connected in parallel. As cone valves the directional seated valves have zero leakage in the closed state. The valve sections are connected using banjo bolts. 2/2, 3/2, 4/2 and 4/3-way directional seated valves are available.

Depending on the functional requirement, pressure reducing valves, pressure switches, check valves, restrictors or restrictor check valves are integrated into the valve section. The valve bank can be flange-mounted directly on compact hydraulic power packs or integrated into a pipe system via a piping block.

### Features and benefits:

- Flexible expandability
- Compact and lighter design (elimination of the base plates)

### Intended applications:

- Auxiliary and clamping functions on machine tools and fixtures
- Auxiliary and clamping functions on forming machine tools
- Brake and rotor adjustment modules on wind turbines



<b>Nomenclature:</b>	Valve sections Directional seated valve Zero leakage
<b>Version:</b>	Valve sections for pipe connection
<b>Actuation:</b>	Solenoid
<b>p<sub>max</sub>:</b>	400 bar
<b>Q<sub>max</sub>:</b>	20 lpm

### Design and order coding example

BVH 11 M/CZ/35/M/R/2 - 8 - G24

**Solenoid voltage** 12V DC, 24V DC, 110V AC, 230V AC

- End plate**
- With tapped plugs at P, R
  - With accumulator port and drain valve

- Valve sections**
- With individual pressure reduction (parallel connection)
  - Additional elements:
    - Pressure-reducing valves
    - Orifice and/or check valve in P gallery
    - Orifice or restrictor check valve for A
    - Return pressure block in R gallery
    - Pressure switches for A

**Basic type** Type BVH 11 for direct mounting onto connection blocks type A etc. (for compact hydraulic power packs type KA, MPN, HC, HK, HKF, HKL)

## Function

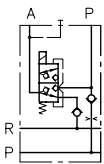
### Connection blocks/adapter plates:

#### BVH

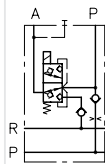
Direct mounting onto connection blocks type A etc.  
for compact hydraulic power packs type KA, MPN, HC, HK, HKF, HKL

### Valve sections:

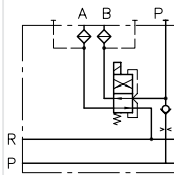
#### H



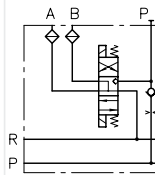
#### M



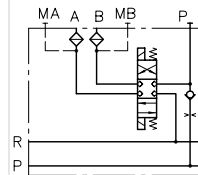
#### W



#### D



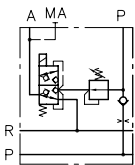
#### G



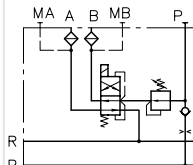
### Additional options for the valve sections:

#### Individual pressure reduction (parallel connection)

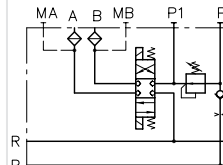
##### BVH 11 H/CZ...



##### BVH 11 W/CZ...

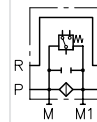


##### BVH 11 G/CZ...



#### Pressure filter

##### BVH 11 ZD



### Actuations:

M: Solenoid actuation ( $p_{max}=400$  bar)

GM: Solenoid actuation ( $p_{max}=250$  bar)

### End plates:

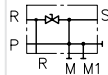
#### -1

Tapped plug at P, R



#### -81

with accumulator port and drain valve



## General parameters and dimensions

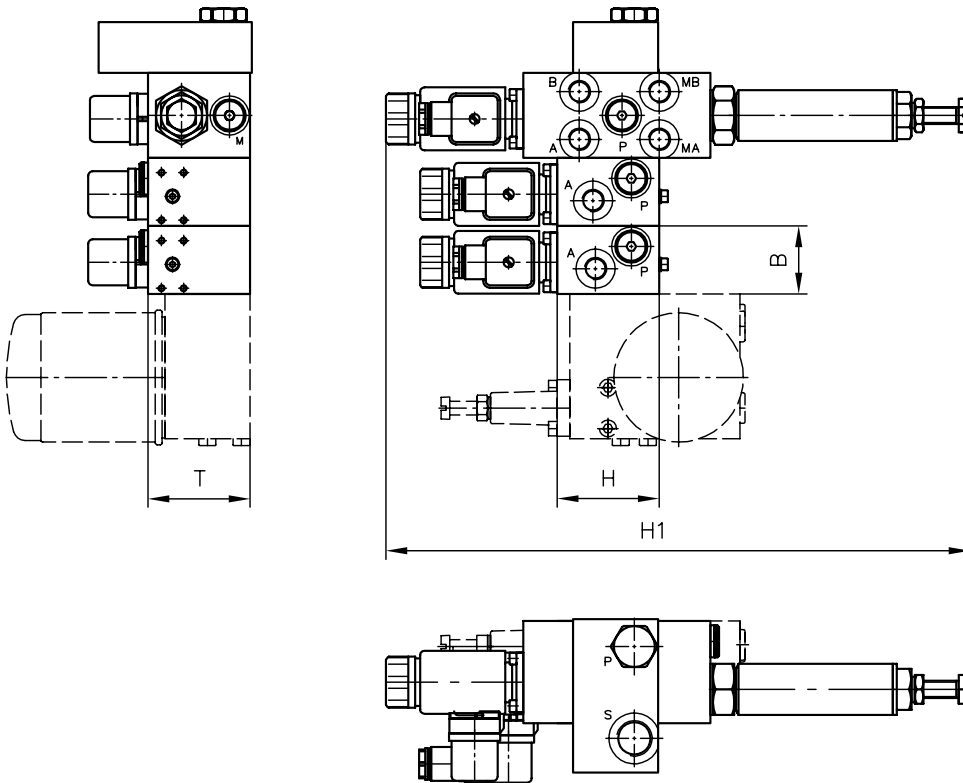
(A1F1/310)

- BVH 11 H/M/R/2
- BVH 11 M/M/R B2.5/3
- BVH 11 W/CZ 5/35/M/R/22 - 81 - G 24

Type BVH valve bank for direct mounting at type A connection block

- Valve section 1** with 3/2-way function circuit symbol H, P check valve (coding R), no pressure switch (coding 2)
- Valve section 2** with 3/2-way function circuit symbol M, check valve and orifice in P gallery (coding R, B, 2, 5) and pressure switch for A (coding 3)
- Valve section 3** with 4/2-way function circuit symbol W, individual pressure-reducing valve set to 35 bar (coding CZ5/35) and check valve in P gallery (coding R), no pressure switch
- End plate** for accumulator port (coding 8) and 24V DC solenoid voltage

### Mounted valve type BVH



	Q <sub>max</sub> [lpm]	p <sub>max</sub> [bar]	Ports (BSPP)	Dimensions [mm]				m [kg]
				H	H1	B	T	
<b>BVH</b>	20	400	G 1/4	60	343	40/50	60	0,8

**Example circuit:**

KA 281 SKT/Z 9.8

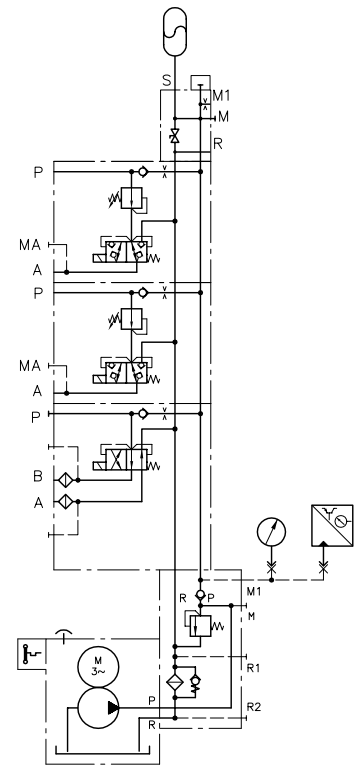
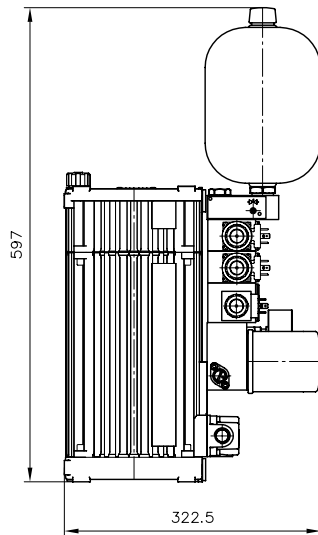
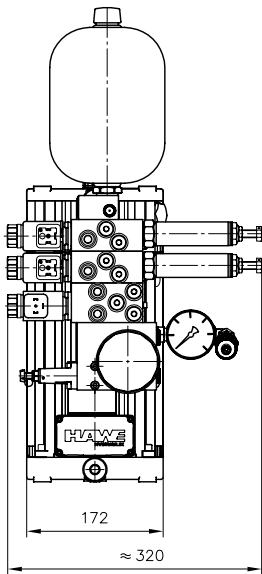
- AX 3 F 1 E/120
- BVH 11 W/M/RH/2
- BVH 11 M/CZ5/35/M/RHB 2.5
- BVH 11 M/CZ5/35/M/RHB 2.5
- 82-X 24 - AC 2001/60/3/A 3x400V 50 Hz

**Parameters of the example circuit:**

- $Q_{Pu} = 9.8$  lpm (at 1450 rpm)
- $p_{max Pu} = 170$  bar
- $p_{system} = 120$  bar
- $p_{switch-off feature} = 50$  bar
- $V_{load} =$  approximately 3 l

Type KA compact hydraulic power pack 1 kW motor output; Connection block with return line filter and TÜV-approved safety valve set to 120 bar

Type BVH valve bank with three valve segments, two clamping functions with individually adjustable clamping pressure



**Associated technical data sheets:**

- [Valve bank \(directional seated valve\) type BVH: D 7788 BV](#)

**Compact hydraulic power packs:**

- See section "Compact hydraulic power packs"

**Connection blocks:**

- Type A: [Page 68](#)

**Combinable products:**

- Directional seated valves type NBVP: [Page 144](#)
- Pressure reducing valves type CDK, DK: [Page 186](#)

**Accessories:**

- Pressure switches type DG: [Page 270](#)
- Hydraulic accumulator type AC: [Page 266](#)

**Plug:**

- [Line connector type MSD and others: D 7163](#)

## 2.1 Directional spool valves

Directional spool valve type SG and SP	84
Directional spool valve type SW, SWP and NSWP	88
Directional spool valve bank type SWR and SWS	92
Directional spool valve type HSF	96
Proportional directional spool valve type EDL	98
Directional spool valve bank type DL	102
Proportional directional spool valves type PSL and PSV	106
Proportional directional spool valve type PSLF, PSLV and SLF	112
Clamping module type NSMD	116



*Directional spool valves  
type SWR and SWS*



*Proportional directional spool valves  
type PSL and PSV*



### On/off directional spool valves

Type	Nomenclature/version	Actuation	$p_{max}$ (bar)	$Q_{max}$ (lpm)
SG, SP	<b>Directional spool valve, individual valve</b> <ul style="list-style-type: none"> <li>▪ Individual valve for pipe connection</li> <li>▪ Individual manifold mounting valve</li> </ul>	- Solenoid - Manual - Mechanical - Pressure-actuated	SG - 0: 400 SG - 1: 400 SG - 2: 400 SG - 3: 400 SG - 5: 400  SP - 1: 400 SP - 3: 400 SP - 5: 400	SG - 0: 12 SG - 1: 20 SG - 2: 30 SG - 3: 50 SG - 5: 100  SP - 1: 12 SP - 3: 50 SP - 5: 100
SW, SWP, NSWP	<b>Directional spool valve, individual valve</b> <ul style="list-style-type: none"> <li>▪ For pipe connection</li> <li>▪ Individual manifold mounting valve</li> </ul> <b>Directional spool valve, valve bank</b> <ul style="list-style-type: none"> <li>▪ With sub-plates</li> <li>▪ Combination with hydraulic power packs</li> </ul>	- Solenoid	SW - 1: 315 SW - 2: 315  SWP - 1: 315 SWP - 2: 315  NSWP - 2: 315	SW - 1: 12 SW - 2: 25  SWP - 1: 12 SWP - 2: 25  NSWP - 2: 25
SWR, SWS	<b>Directional spool valve, valve bank</b> <ul style="list-style-type: none"> <li>▪ Connected in series</li> <li>▪ Combination with hydraulic power packs</li> </ul>	- Solenoid	SWR - 1: 315  SWS - 2: 315	SWR - 1: 12  SWS - 2: 25
HSF	<b>Directional spool valve, individual valve</b> <ul style="list-style-type: none"> <li>▪ Individual manifold mounting valve</li> </ul>	- Electro-hydraulic - Hydraulic	3: 400 4: 400	3: 80 4: 160

## Proportional directional spool valve

Type	Nomenclature/version	Actuation	$p_{\max}$ (bar)	$Q_{\max}$ (lpm)
EDL	<b>Prop. directional spool valve (Load-Sensing), valve bank</b> <ul style="list-style-type: none"> <li>▪ Connected in series</li> </ul>	- Solenoid	2: 320	2: 50
PSL, PSV	<b>Prop. directional spool valve (Load-Sensing), valve bank</b> <ul style="list-style-type: none"> <li>▪ Connected in series</li> </ul>	- Manual - Electro-hydraulic - Pressure	2: 420 3: 420 5: 400	2: 60 3: 120 5: 270
PSLF, PSVF, SLF	<b>Prop. directional spool valve (Load-Sensing), individual valve</b> <ul style="list-style-type: none"> <li>▪ Individual manifold mounting valve</li> </ul> <b>Valve bank</b> <ul style="list-style-type: none"> <li>▪ With sub-plates</li> </ul>	- Manual - Electro-hydraulic - Pressure	3: 420 5: 400 7: 420	3: 120 5: 270 7: 500

### Valve combinations

Type	Nomenclature/version	Actuation	$p_{\max}$ (bar)	$Q_{\max}$ (lpm)
NSMD	<p><b>Combination of directional spool valve and pressure-reducing valve</b></p> <p><b>As individual valve</b></p> <ul style="list-style-type: none"> <li>Individual manifold mounting valve</li> </ul> <p><b>As valve bank</b></p> <ul style="list-style-type: none"> <li>Valve banks are available with type BA</li> </ul>	- Solenoid	2: 120	2: 25

# Directional spool valves

## 2.1 Directional spool valve type SG and SP

Directional spool valves are a type of directional valve. They control the direction of movement and the velocity of single and double-acting hydraulic consumers.

The directional spool valve type SG is available as a single valve for pipe connection. Type SP is available as a valve for manifold mounting. Due to the robust design the directional spool valve type SG and SP reaches operating pressures up to 400 bar. It is of versatile use due to different types of actuation.

Intended applications include mobile hydraulics, in particular in special vehicles, in municipal trucks and in shipbuilding.

### Features and benefits:

- Sturdy design
- Suited for maritime applications
- Various actuation variants

### Intended applications:

- Mining machinery
- Cranes and lifting equipment
- Ship building
- Road vehicle



<b>Nomenclature:</b>	Directional spool valve
<b>Design:</b>	Individual valve for pipe connection or manifold mounting
<b>Actuation:</b>	Solenoid Manual <ul style="list-style-type: none"><li>▪ With automatic return spring</li><li>▪ With detent</li></ul> Mechanical <ul style="list-style-type: none"><li>▪ Roller head</li><li>▪ Pin head</li></ul> Pressure (only or combined with manual actuation) <ul style="list-style-type: none"><li>▪ Hydraulic</li><li>▪ Pneumatic</li></ul>
<b>p<sub>max</sub>:</b>	400 bar
<b>Q<sub>max</sub>:</b>	100 l/min

## Design and order coding example

SP 1	D	- A	
SG 3	E	3E	- MD 3/24 - 120

Pressure setting pressure limiting valve [bar]

Actuation mode

Pressure limiting valve

- Function**
- Parallel- or series connection
  - Directional spool valves either with positive (blocked between switching positions) or negative (slightly floating position) overlap
  - SP 1 with/without check valve insert

**Basic type and size** Directional spool valve SG 0 to 5, SP 1, SP 3, SP 5  
Directional spool valves type SP for manifold mounting, sizes 1, 3, 5

## Function

### Basic symbol



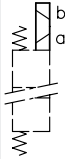
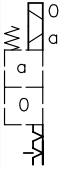
SG	SP
Individual valve for pipe connection	Individual valve for manifold mounting
With pressure-limiting valve	

### Circuit symbol



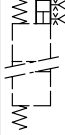


G	C	D	E	N	W	R	V	Z	U
L	F	H	Y	S	X				

- Circuit symbol Z, U, X: only for size 2, 3 and 5

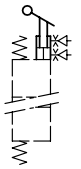
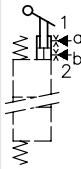
**Actuations:**

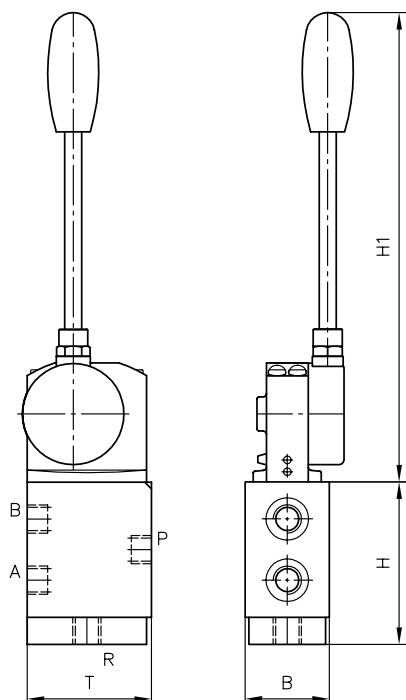
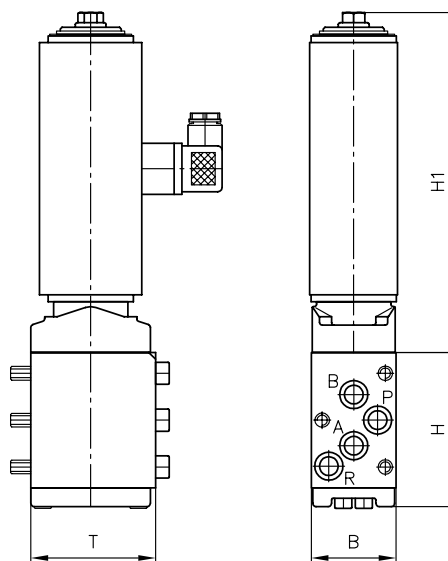
Manual		Solenoid	
A, AK	C, CK	ME, MD	MU
Return spring	Detent	Solenoid voltage: 12V DC, 24V DC, 110V AC, 230V AC	
			

**Actuations:**

Mechanical		Pressure		
RE, RD	BE, BD	NE, ND	NU	NM
Roller head	Pin head	Pneumatic		Hydraulic
				
Actuation forces: 90 - 280 N (according to size)		Control pressures: pneumatic 5 - 10 bar hydraulic 12 - 20 bar		

**Actuations:**

Double acting	
KD	KM
Pneumatic / manual	Hydraulic / manual
	
Control pressure: Pneumatic 5 ... 10 bar Hydraulic 12 ... 20 bar	

**General parameters and dimensions**
**SG with manual actuation**

**SP with solenoid actuation**


	$Q_{\max}$ [lpm]	Operating pressure $p_{\max}$ [bar] for actuation			Ports (BSPP)	Dimensions [mm]				$m_{\max}$ [kg]
		Solenoid	Mechanical	Manual/ pressure		H	H1	B	T	
<b>SG 0</b>	12	200	400	400	G 1/4, G 3/8	59.5	151	39.5	51	0.8 ... 1.0
<b>SG 1</b>	20	200	400	400	G 3/8	59.5	151	39.5	51	0.8 ... 1.0
<b>SG 2</b>	30	315	400	400	G 3/8	max. 100.5	342	49.5	73	2.5 ... 5.7
<b>SG 3</b>	50	315	400	400	G 1/2	max. 100.5	342	49.5	73	2.5 ... 5.7
<b>SG 5</b>	100	200	315	400	G 1	110	342	50	80	2.9 ... 6.1
<b>SP 1</b>	20	200	400	400	-	59.5	151	40	51	0.8 ... 1.0
<b>SP 3</b>	50	315	400	400	-	94.5	342	49.5	73	2.5 ... 5.7

**Associated technical data sheets:**

- [Directional spool valve type SG and SP: D 5650/1](#)
- Actuations:
  - [Manual operation for directional spool valves, type S: D 6511/1](#)
  - [Electrical operation for directional spool valves type S: D 7055](#)
  - [Mechanical operation for directional spool valves, type S: D 5870](#)
  - [Pressure actuation for directional spool valves: D 6250](#)

**Male connectors:**

- [Line connector type MSD and others: D 7163](#)
- With economy circuit: [D 7813](#), [D 7833](#)

# Directional spool valves

## 2.1 Directional spool valve type SW, SWP and NSWP

Directional spool valves are a type of directional valve. They control the direction of movement and the velocity of single and double-acting hydraulic consumers. The directional spool valve type NSWP and SWP is available as a manifold mounting valve. Type NSWP is available with a nominal size 6 hole pattern (NG 6). Type SW is available as a single valve for pipe connection. The directional spool valve type NSWP can be flexibly adapted to different control tasks by means of additional functions in the pump line and/or on the consumer side (e.g. restrictors, restrictor check valves). Intended applications for the directional spool valve type NSWP, SWP and SW include industrial hydraulics, in particular machine tools.

**Features and benefits:**

**Intended applications:**



<b>Nomenclature:</b>	Directional spool valve
<b>Design:</b>	Individual valve for pipe connection Individual manifold mounting valve Valve bank manifold mounting Combination with hydraulic power packs
<b>Actuation:</b>	Solenoid
<b>p<sub>max</sub>:</b>	315 bar
<b>Q<sub>max</sub>:</b>	25 l/min

### Design and order coding example

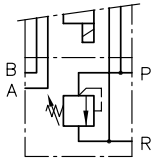
NSWP2	G	/M	/R	/ ABR1,0	/50	/G24	- 3/8	
								<b>Single connection block</b> for direct installation in the pipe G 3/8 (type NSWP and SWP2)
								<b>Voltage of the actuation solenoids</b> 12V DC, 24V DC, 110V AC, 230V AC ▪ Solenoids with various plug versions
								<b>Pressure switch or pressure gauge at A or B</b>
								<b>Additional elements at A and/or B</b> Restrictor check valve or orifice
								<b>Additional elements at P</b> Check valve or orifice
								<b>Solenoid version</b> ▪ black/white solenoid or proportional solenoid ▪ Solenoid with detent ▪ Solenoid version conforming ATEX (p <sub>max</sub> = 210 bar)
								<b>Function</b> ▪ Indiv. valve with check valve or orifice in gallery P and/or check valve in gallery R (type SWP) ▪ Indiv. valve with 6/2-way function
<b>Basic type, size</b>	Directional spool valve SW, SWP size 1 and 2 NSWP size 2, connection hole pattern NG 6 (CETOP)							



## Function

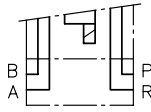
### Sub-plate for pipe connection

- 1/4 S(R)



Sub-plate with pressure limiting valve<sup>1)</sup>

- 3/8



Sub-plate<sup>2)</sup>

1) Only for type SWP 1

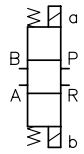
2) Only for type NSWP and SWP 2

## Valve sections

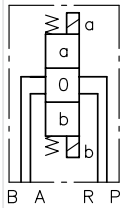
### Basic symbol

#### Individual valve

SW



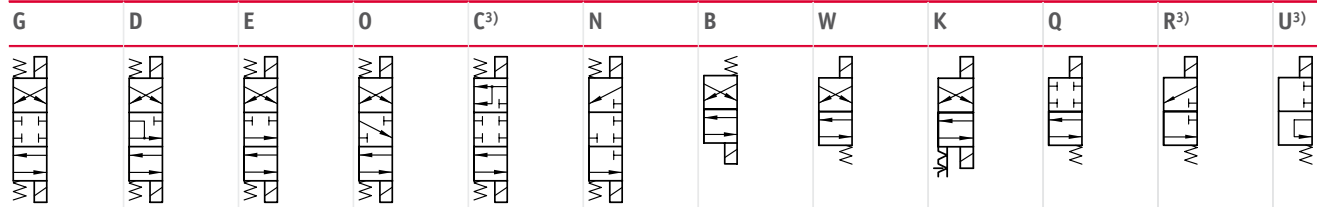
SWP / NSWP



## Valve sections

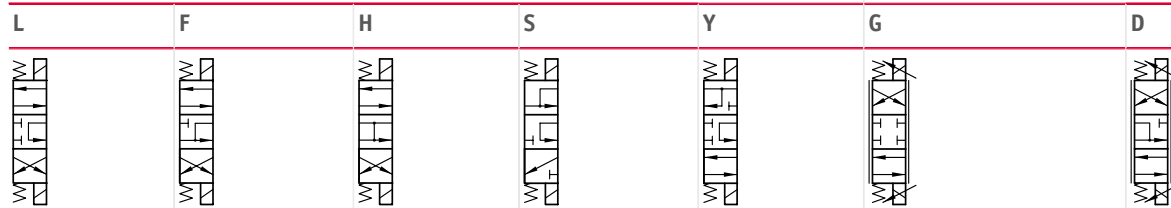
### Circuit symbol

May be connected either in parallel or in series within a valve bank



Only connected in series within a valve bank (only type SW1)

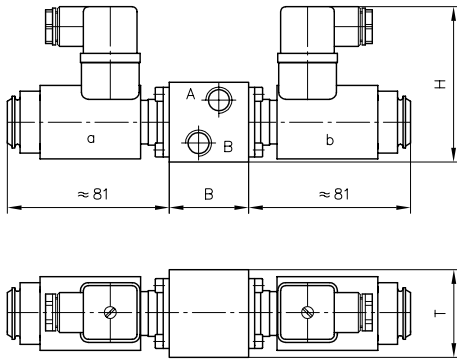
Spool for proportional adjustment



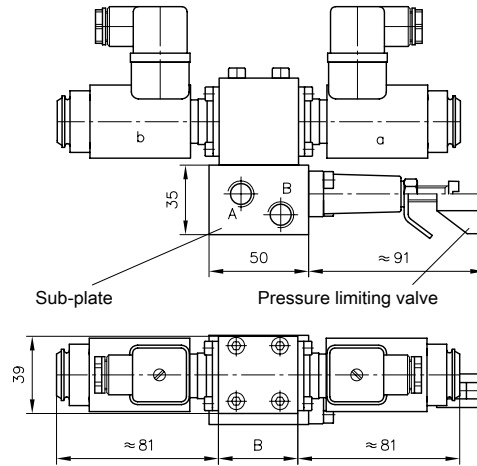
3) Only for type SWR 1

## General parameters and dimensions

SW



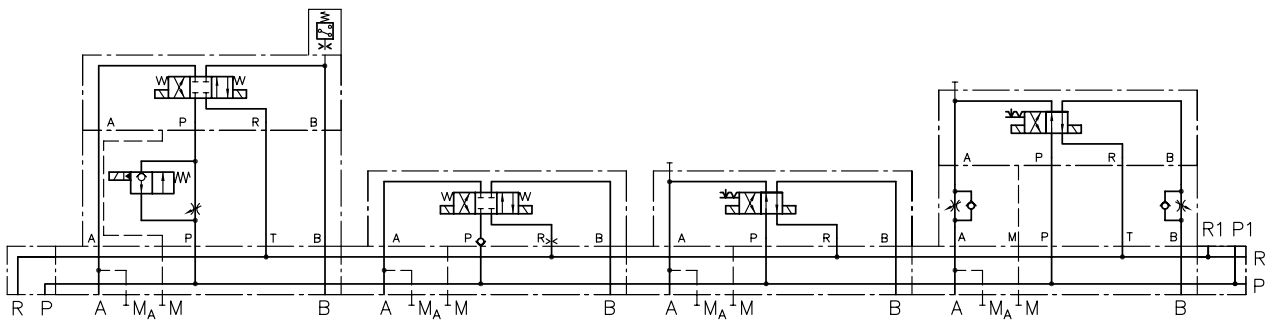
SWP/NSWP2



	$Q_{max}$ [lpm]	$p_{max}$ [bar]	Ports (BSPP)	Dimensions [mm]			m [kg]	
				H	B	T	Individual directional spool valve	Sub-plate
SW/SWP 1	12	315	G 1/4	77 ... 90	40	40 ... 44	1.1 ... 1.5	0.6 ... 0.7
SW/SWP 2	25	315	G 3/8, G 1/4	78 ... 82.5	60 ... 70	40 ... 45	1.1 ... 2.4	approx. 0.8
NSWP2			NG 6					

### Circuit example 1:

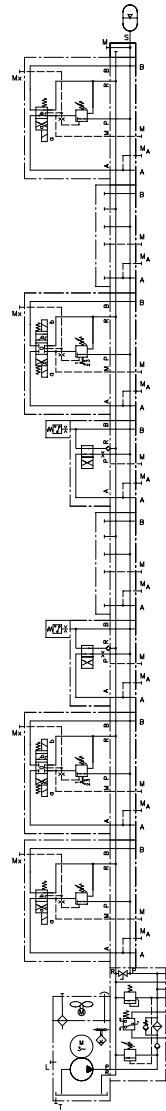
BA2-A5  
 -NSWP2G/M/03/NZP16V/PQ20/0  
 -NSWP2G/M/R/B1,0  
 -NSWP2K/M/20/0  
 -NSWP2K/M/20/NZP16Q33/0  
 -2-L24



**Circuit example 2:**

HKF44V9LD/1-Z16

- AL21D10V-F60/80-2
- BA2-NSMD2K/G/B2/O
- NSMD2G/GRK/B2/O
- NSWP2W/M/B1,0/06/S/O
- NG6X/O
- NSWP2W/M/B1,0/06/S/O
- NSMD2G/GRK/B2/O
- NG6X/O
- NSMD2K/G/B2/O
- 80-AC2001/40-X24



**Combinable products:**

- Valve bank type BA: [Page 70](#)
- Intermediate plate type NZP: [D 7788 Z](#)
- 6/2-way directional valve: **Sk 7951-J-6/2**

**Similar products:**

- Valve banks types SWR and SWS: [Page 92](#)
- Clamping modules type NSMD: [Page 116](#)

**Associated technical data sheets:**

- [Directional spool valve type SW: D 7451](#)
- [Directional spool valve type NSWP 2: D 7451 N](#)

**Male connectors:**

- [Line connector type MSD and others: D 7163](#)
- With economy circuit: [D 7813](#), [D 7833](#)

# Directional spool valve

## 2.1 Directional spool valve bank type SWR and SWS

Directional spool valves are a type of directional valve. They control the direction of movement and the velocity of single and double-acting hydraulic consumers. The directional spool valve bank type SWS is available with series connection. The consumers can be operated with on-off or proportional control. Versions are available for usage in potentially explosive atmospheres. By means of additional functions in the pump line, in the intermediate plates (longitudinal and sandwich valve combination) and ancillary blocks the directional spool valve bank can be flexibly adapted to different control tasks.

Intended applications include mobile hydraulics, in particular civil engineering, agricultural engineering and material handling.

### Features and benefits:

- Can be combined for forklift trucks with lifting modules
- Proportional movements can also be controlled independently of the load
- Extensive range of ancillary blocks
- Compact and extremely space-saving dimensions

### Intended applications:

- Material handling
- Wind turbines
- Construction and construction materials
- Handling and assembly techn.
- Municipal trucks



<b>Nomenclature:</b>	Directional spool valve
<b>Design:</b>	Valve bank Combination with hydraulic power packs
<b>Actuation:</b>	Solenoid
<b>p<sub>max</sub>:</b>	315 bar
<b>Q<sub>max</sub>:</b>	25 l/min

### Design and order coding example

SWR1 A-6/230 - GG - 1 - G24

**Solenoid voltage** 12V DC, 24V DC, 110V AC, 230V AC

- Solenoids with various plug versions

- End plate**
- Additional ports P and/or R (P can be blocked)
  - Idle circulation valve (ON/OFF, proportional)
  - End spool valve

- Valve sections**
- Directional spool valve
  - Additional options for the valve sections:
    - Options upstream (orifice, flow controller)
    - Consumer-side additional functions in ancillary block, e.g. double check valves, shock valves (load-holding valves etc.)

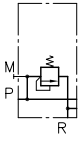
- Connection block/adaptor plate**
- Pressure limiting valve (for pipe connection)
  - Idle circulation valve
  - 3-way flow controller

Basic type, size Type SWR 1 and SWS 2

## Function

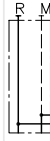
### Connection blocks:

A 6



With fixed pressure limiting valve  
(for pipe connection)

F/D



For direct mounting onto hydraulic power packs  
(type KA, HC, MP, HK)

### Valve sections:

#### Basic symbol

SWR 1	SWS 2	Symbol												
		G	D	E	O	C	N	B	W	K	Q	R	U	
		Spool valves suited for prop. actuation												
		G	D											

### Additional versions for valve sections:

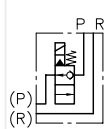
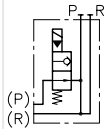
- b/w solenoids with stroke limitation
- prop. solenoids with stroke limitation
- solenoids also available in ATEX-compliant version ( $p_{max} = 210$  bar)

### End plates (SWR 1/SWS 2):

Series

With circulation valve

With lockable pump output



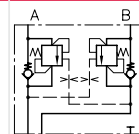
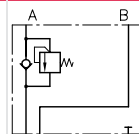
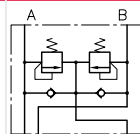
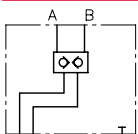
### Ancillary block type SWS 2 with additional functions (consumer side):

Releasable check valve

Shock valve

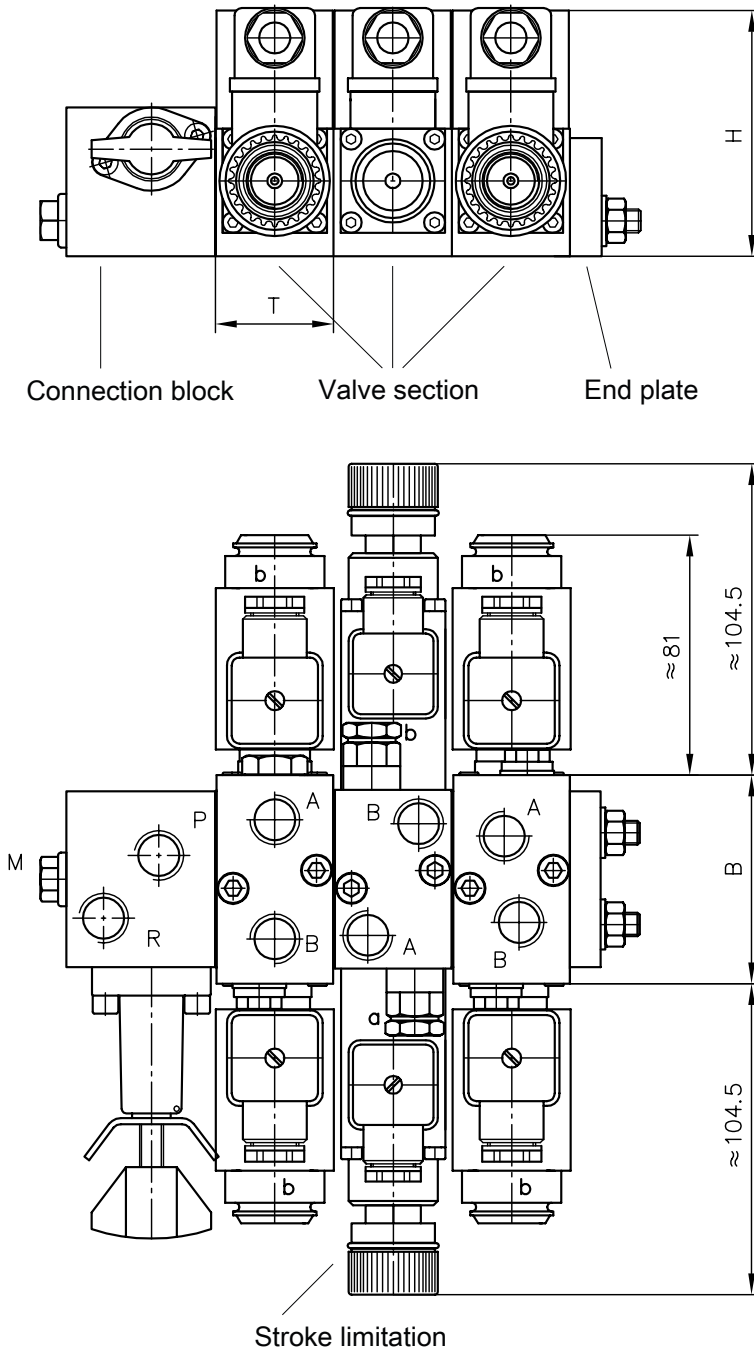
Sequence valve

Over center valve



## General parameters and dimensions

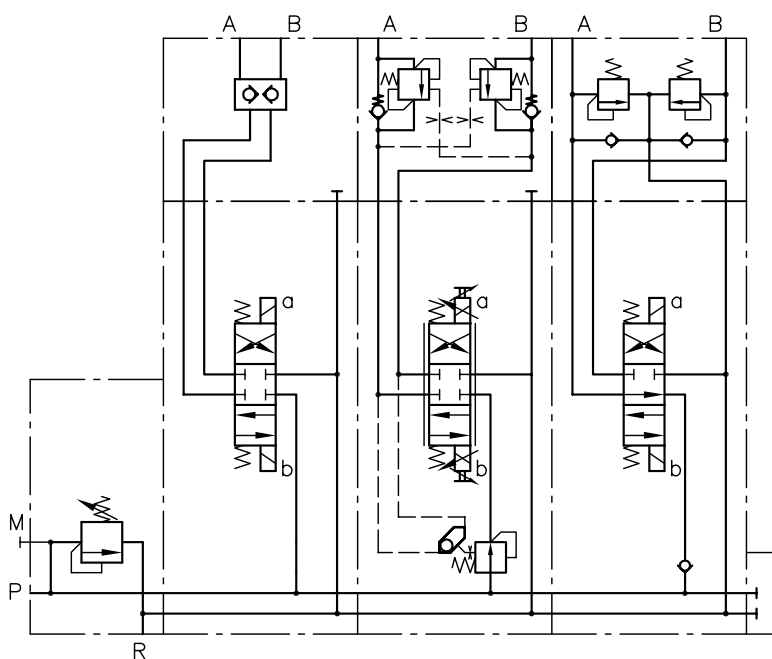
SWR 1, SWS 2



	$Q_{\max}$ [lpm]	$p_{\max}$ [bar]	Ports	Dimensions [mm]			$m_{\max}$ [kg]	
				H	B	T	Individual section	Connection block
SWR 1	12	315	G 1/4	77 - 90	40	40	1.1 - 1.5	0.6 - 0.7
SWS 2	25	315	G 3/8, G 1/4	78 - 82.5	60	40	1.1 - 2.4	approx. 0.8

**Circuit example:**

SWS 2 A 7/200	- G/M/2/2 RH	- G 10/MPF/DW/2 AL B 7/180 BLC 4/140	- E/M/R/2 AN100 BN 100-1-G 24
Valve bank type SWS, size 2, connection block with pressure limiting valve (manually adjustable, factory set to 200 bar)	1. Valve section flow pattern G with solenoid actuation, no additional function in gallery P, with ancillary block featuring releasable check valves for ports A and B	2. Valve section flow pattern G with prop. solenoid actuation (MP) and stroke limitation for A and B (FAB), max. flow for ports A and B is 10 lpm, flow control in gallery P of the basic valve body (DW), ancillary block with over center valves (factory set to A = 180 bar and B = 140 bar)	3. Valve section flow pattern E with solenoid actuation, check valve in gallery P, ancillary block featuring shock and suction valves for ports A and B (both factory set to 100 bar), standard end plate. All solenoids 24V DC


**Associated technical data sheets:**

- [Directional spool valve type SW: D 7451](#)
- [Directional spool valve bank type SWS: D 7951](#)

**Suited products for combination:**

- Pressure switches type DG3..., DG5.E: [Page 270](#)

**Suitable male connectors:**

- [Line connector type MSD and others: D 7163](#)
- With economy circuit: [D 7813](#), [D 7833/1](#)

# Directional spool valve

## 2.1 Directional spool valve type HSF

Directional spool valves are a type of directional valve. They control the direction of movement and the velocity of single and double-acting hydraulic consumers.

The directional spool valve type HSF is a manifold mounting valve. Due to the robust design, it reaches operating pressures of up to 400 bar.

Adjustable threaded throttles are used to adjust the response time. Harsh switching operations and decompression surges, particularly in the event of high pressure and large consumer volumes, can be avoided this way.

### Features and benefits:

- Smooth switching for large flow rate
- Suitable for high pressures due to steel housing

### Intended applications:

- Mining machinery (incl. oil production)
- Cranes and lifting equipment
- Construction and construction materials machinery
- Material handling (industrial trucks, etc.)



<b>Nomenclature:</b>	Directional spool valve
<b>Design:</b>	Individual valve for manifold mounting
<b>Actuation:</b>	Electro-hydraulic Hydraulic
<b>p<sub>max</sub>:</b>	400 bar
<b>Q<sub>max</sub>:</b>	80 ... 160 lpm

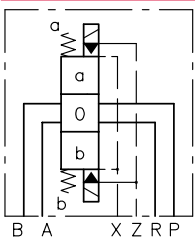
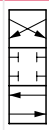
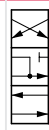

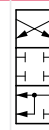


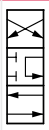

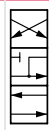
### Design and order coding example

HSF4	/C321	- L	- 1	- G24	- 300
				Pressure setting pressure limiting valve [bar]	
			Solenoid voltage	12V DC, 24V DC, 98V DC, 205V DC, 110V AC, 230V AC	
		End plate	Internal or external control oil return		
		Valve sections	With/without adjustable switching speed		
	Connection block	<ul style="list-style-type: none"> <li>▪ With/without pressure limiting valve (Fixed or manually adjustable)</li> <li>▪ Internal or external control oil supply (max. 160 bar)</li> </ul>			
Basic type and size	Type HSF: Manifold mounting				

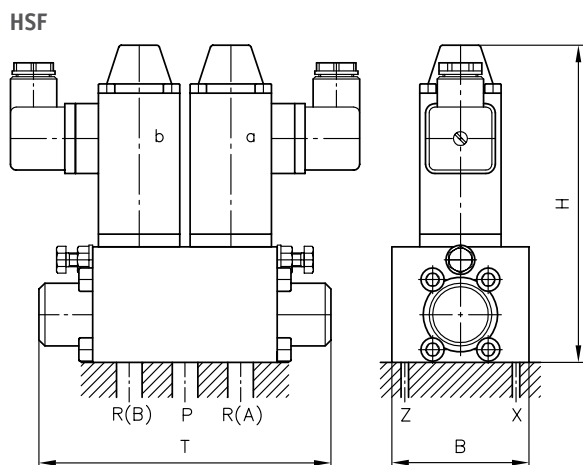


**Function**

**Valve sections:**

Basic symbol	Symbol									
HSF	G	D	E	C	W	B	L	H	F	
										
Manifold mounting valve	All flow pattern symbols also available with adjustable response time									

**General parameters and dimensions**



	$Q_{max}$ [l/min]	$p_{max}$ [bar]	Dimensions [mm]			m [kg]
			H	B	T	
HSF 3	80	400	137	59	126	2,8
HSF 4	160	400	157	70	184	5

**Associated technical data sheets:**

- Directional spool valve types PSL and PSV: [D 7700-2](#); [D 7700-3](#)
- [Directional spool valve type HSF: D 7493 E](#)
- [Directional spool valve type HSL: D 7493 L](#)

**Male connectors:**

- [Line connector type MSD and others: D 7163](#)
- With economy circuit: [D 7813](#), [D 7833/1](#)

# Directional spool valve

## 2.1 Proportional directional spool valve type EDL

Proportional directional spool valves are a type of directional valve. They control the direction of movement and the velocity of individual or multiple hydraulic consumers actuated simultaneously. Control is independent of the load and continuous.

The directional spool valve type EDL with series connection is actuated directly. The flows for the individual consumers can be individually adjusted. By means of additional functions in the intermediate plates (longitudinal and sandwich valve combination) and ancillary blocks the proportional directional spool valve can be flexibly adapted to different control tasks.

The directional spool valve type EDL can be combined directly with the proportional directional spool valve type PSL and PSV in size 2. It is used in mobile hydraulics, in particular in civil engineering and agricultural engineering.

### Features and benefits:

- One product for various control functions and small volume quantities
- Energy-saving closed-centre systems
- Compact and lightweight design
- Modular system can be directly combined with type PSL/PSV-2

### Intended applications:

- Construction and construction materials machinery
- Cranes and lifting equipment
- Machines for forestry and agricultural purposes
- Municipal trucks



<b>Nomenclature:</b>	Directly Prop. directional spool valves as per load-sensing principle
<b>Version:</b>	Valve bank in series connection
<b>Actuation:</b>	solenoid-actuated
<b>p<sub>max</sub>:</b>	320 bar
<b>Q<sub>max, consumer</sub>:</b>	3 ... 40 l/min
<b>Q<sub>pu max</sub>:</b>	Approx. 80 l/min

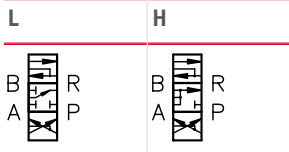
### Design and order coding example

<b>EDL</b>	<b>- DA2</b>	<b>L</b>	<b>40/25</b>	<b>E</b>	<b>/2</b>	<b>- G24</b>	
							<b>Solenoid voltage</b> 12V DC, 24V DC
							▪ Actuated via prop. amplifier or PLVC
							<b>Ancillary blocks</b>
							<b>Confirmation</b> Type E, EI
							<b>Volumetric flow</b> Volumetric flow indicator, side A, B (3...40)
							<b>Spool</b> Type L, H
							<b>Spool block</b> Block with inflow controller
<b>Basic type</b>	Type EDL directly actuated proportional directional spool valve						

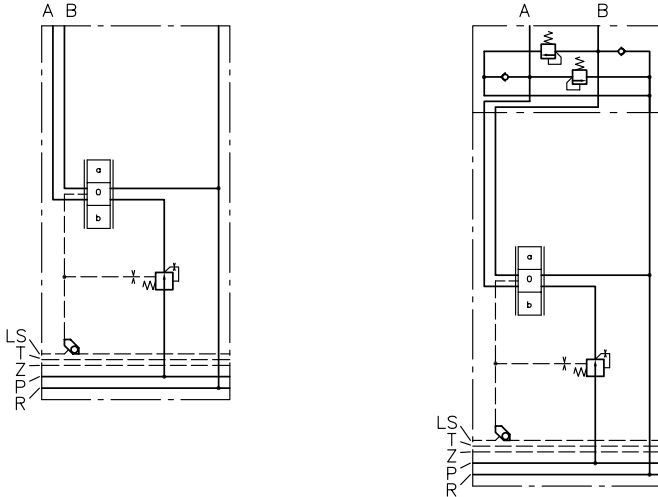
## Function

### Valve sections:

#### Circuit symbol



### Versions of valve sections:



### Additional functions in the ancillary block:

- Shock and servo-suction valves
- Load-holding valves
- Check valves with release, no leakage
- Floating and block functions can be switched

### Characteristic values for max. volumetric flows:

Size 2	$Q_{A, B}$				
	3	6	10	25	40

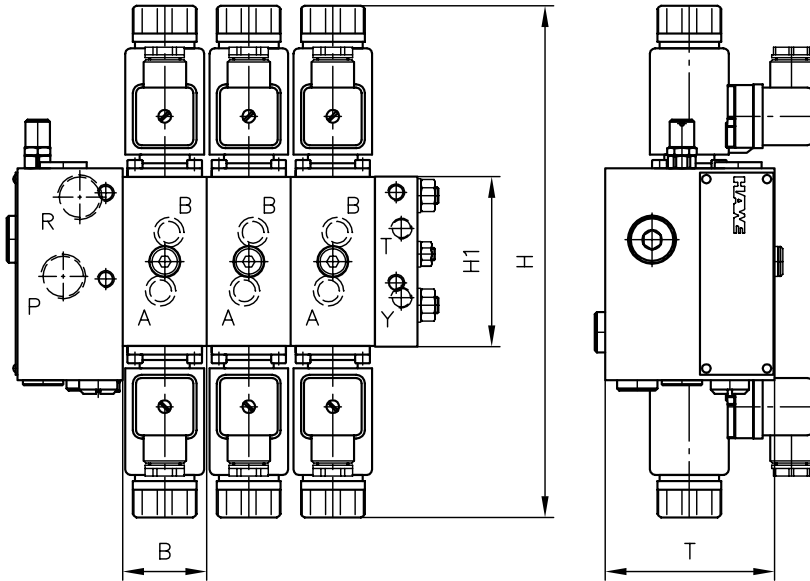
- Characteristic value corresponds to the max. volumetric flow [lpm] of inflow controller versions at the consumer ports A and/or B
- Volumetric flows for A and/or B can be selected separately

### Actuations:

Basic type	Brief description	Circuit symbol (example)
E	electrical actuation with stroke limitation	
EI	electrical actuation without stroke limitation	

## General parameters and dimensions

PSL/EDL

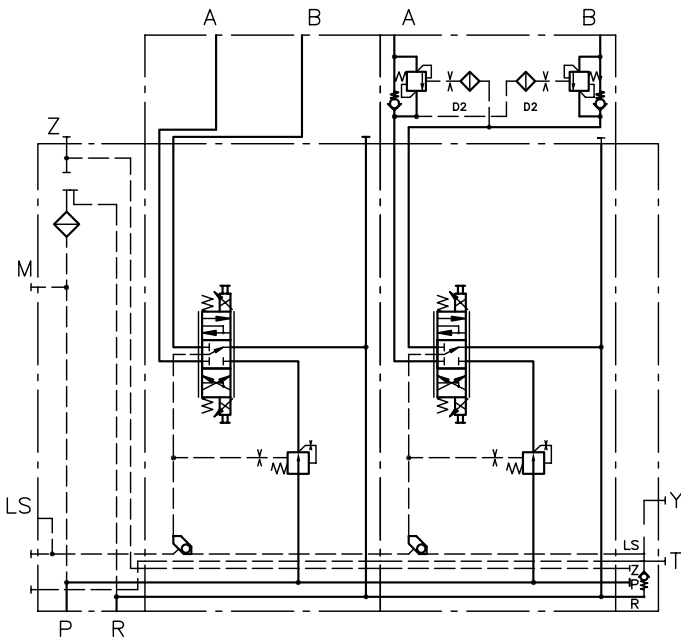


	Flow [lpm]		Oper. pressure [bar]	Ports (BSPP)		Dimensions [mm]				m [kg]
	Q <sub>max</sub>	Q <sub>pu max</sub>	p <sub>max</sub>	P, R	A, B	H	H1	B	T	Per valve section <sup>1)</sup>
<b>EDL</b>	3 ... 40	80	320	G 1/2, 3/4-16 UNF-2B	G 3/8, 3/4-16 UNF-2B	Approx. 241	Approx. 80	40	64	1.8 ... 2.9

1) Dep. on actuation and additional functions

**Example circuit:**

PSV 3-2  
 - DA2M40/25/E/2  
 - DA2M25/16/E/24L-0-A4/210-B10-B4/210  
 - E4  
 -G24



**Associated technical data sheets:**

- [Proportional directional spool valve type EDL: D 8086](#)
- [Proportional directional spool valve, type PSL and PSV size 2: D 7700-2](#)
- [Proportional directional spool valve, type PSL, PSM and PSV size 3: D 7700-3](#)
- [Proportional directional spool valve, type PSL, PSM and PSV size 5: D 7700-5](#)
- [Connection block type HMPL and HMPV for proportional directional spool valve: D 7700 H](#)

# Directional spool valve

## 2.1 Directional spool valve bank type DL

Throttling directional spool valves are a type of directional valve. They continuously and manually meter the flow rate in hydraulic systems with single and double-acting consumers. The throttling directional spool valve type DL influences the speed of the consumer by throttling the pump circulation via a parallel circuit (bypass control). The close fit of the spool in the throttling directional spool valve means that the leakage is limited to a minimum for lifting functions.

The throttling directional spool valve type DL is suitable for applications in material handling and for lifting equipment.

### Features and benefits:

- Compact design with up to 10 segments
- Various actuation variants for manual actuation
- Simple pressure reductions in downstream sections using intermediate plates
- Combinations possible for controlling lifting devices

### Intended applications:

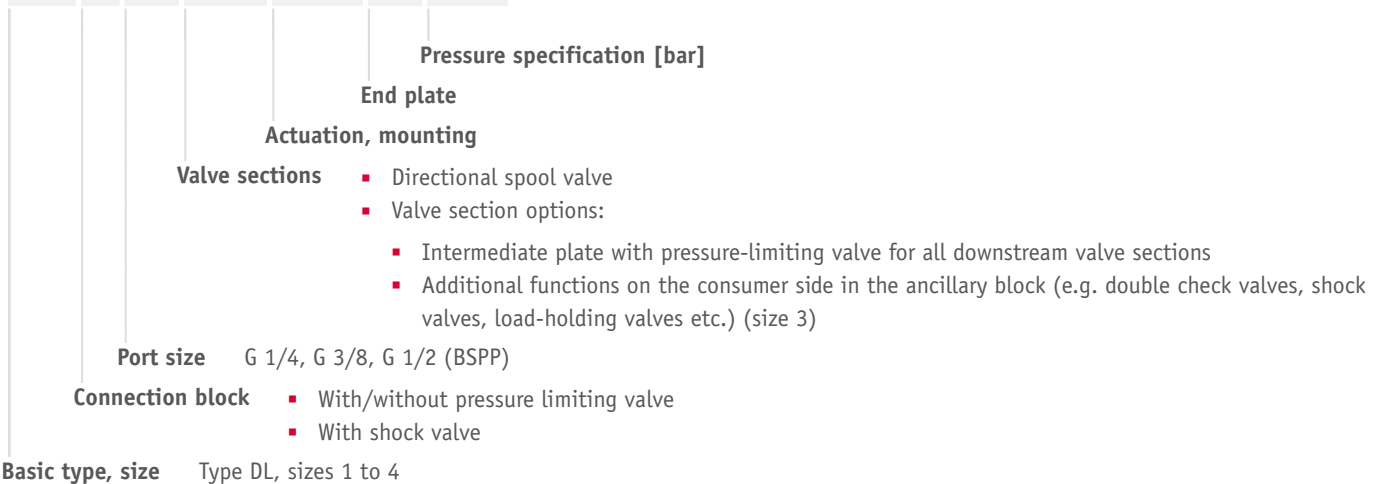
- Material handling (industrial trucks, etc.)
- Machines for agricultural and forestry purposes
- Construction and construction materials machinery
- Road vehicle



<b>Nomenclature:</b>	Throttling directional spool valve
<b>Design:</b>	Valve bank, featuring integrated by-pass idle pump circulation
<b>Actuation:</b>	Manual: <ul style="list-style-type: none"> <li>▪ Return spring, detent</li> </ul>
<b>P<sub>max</sub>:</b>	250 ... 315 bar
<b>Q<sub>max</sub>:</b>	12 ... 90 lpm

### Design and order coding example

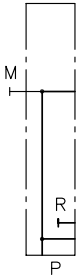
DL3 1 - 3 - GGD - B/E1 - 2 - 210



## Function

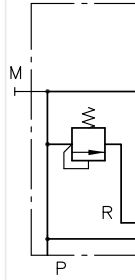
### Connection blocks:

DL .5



Without pressure-limiting valve

DL .1

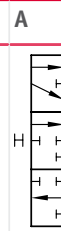
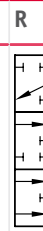
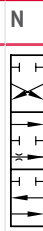
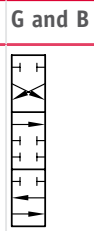
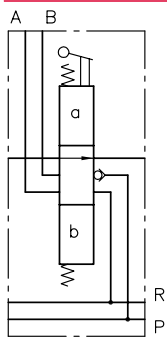


With pressure-limiting valve

### Valve sections:

Basic symbol

Symbol



Reduced internal leakage due to reduced spool valve play

### Versions of valve sections:

- Additional function on the pump side (orifice, 2-way flow control valve)
- Valve sections for size 3 with consumer-side additional functions in ancillary block (e.g. double check valves, shock valves, load-holding valves etc.)
- Manual operation with return spring for switching position "a" and detent for switching position "b"
- Manual operation with detent in both switching positions
- Manual operation with combinations of contact switch, switch cam and switch carrier
- Manual operation with different mounting directions

### End plates:

2



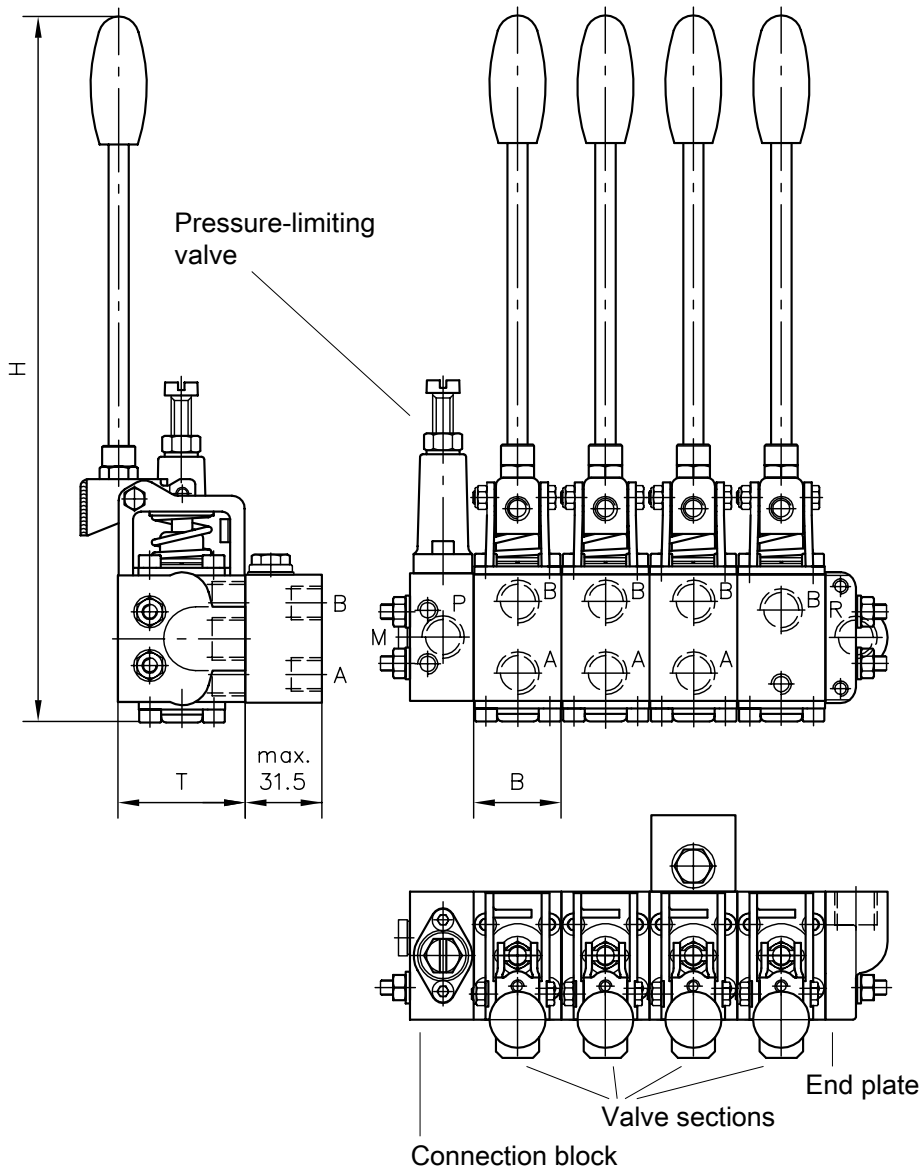
Standard end plate with port R

3



End plate for subsequent connection of a DL

## General parameters and dimensions



	$Q_{\max}$ [lpm]	$p_{\max}$ [bar]	Tapped ports			Dimensions [mm]			m [kg]
			Characteris- tic value	A, B	H, P, R	H	B	T	
DL 1	12 ... 16	315	1	G 1/4	G 1/4	approx. 192	31,5	45	0,5
DL 2	20 ... 30	315	1	G 1/4	G 3/8	approx. 278	34,5	50	0,85
			2	G 3/8	G 3/8				
DL 3	30 ... 60	250	2	G 3/8	G 1/2	approx. 351	39,5	60	1,4
			3	G 1/2	G 1/2				
DL 4	90	250	3	G 1/2	G 3/4	approx. 368	39,5	70	1,8

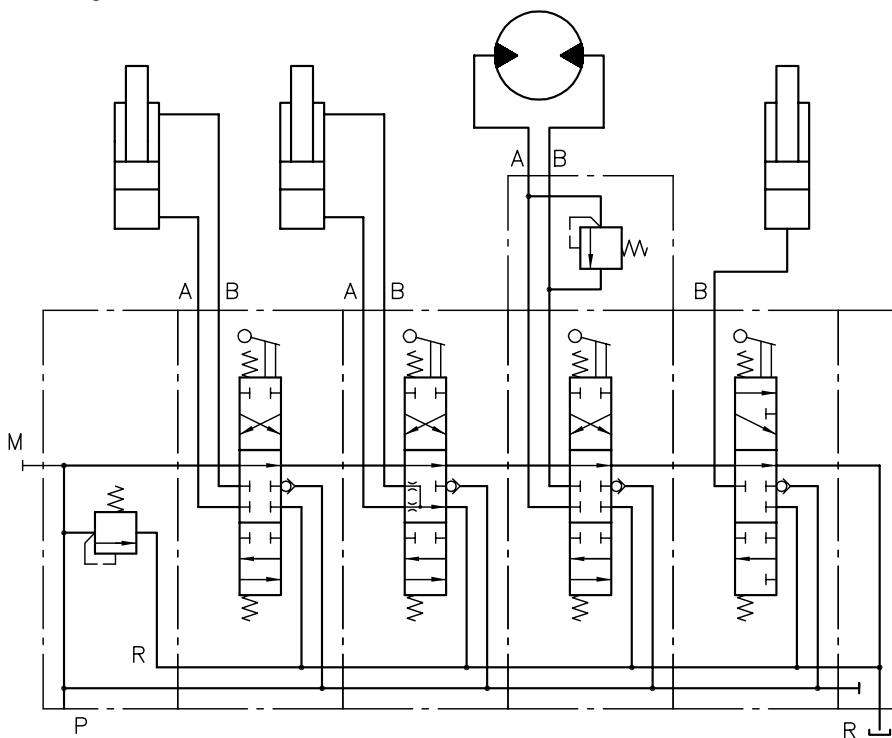


Example circuit:

**DL 21-2-G D G71 N-B/E1-2-180**

Size 2 DL directional spool valve with pressure-limiting valve (set to 180 bar), size 2 ports with G 3/8 tapped ports, symbols G, D, G, N; symbol G with pressure-limiting valve in port A (coding 71), valve sections with manual operation B (series with hand lever) and mounting type E1 (ports A, B are directed towards the front, valve spool is pushed into the housing for switching position "a"), valve bank with end plate 2 (coding 2)

Circuit symbol



**Associated technical data sheets:**

- [Directional spool valve bank type DL: D 7260](#)

# Directional spool valves

## 2.1 Proportional directional spool valves type PSL and PSV

Proportional directional spool valves are a type of directional valve. They control the direction of movement and the velocity of individual or multiple hydraulic consumers actuated simultaneously. Control is independent of the load and continuous.

The proportional directional spool valve type PSL is suitable for constant pump systems and type PSV for variable pump systems with a pressure/flow controller. The volumetric flows and load pressures for the individual consumers can be individually adjusted. The proportional directional spool valve type PSL and PSV can be adapted to various control tasks, e.g. for safety functions. All sizes can be combined with each other.

The proportional directional spool valve type PSL and PSV is used in mobile hydraulics, in particular in crane and lifting equipment, construction and mining machinery, drilling equipment as well as in offshore and marine technology.

### Features and benefits:

- One product for various control functions and volume quantities
- Energy-saving Closed-Center systems
- Compact and lightweight design
- Modular system with wide range of design variants

### Intended applications:

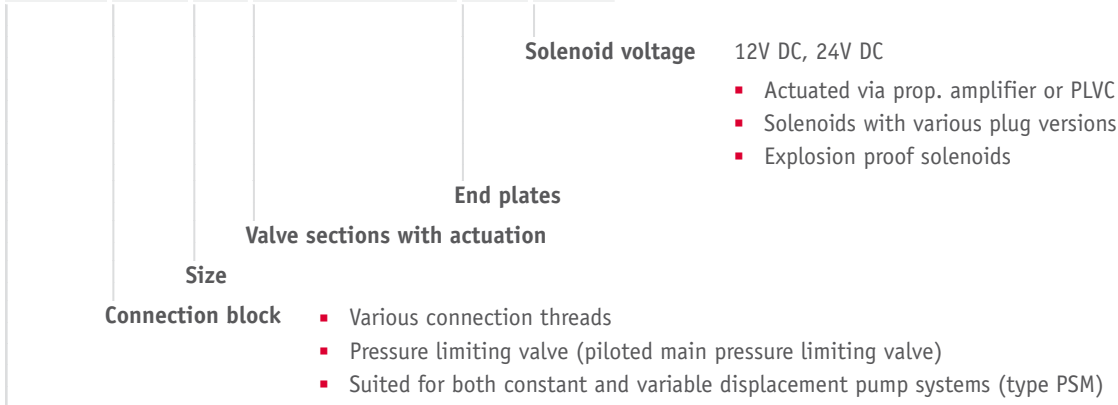
- Construction/construction material machinery
- Mining machinery (incl. oil production)
- Cranes and lifting equipment
- Machines for forestry and agricultural purposes



<b>Nomenclature:</b>	Prop. directional spool valves as per load-sensing principle
<b>Version:</b>	Valve bank in series connection
<b>Actuation:</b>	Manual <ul style="list-style-type: none"> <li>▪ Return spring</li> <li>▪ Detent</li> </ul> Electro-hydraulic Pressure-actuated <ul style="list-style-type: none"> <li>▪ Hydraulic</li> <li>▪ Pneumatic</li> </ul>
<b>p<sub>max</sub>:</b>	400 bar
<b>Q<sub>max. consumer</sub>:</b>	240 l/min
<b>Q<sub>pu max</sub>:</b>	approx. 300 lpm

### Design and order coding example

PSL41F /380 - 3 - A2J40/40/EA/3 - E4 - G24

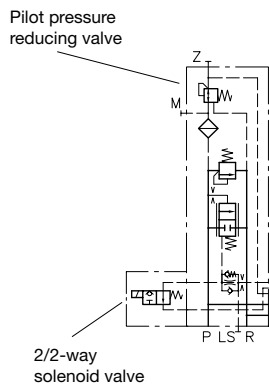


Type PSL (hydraulic oil supply by constant pump), sizes 2, 3 and 5  
 Type PSV (hydraulic oil supply by variable pump), sizes 2, 3 and 5  
 Type HMPL (hydraulic oil supply by constant pump) for industrial trucks, sizes 2 and 3  
 Type HMPV (hydraulic oil supply by variable pump) for industrial trucks, sizes 2 and 3

## Function

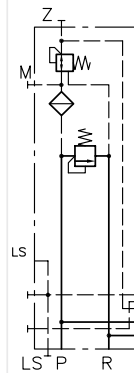
### Connection blocks:

#### PSL



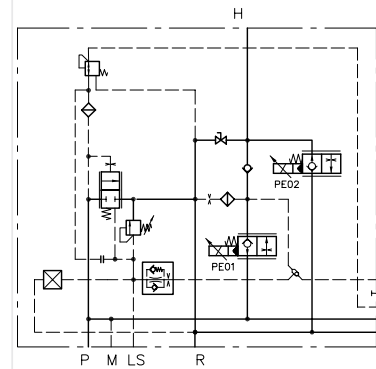
Connection block for constant pump systems with integrated 3-way controller, pressure-limiting valve and LS shutdown

#### PSV



Connection block for variable pump systems with or without pressure-limiting valve

#### HMPL (HMPV)



Connection block for constant delivery pump with incorporated proportional seated valve for lifting and lowering

### Additional versions of connection blocks:

- 2/2-way solenoid valve for randomly switching the pump direction
- Additional damping option of the 3-way/pump controller
- Additional isolation valve to minimise the pump direction resistance
- Version with additional shut-off valve for the pump line, can be switched randomly
- Proportionally adjustable pressure limitation

### Valve sections:

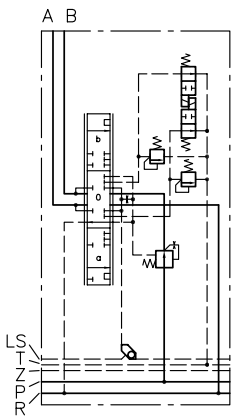
#### Basic symbols

#### Circuit symbol

Basic symbols	L	M	F	H	J	B	R	O	G

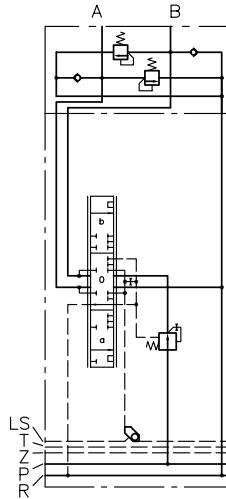
### Versions of valve sections:

- Load pressure signal outputs at A, B; A and B together
- 3/3 directional spool valve with 2-way input and output controller
- Version with and without 2-way inflow controller
- Function deactivation feature
- Secondary pressure-limiting valves (can be selected for A and/or B)
- Prop. Pressure limitation of individual functions
- Version with ancillary blocks
- Intermediate plates for various additional functions
- Combination of various sizes possible in one valve bank
- Version with ATEX solenoid for use in explosive environments
- Version with explosion-proof, intrinsically safe magnets for mining applications
- Version with direct CAN actuation



### Additional functions in the ancillary block:

- Shock and servo-suction valves
- Load-holding valves
- Differential circuits
- Check valves with release, zero-leakage
- Floating and block functions can be switched
- Proportional seated valves in accordance with [D 7490/1](#) for lifting and lowering functions with plunger cylinders




### Characteristic values for max. volumetric flows:

Size	Q <sub>A, B</sub>							
	3	6	10	16	25	40	63	80
Size 2	3	6	10	16	25	40		
Size 3	3	6	10	16	25	40	63	80
Size 5	16	25	40	63	80	120	160	

- Characteristic value corresponds to the max. volumetric flow [lpm] of inflow controller versions at the consumer ports A and/or B
- Volumetric flows for A and/or B can be selected separately
- Increasing the control pressure enables 60 lpm (size 2), 120 lpm (size 3) and 240 lpm (size 5) per consumer port side.
- Version with 2-way inflow controller and check valve function, or damping elements

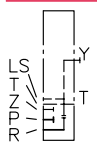
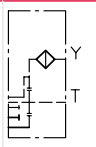
## Actuations:

Basic type	Brief description	Circuit symbol (example)
A	Manual actuation	 Combination of electro-hydraulic and manual actuation
C	Detent (continuous)	
K	Manual actuation via mechanical joystick	
E EA EI CAN EA CAN	Electro-hydraulic actuation in combination with manual actuation CAN: Actuation variant with direct CAN actuation	
H, P HA, PA	Hydraulic and pneumatic actuation in combination with manual actuation	
HEA	Combination of H, E and A actuation	

## Intermediate plates:

- Electrically or hydraulically actuated shut-off valve for all downstream consumers
- With pressure-limiting valve for limiting the operating pressure of all downstream valves
- For random switchable reduction of the volumetric flow of all downstream consumers
- Priority module, size 3

## End plates:

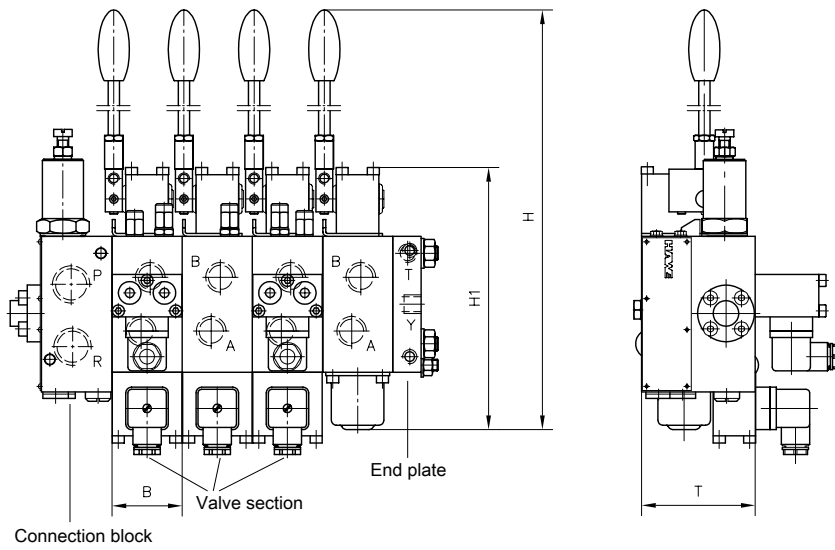
E1	E2
	
Standard end plate	With additional Y-port for LS-input signal

## Additional versions of end plates:

- End plate with internal leakage oil routing (no T gallery)
- End plates with additional P and R gallery
- Adapter plate to combine size 5 and 3 (coding ZPL 53), size 5 and 2 (coding ZPL 52) and size 3 and 2 (coding ZPL 32)
- End plate with integrated connection block function for dual-pump/dual-circuit systems

## General parameters and dimensions

PSL



	Flow [lpm]		Oper. pressure [bar]	Ports (BSPP)		Dimensions [mm]				m [kg]
	$Q_{max}$	$Q_{pu\ max}$	$p_{max}$	P, R	A, B	H	H1	B	T	Per valve section <sup>1)</sup>
<b>PSL/PSV 2</b>	3 ... 54	80	420	G 1/2, 3/4-16 UNF-2B	G 3/8, 3/4-16 UNF-2B	approx. 272	approx. 150	40	60	1.8 ... 2.9
<b>PSL/PSV 3</b>	3 ... 120	200	420	G 1/2, G 3/4, G 1, 1 1/16-12 UNF-2B	G 1/2, G 3/4, 7/8-14 UNF-2B	approx. 364	approx. 195	50	80	3.3 ... 4.1
<b>PSL/PSV 5</b>	16 ... 240	300	400	G 1, G 1 1/4, 1 5/8-12 UN-2B	G 1, 5/16-12 UNF-2B	approx. 400	approx. 224	62.5	100	3.7 ... 4.5

1) Dep. on actuation and additional functions

### Example circuit:

PSL 41/350 - 3

-32 J 25/16 A300 F1/EA  
 -42 O 80/63 C250/EA  
 -42 J 63/63 A100 B120 F3/EA  
 -31 L 40/16/A

- E2 - G24

Type PSL valve bank for constant pump systems

Connection block:

- Coding for thread size (here 4 = G 3/4)
- Coding for pilot pressure-reducing valve (here 1)
- Coding for set pressure at pressure-limiting valve (here 350 bar)

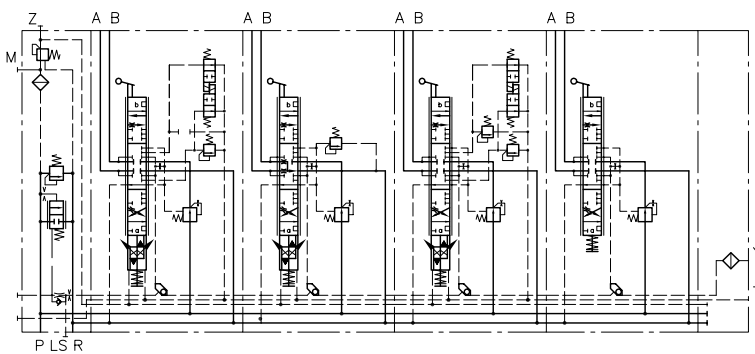
Size: 3

1. Valve section: (exemplary for all subsequent valve sections):

- Directional spool valve block with coding for consumer connection size (here 3 = G 1/2)
- Coding for the type of directional spool valve block (here 2)
- Circuit symbol (here J)
- Coding for max. consumer volumetric flow to ports A and B (here 25 and 16 lpm)
- Coding of additional functions (here A 300; secondary pressure-limiting valve at port A set to 300 bar, function deactivated for port A (here F1))
- Coding for actuation type (here EA)

End plate:

- Coding for end plate (here E2)
- Coding for 24V DC solenoid voltage (here G24)



### Products suitable for combination:

- Load-holding valves type LHT, LHDV: [Page 204](#)
- Joystick: [Proportional pressure-reducing valve type KFB 01 and FB 01: D 6600-01](#)

### Additional electrical components:

- Proportional amplifier: [Page 278](#)
- Programmable logic valve control type PLVC: [Page 280](#)
- CAN node type CAN-IO: [Page 282](#)
- Other electronic accessories [See "Electronics"](#)

### Associated technical data sheets:

- [Proportional directional spool valve, type PSL and PSV size 2: D 7700-2](#)
- [Proportional directional spool valve, type PSL, PSM and PSV size 3: D 7700-3](#)
- [Proportional directional spool valve, type PSL, PSM and PSV size 5: D 7700-5](#)
- [Actuation for proportional directional spool valves type PSL/PSV: D 7700 CAN](#)

### Associated technical data sheets:

- [Connection block type HMPL and HMPV for proportional directional spool valve: D 7700 H](#)
- [Proportional directional spool valve type EDL: D 8086](#)

# Directional spool valve

## 2.1 Proportional directional spool valve type PSLF, PSLV and SLF

Proportional directional spool valves are a type of directional valve. They control the direction of movement and the velocity of individual or multiple hydraulic consumers actuated simultaneously. Control is independent of the load and continuous.

The proportional directional spool valve type PSLF is suitable for constant pump systems and type PSVF for variable pump systems with a pressure/flow controller. The proportional directional spool valve type PSLF and PSVF is available as an individual manifold mounting valve or in the valve bank. The volumetric flows and load pressures for the individual consumers can be individually adjusted. The directional spool valve can be adapted to different control tasks. Connections on the rear permit easy access to the valve for servicing, even in tight installation spaces. All sizes can be combined with each other. The proportional directional spool valve type PSLF and PSVF is used in mobile hydraulics, in particular in crane and lifting equipment, construction and mining machinery, drilling equipment as well as in offshore and marine technology.

### Features and benefits:

- Max. flow 1000 lpm at 420 bar
- Rear side ports for easy access to valves, even in small installation spaces
- Flange design can be combined across all sizes with fast valve replacement
- Simultaneous operation of several functions at full speed

### Intended applications:

- Construction machinery and machines for building materials
- Cranes and lifting equipment
- Offshore and marine technology
- Mining machinery



<b>Nomenclature:</b>	Prop. directional spool valve acc. to the Load-Sensing principle
<b>Design:</b>	Individual manifold mounting valve Valve bank via individual manifold mounting valves
<b>Actuation:</b>	Manual <ul style="list-style-type: none"><li>▪ Return spring</li><li>▪ Detent</li></ul> Electro-hydraulic Pressure <ul style="list-style-type: none"><li>▪ Hydraulic</li><li>▪ Pneumatic</li></ul>
<b><math>p_{max}</math>:</b>	400 bar
<b><math>Q_{max, consumer}</math>:</b>	400 l/min
<b><math>Q_{pu max}</math>:</b>	approx. 1000 lpm



## Design and order coding example

PSLF A1/380/4 - 3 - A2J40/40/EA/3 - E2 - G24

Solenoid voltage 12V DC, 24V DC

- Operated using a proportional amplifier or PLVC
- Magnets with different plug versions
- Explosion-proof magnets

End plates

Valve sections with actuation

Size

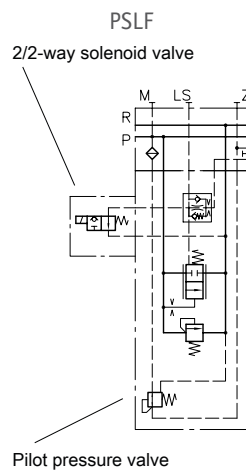
Connection block

- Various connection threads
- Pressure-limiting valve (pilot-controlled main pressure-limiting valve) in connection block

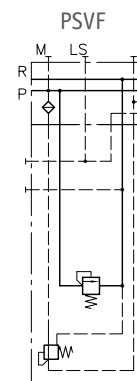
**Basic type** Type PSLF (supply via constant pump),  
Type PSVF (supply via variable displacement pump),  
size 3, 5 and 7

## Function

### Connection blocks:



Connection block for constant pump systems with integrated 3-way controller, pressure-limiting valve and LS shutdown



Connection block for variable pump systems with and without pressure-limiting valve

### Additional versions of connection blocks:

- 2/2-way solenoid actuated directional valve for arbitrary idle pump circulation
- Additional damping of the 3-way flow controller or pump controller
- Proportional adjustable pressure limitation

### Valve sections:

Basic symbol	Symbol									
	L	M	F	H	J	B	R	O	G	

### Coding for max. consumer flow:


	Q <sub>A, B</sub>							
Size 3	3	6	10	16	25	40	63	80
Size 5	16	25	40	63	80	120	160	
Size 7	120	160	250	320	400			

- Key figure corresponds to the max. volumetric flow (lpm) at the consumer ports A and/or B of inflow controller versions
- Volumetric flows for A and/or B can be selected individually
- Increasing the control pressure enables 60 lpm (size 2), 120 lpm (size 3), 240 l/min (size 5) and 500 l/min (size 7) per consumer port side.
- Version with 2-way inflow controller and check valve function

### Versions of valve sections:

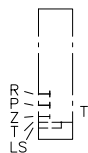
- Load pressure signal outputs at A, B; A and B together
- Version with and without 2-way inflow controller
- Function deactivation
- Secondary pressure-limiting valves (can be individually selected for A and/or B)
- Proportional pressure limitation of individual functions
- Sub-plates with different additional functions
- Sub-plates for ancillary blocks
- Sub-plates for a combination of different sizes
- Combination of various sizes possible in one valve bank
- Version with ATEX solenoid for use in explosive areas
- Version with explosion-proof, intrinsically safe magnets for mining applications

### Actuations:

Basic type	Brief description	Symbol (example)
A	Manual actuation	 <p>For combination of electro-hydraulic and manual actuation</p>
C	Detent (stepless)	
E	Electro-hydraulic actuation	
EA	in combination with manual actuation	
H, P	Hydraulic and pneumatic actuation	
HA, PA	in combination with manual actuation	
HEA	Combination of actuation H, E, and A	

### End plates:

E1



End plate (std. )

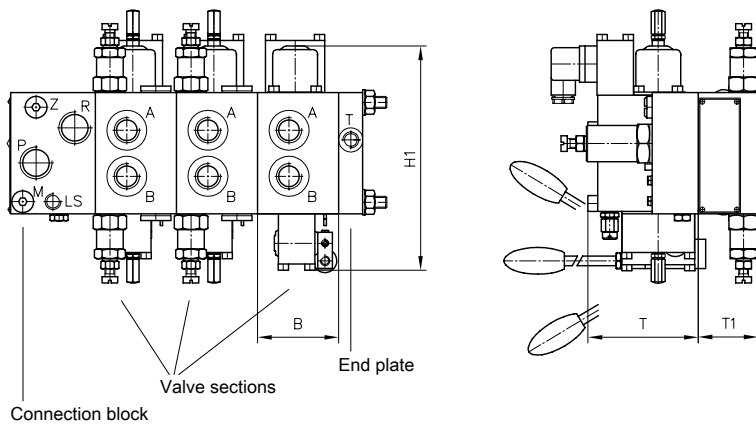
E2



With additional Y-port for LS-input signal

### Additional versions of end plates:

- End plate with internal drain line (without T-port)
- End plates with an additional port R
- Adapter plate enabling combination of size 5 with size 3 (coding ZPL 53)

**General parameters and dimensions**
**PSVF**


	Flow [lpm]		Oper. pressure [bar]	Ports (BSPP)		Dimensions [mm]				m [kg]	
	$Q_{max}$	$Q_{PU\ max}$	$p_{max}$	P, R	A, B	H1	B	T	T1	1)	2)
<b>PSLF/PSVF 3</b>	3 - 120	200	420	G 3/4, 1 1/16-12 UN-2B	G 1/2, G 3/4, 7/8-14 UNF-2B	approx. 195	50	80	50	3.3 ... 4.1	6.6 ... 7.6
<b>PSLF/PSVF 5</b>	16 - 210	350	400	G 1, G 1 1/4, SAE 1 1/2"	G 1, SAE 1"	approx. 224	62.5	100	100	3.7 ... 4.5	10.9 ... 16.3
<b>PSLF/PSVF 7</b>	120 - 500	1000	400	G 1 1/2, SAE 1 1/2"	G 1 1/4, SAE 1 1/4"	approx. 305	106	101	95	13	23

- 1) Per valve section depending on actuation and additional functions  
 2) Per valve section complete with sub-plate

**Products suitable for combination:**

- Load-holding valves type LHT, LHDV: [Page 204](#)
- Joystick: [Proportional pressure-reducing valve type KFB 01 and FB 01: D 6600-01](#)

**Additional electrical components:**

- Proportional amplifier: [Page 278](#)
- Programmable logic valve control type PLVC: [Page 280](#)
- CAN node type CAN-IO: [Page 282](#)
- Other electronic accessories [See "Electronics"](#)

**Associated technical data sheets:**

- Prop. directional spool valve type PSLF/PSVF: [Page 112](#)

# Directional spool valve

## 2.1 Clamping module type NSMD

Clamping modules combine a directional spool valve, pressure reducing valve and pressure switch.

The clamping module type NSMD has the standard connection pattern nominal size NG 6. It controls force-actuated clamping devices, e.g. hydraulically actuated hollow and solid clamping cylinders for automatic lathes. The device is used to clamp and release a clamping cylinder. It regulates the clamping pressure and monitors it. The clamping pressure is adjusted at the downstream pressure switch using a manual, mechanical or electrical-proportional adjustment device. A special safety circuit monitors the switching position of the valve.

Throttling options in the spool end position and/or rapid and creeping movements are possible as an additional function for one or both consumer ports. The clamping module type NSMD can be combined with other valves as a valve bank type BA to form a valve block.

### Features and benefits:

- Directional valve, pressure-reducing valve and pressure switch in one device
- Adjustment of pressure-reducing valve and pressure switch with an adjustment device (manual or electro-proportional)
- The controlled pressure is picked up directly at the consumer port
- Valve with connection pattern according to DIN 24340-A4

### Intended applications:

- Machine tools (cutting)
- Machine tools (non-cutting) - forming and cutting
- Handling and mounting technology (industrial robots, etc.)



<b>Nomenclature:</b>	Valve combination consisting of: <ul style="list-style-type: none"> <li>▪ Directional spool valve (4/3-, 4/2-way function)</li> <li>▪ Pressure reducing valve with tracked pressure switch</li> </ul>
<b>Design:</b>	Individual valve for manifold mounting (Valve banks with sub-plates type BA are available)
<b>Actuation:</b>	Solenoid
<b>p<sub>max</sub>:</b>	120 bar
<b>Q<sub>max</sub>:</b>	25 lpm

### Design and order coding example

NSMD 2 D1 60 R - G24

**Solenoid voltage** 12V DC, 24V DC, 110V AC, 230V AC  
Solenoids with various plug versions

**Means of adjustment for the clamping pressure**

- Slotted head screw + hexagon nut
- Wing screw + wing nut
- Lockable turning handle
- Electro-proportional adjustment with/without additional function monitoring

**Additional functions**

- Throttle
- Rapid and creeping movement (one or both directions)

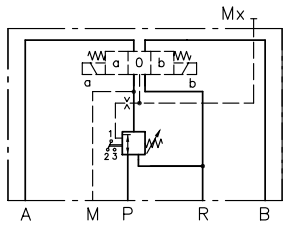
**Function**

- With pressure switch
- With orifice (flow limitation in accumulator mode)

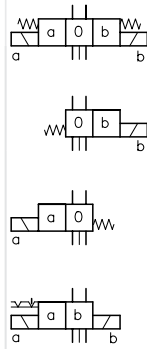
**Basic type, size** Type NSMD size 2 with connection hole pattern conf. NG 6

## Function

### Basic symbols



#### D, E, G, D1, E1, G1



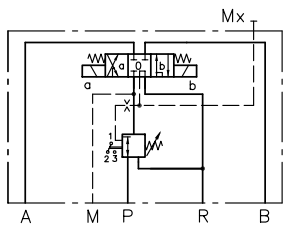
### Symbols

D	E	G
D1	E1	G1
B, W, K	B1, W1, K1	

### Further functions:

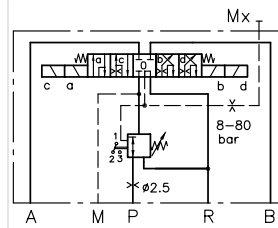
#### G1/MD

Pressure reducing function and throttle in switching positions a and b



#### G/MM6

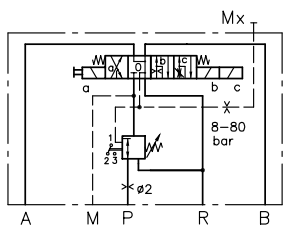
Rapid traverse and creeping in both directions



#### G/MMDA7

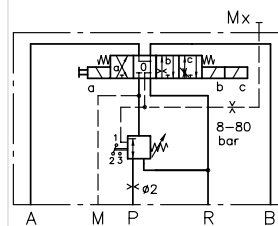
Rapid traverse and creeping in one direction featuring also a limitation for rapid traverse (switching position a, c) rapid traverse in opposing direction (switching position b)

Switching position a, speed limitation is possible by means of a throttle with pressure reduction and pressure monitoring



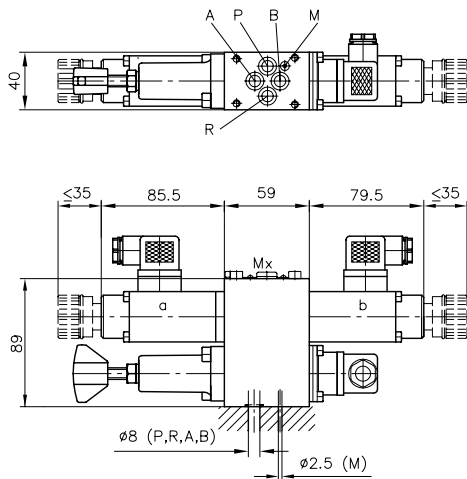
#### G/MMA7

Switching position with fixed rapid traverse speed without pressure reduction and pressure monitoring.

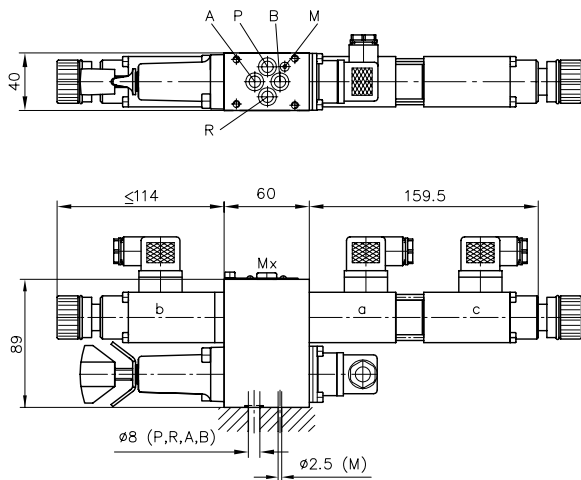


## General parameters and dimensions

### NSMD2 K...



### NSMD2 G...



	$Q_{max}$ [lpm]	$p_{max}$ [bar]	Clamping pressure range [bar]	Trigger flow [lpm]	Connection hole pattern <sup>1)</sup>	Dimensions [mm]			m [kg]	
						H	B	T	Individual valve <sup>2)</sup>	Additional function
<b>NSMD2</b>	25	120	5 ... 50 8 ... 80	2 ... 4 3 ... 5 4 ... 6	Hole pattern conf. DIN 24340- A6	see illustration			2.2 ... 3.8	+ 0.6 ... 1.1

1) Mx port: G 1/8

2) Depending on circuit symbol and actuation type

**Circuit example:**

**NSMD2K/M/GDK/B2,5-G24**

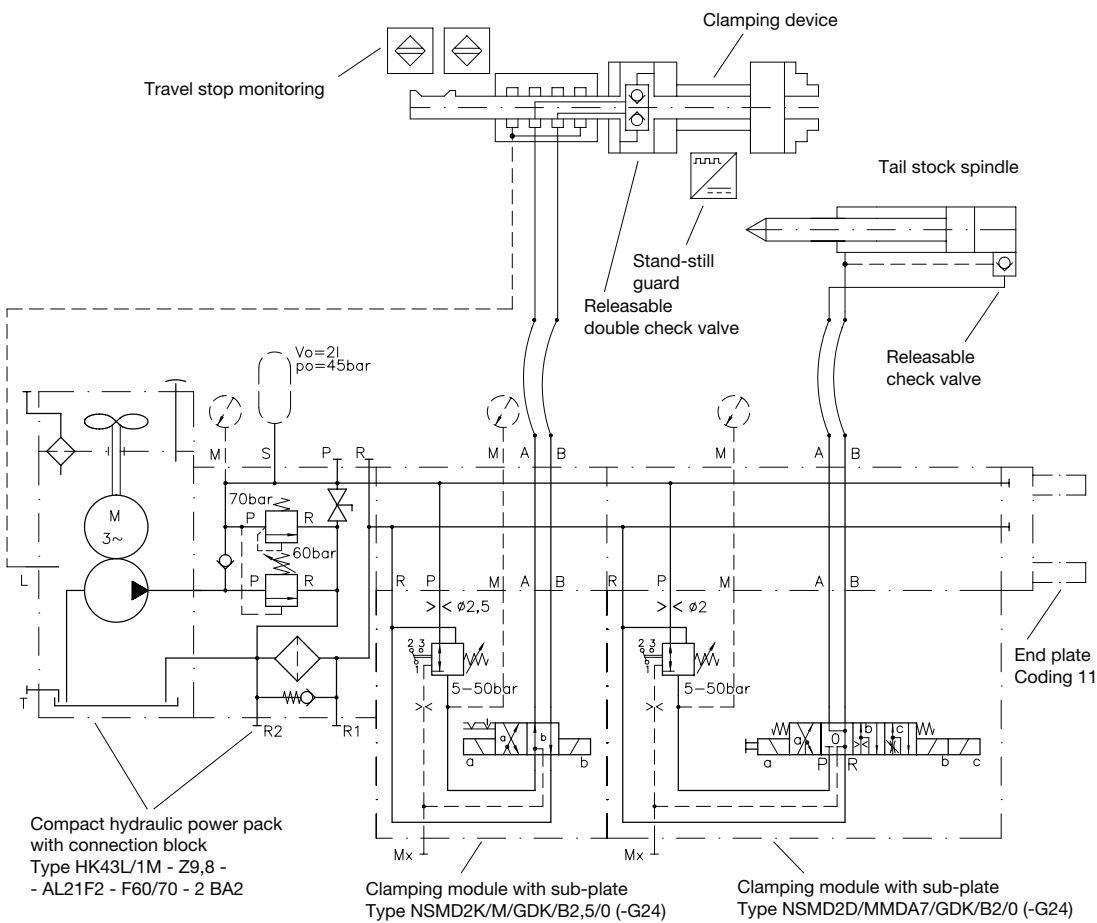
Clamping module type NSMD size 2 with industrial standard (DIN 24340-A6) connection hole pattern, flow pattern symbol K, detented version, clamping pressure range G, 5-50 bar and min. operational flow 2-4 lpm. The actuation for the adjustment of the clamping pressure and tracked pressure switch takes place by means of wing screw and wing nut. An orifice  $\text{AE } 2.5 \text{ mm}$  is installed in the P gallery, solenoid voltage 24V DC

**NSMD2G1/MD/E4VK/B1-G12**

Clamping module type NSMD size 2 with industrial standard connection hole pattern conf. DIN 24340-A6, flow pattern symbol G1 with pressure monitoring at port A, adjustable throttle setting for switching position a and b. Valve for clamping pressure range E, 8-80 bar and min. operational flow 4-6 lpm. The actuation for the adjustment of the clamping pressure and tracked pressure switch takes place with self-locking turn knob. An orifice  $\text{AE } 1 \text{ mm}$  is installed in the P gallery, solenoid voltage 12V DC

**Circuit example:**

**HK 43L/1M-Z 9,8-AL 21F2-F60/70-2-BA 2** - NSMD2K/M/GDK/B2,5/0  
 - NSMD2D/MMDA7/GDK/B2/0-G24



**Associated technical data sheets:**

- [Clamping module type NSMD: D 7787](#)

**Products:**

- Directional valves type NSWP2: [Page 88](#)
- Directional seated valves type NBVP16: [Page 144](#)

**Plates:**

- Valve banks type BA2: [Page 70](#)
- [Intermediate plate type NZP: D 7788 Z](#)

**Male connectors:**

- [Line connector type MSD and others: D 7163](#)
- With economy circuit: [D 7813](#), [D 7833](#)

## 2.2 Directional seated valves

Directional seated valve type G, WG and others	124
Valve bank (directional seated valve) type VB	130
Directional seated valve type WN and WH	134
Valve bank (directional seated valve) type BWN and BWH	136
Directional seated valve type EM and EMP	140
Directional seated valve type BVG, BVP and NBVP	144
Directional seated valve type BVE	148
Directional seated valve type VP	150
Lifting/lowering valve type HSV	152
Switch unit type CR	154
Lifting module type HMT and HST	156
Directional seated valve type VH, VHR, and VHP	160
Directional seated valve type VZP	162



*Directional seated valve bank  
type VB*



*Directional seated valves  
type BVG, BVE, BVP and NBVP*



**(Solenoid-actuated) seated valves**

Type	Nomenclature/Design	Actuation	p <sub>max</sub> (bar)	Q <sub>max</sub> (lpm)
G, WG and Others	<b>Directional seated valve with various actuations</b> <ul style="list-style-type: none"> <li>Individual valve for manifold mounting</li> </ul>	- Solenoid - Pressure - Manual	0: 500 1: 700 2: 700 3: 400 4: 350	0: 6 1: 12 2: 25 3: 65 4: 120
VB	<b>Directional seated valve, zero leakage, valve bank</b> <ul style="list-style-type: none"> <li>For pipe connection</li> <li>For combination with hydraulic power packs</li> </ul>	- Solenoid - Pressure - Manual	01: 500 11: 700 21: 700 31: 400 41: 350	01: 6 11: 12 21: 25 31: 60 41: 120
WN, WH	<b>Directional seated valve, zero leakage, individual valve</b> <ul style="list-style-type: none"> <li>Individual valve for manifold mounting</li> <li>Combination with connection block for pipe connection</li> </ul>	- Solenoid	WN - 1: 350  WH - 1: 450 WH - 2: 350 WH - 3: 350 WH - 4: 350	WN - 1: 5  WH - 1: 8 WH - 2: 15 WH - 3: 30 WH - 4: 60
BWH, BWN	<b>Directional seated valve, zero leakage, valve bank</b> <ul style="list-style-type: none"> <li>For pipe connection</li> <li>For combination with hydraulic power packs</li> </ul>	- Solenoid	BWN - 1: 350  BWH - 1: 450 BWH - 2: 350 BWH - 3: 350	BWN - 1: 5  BWH - 1: 8 BWH - 2: 15 BWH - 3: 30
VZP	<b>Directional seated valve, zero leakage, individual valve</b> <ul style="list-style-type: none"> <li>Individual valve for manifold mounting</li> </ul>	- Solenoid	1: 450	1: 15
EM, EMP	<b>Directional seated valve, zero leakage, individual valve</b> <ul style="list-style-type: none"> <li>Screw-in valve</li> <li>Combination with connection block for pipe connection</li> <li>Combination with connection block for swivel fitting</li> </ul>	- Solenoid	EM - 1: 450 EM - 2: 400 EM - 3: 400 EM - 4: 350  EMP - 2: 400 EMP - 3: 400 EMP - 4: 350	EM - 1: 20 EM - 2: 40 EM - 3: 80 EM - 4: 160  EMP - 2: 40 EMP - 3: 80 EMP - 4: 160
BVG, BVP, NBVP	<b>Directional seated valve, zero leakage, individual valve</b> <ul style="list-style-type: none"> <li>For pipe connection</li> <li>Individual valve for manifold mounting</li> </ul>	- Solenoid - Hydraulic - Pneumatic - Manual	1: 400	1: 20
BVE	<b>Directional seated valve, zero leakage, individual valve</b> <ul style="list-style-type: none"> <li>Screw-in valve</li> <li>Combination with connection block for pipe connection</li> <li>Combination with connection block for manifold mounting</li> </ul>	- Solenoid	1: 500 3: 400 5: 400	1: 20 3: 70 5: 300

Type	Nomenclature/Design	Actuation	p <sub>max</sub> (bar)	Q <sub>max</sub> (lpm)
VP	<b>Directional seated valve, zero leakage, individual valve</b> <ul style="list-style-type: none"> <li>▪ Individual valve for manifold mounting</li> </ul>	- Solenoid - Hydraulic - Pneumatic	1: 400	1: 15
VH, VHR, VHP	<b>Directional seated valve, zero leakage</b> <ul style="list-style-type: none"> <li>▪ Individual valve for pipe connection</li> <li>▪ Single manifold mounting valve</li> <li>▪ Valve bank</li> </ul>	- Manual	VH - 1: 700 VH - 2: 500  VHP - 1: 700  VHR - 1: 700 VHR - 2: 500	VH - 1: 12 VH - 2: 25  VHP - 1: 12  VHR - 1: 12 VHR - 2: 25

### Valve combinations

Type	Nomenclature/Design	Actuation	p <sub>max</sub> (bar)	Q <sub>max</sub> (lpm)
HSV	<ul style="list-style-type: none"> <li>Individual valve for pipe connection</li> </ul>	- Solenoid	21: 315 22: 315 61: 350 71: 400	21: 20 22: 30 61: 60 71: 120
CR	<ul style="list-style-type: none"> <li>Individual valve for pipe connection</li> </ul>	- Solenoid - Manual	HP/LP: 4: 400/60 5: 400/60	HP/LP: 4: 8/80 5: 20/160
HMT, HST	<ul style="list-style-type: none"> <li>Valve bank</li> </ul>	- Solenoid	HST - 2: 315 HST - 3: 315  HMT - 3: 315	HST - 2: 40 HST - 3: 80  HMT - 3: 90

# Directional seated valves

## 2.2 Directional seated valve type G, WG and others

Directional seated valves are a type of directional valve. As ball valves they have zero leakage in the closed state.

The directional seated valve type G, WG, H, P, K, T and D is available as a 2/2, 3/2, 4/2, 3/3 and 4/3 directional seated valve with different actuation types. Actuation using a hand lever enables switchable pressures of up to 700 bar.

Appropriate connection blocks make possible direct pipe connection. The directional seated valves are available as a combination of valves in a valve bank type VB.

### Features and benefits:

- Zero-leakage ball valve construction with high switching reliability
- Solenoid, pressure, mechanical or manual actuation
- Low shifting forces and gentle, smooth switching
- Operating pressures up to 700 bar

### Intended applications:

- Machine tools (cutting and non-cutting)
- Clamping equipment, punching tools, jigs
- Rubber and plastics machinery
- Oil hydraulics and pneumatics



<b>Nomenclature:</b>	Directional seated valve, zero leakage
<b>Design:</b>	Individual valve, manifold mounting combination with sub-plates for pipe connection
<b>Actuation:</b>	Solenoid Pressure (hydraulic, pneumatic) Mechanical (roller, pin) Manual (hand lever, adjusting knob)
<b>p<sub>max</sub>:</b>	350 ... 700 bar
<b>Q<sub>max</sub>:</b>	6 ... 120 lpm

## Design and order coding example

G R2 - 3 R - 1/2 - G24

**Solenoid voltage** 12V DC, 24V DC, 110V AC, 230V AC

**Indiv. connection blocks for pipe connection**

**Additional versions:**

- Connection blocks with by-pass check valve or pressure limiting valve between P and R
- Connection block with bridge rectifier circuit. Check valves in "GRAETZ"-circuitry ensure flow direction through the valve

**Additional elements**

- With check valve insert for port P
- With check valve insert for port P
- With return pressure stop for port R
- Position monitoring (size 3 and 4)

**Size** Size 0 to 4

- Size 1 also available with industrial connection hole pattern NG 6 (CETOP), type NG

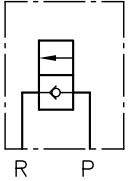
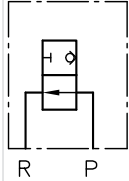
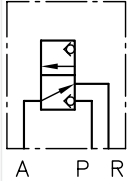
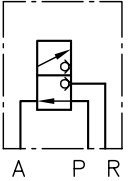
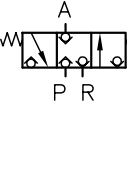
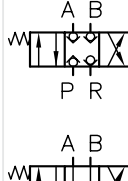


**Function**

- 2/2-way directional valve (R2, S2)
- 3/2-way directional valve (3, Z3)
- 3/3-way directional valve (21, 39)
- 4/3-way directional valve (22, 48, 49)
- 4/2-way directional valve (4, Z4)

**Actuation**

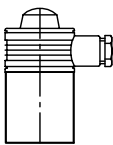

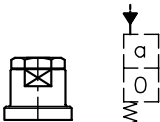
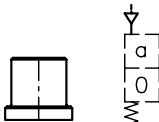
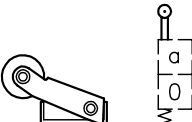
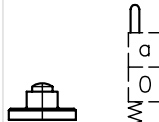
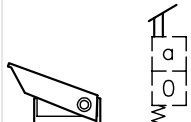
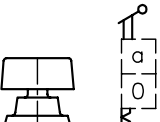
- Solenoid (G, WG)
- Hydraulic (H)
- Pneumatic (P)
- Mechanical (K, T, F, D)

## Function

2/2-way directional valve		3/2-way directional valve		3/3-way directional valve	4/3-way directional valve	4/2-way directional valve	
R2	S2	3	Z3	21, 39	22, 48, 49	4	Z4
							

- Simplified symbols for 3/3-, 4/3- and 4/2-way functions
- Type 21, 22 not in size 4
- Type 39, 48, 49 only in size 22
- Type 4, Z4 only in size 1

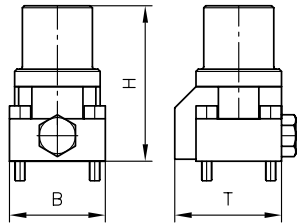
**Actuation:**

Solenoid		Pressure		Mechanical		Manual	
G	WG	Hydraulic	Pneumatic	Roller	Pin	Hand lever	Turn knob
G	WG	H	P	K	T	F	D
							
Solenoid voltages: 12V DC, 24V DC (type G) 230V AC (type WG)		Control pressure $p_{\text{contr. max}}$ [bar]: 400... 700		Shifting force [N]: 25... 80		Shifting force [N]: 25... 80	
		Control pressure $p_{\text{contr. min}}$ [bar]: 9... 16		Shifting travel [mm]: 10.5... 30		Shifting travel [mm]: 20.5... 45	
		15		51... 20		45... 98	
		2.5... 4		4 and 5			

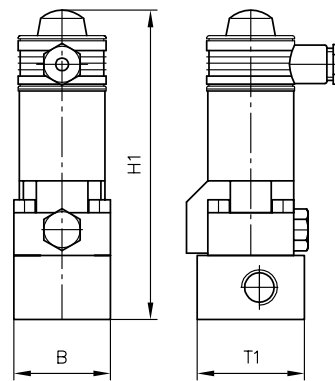
- Valve with solenoid actuation also available in ATEX-compliant version (24V DC)

## General parameters and dimensions

Individual valve



Valve with connection block



### Dimensions

Size	H <sub>max</sub>	H1 <sub>max</sub>	B		T <sub>max</sub>	T1	m <sub>max</sub> [kg]
			2/2- and 3/2-way	3/3- and 4/3-way			
0	90.5	110.5	36	75	41.5	40.0	0.8/1.0
1, 12	115	145	45	92	50	50	1.4/1.9
2, 22	126.5; 134.5	156.5; 161.5	56; 56	116; 116	62.5; 67.5	56; 56	2.9/3.9; 3.0/4.0
3	162	202	70	144	91.5	70	5.7/7.1
4	226	226	80	162	127	125	16.3/20.1

Size	Q <sub>max</sub> [lpm]	P <sub>max</sub> [bar]		Pressure				Mechanical		Manual		Ports (BSPP)
		Solenoid		Pressure		Mechanical		Manual				
		G	WG	H	P	K	T	F	D			
0	6	300... 500		500	-	-		-	500		G 1/4	
1, 12	12	350... 500 (700)		500... 700		400... 700		400... 700		G 1/4 and G 3/8		
2, 22	25	350... 500 (700)		500		400... 500		400... 500		G 3/8 and G 1/2		
3	65	350... 400		400		350	-	350	-		G 1/2 and G 3/4	
4	120	350		-		-		-		G 3/4 and G 1		

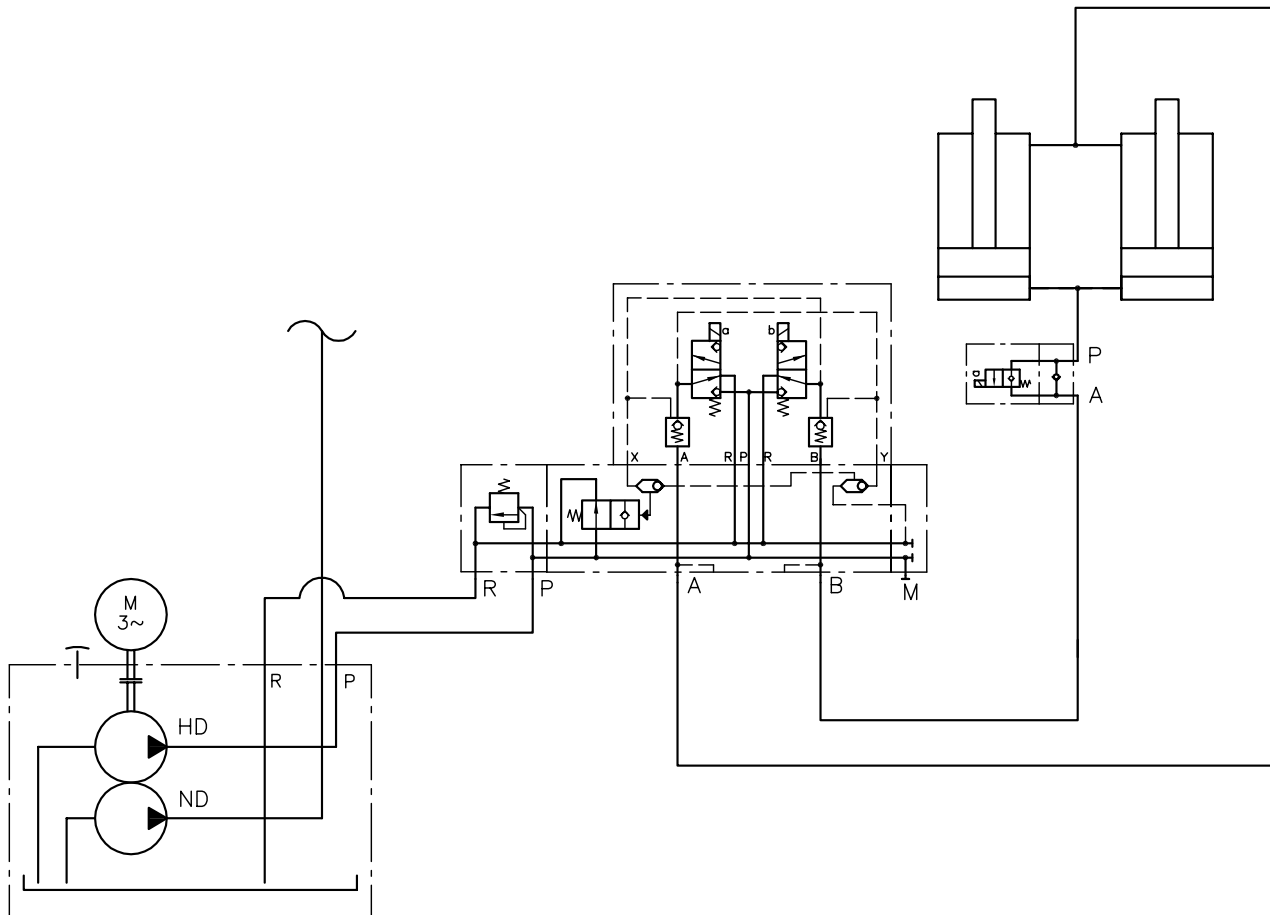


**Example circuit:**

RZ 4.0/2-12.3-B 75-V 5.5  
- 3 x 690/400 V 50 Hz

VB 22 AM 1/500  
-G 49/U 22  
-8 E-2-G 24

GR 2-12-3/8 C-G 24



**Associated technical data sheets:**

- [Directional seated valve type G, WG and others: D 7300](#)
- [Directional seated valve type NG, NGW and others: D 7300 N](#)
- [Directional seated valve type G, WG and others with position monitoring: D 7300 H](#)

**Valve banks:**

- Valve banks type VB: [Page 130](#)

**Male connectors:**

- [Line connector type MSD and others: D 7163](#)
- With economy circuit: [D 7813](#), [D 7833](#)

# Directional seated valves

## 2.2 Valve bank (directional seated valve) type VB

A valve bank combines different valves for operating independent consumers. The valve bank type VB comprises several directional seated valves of type G, WG among others that are connected in parallel. The directional seated valves as ball valves have zero leakage in the closed state. They are attached to sub-plates. These sub-plates are clamped between the inlet section (P and R port) and the end plate via tension rods. Pressure switches or pressure-limiting valves can be integrated into the pumps and/or consumer lines.

2/2 and 3/2- 4/2, 3/3 and 4/3 directional seated valves are available with different types of actuation. The valve bank can be attached directly to the compact hydraulic power pack.

### Features and benefits:

- Compact hydraulic controls for high pressure
- Combination with compact hydraulic power packs result in cost efficient turn-key solutions
- Elimination of time-consuming installation due to integrated hydraulic power packs
- Simple repairs thanks to modular structure of the systems

### Intended applications:

- Machine tools (chipping and non-chipping)
- Clamping, punching and jigs
- Rubber and plastics machinery
- Oil hydraulics and pneumatics



<b>Nomenclature:</b>	Directional seated valve, zero leakage
<b>Design:</b>	Valve bank for pipe connection
<b>Actuation:</b>	Solenoid Pressure: Hydraulic, Pneumatic Manual: Hand lever, Turn knob
<b>p<sub>max</sub>:</b>	500 ... 700 bar
<b>Q<sub>max</sub>:</b>	6 ... 120 lpm

### Design and order coding example

VB12 F M DCNR5 1 WG230

**Solenoid voltage** 12V DC, 24V DC, 110V AC, 230V AC

**Port size** G 1/4 (1), G 3/8 (2), G 1/2 (3) (BSPP)

**Valve sections** Symbols: 2/2-way directional valve, 3/2-way directional valve, 3/3-way directional valve, 4/3-way directional valve, 4/2-way directional valve

#### Valve section options

- Pressure switch for P or the consumer side
- Pressure reducing valve reducing the pressure in the downstream gallery P
- Orifices in gallery P and/or return pressure stop in gallery R

#### Sub-plates

- With 2-way flow controller by-passing to the tank
- Pressure reducing valve reducing the pressure in the downstream gallery P
- With pressure limiting valve and throttle
- With idle circulation valve and/or shuttle valve

#### Intermediate plates

- With pressure reduction for gallery P or throttle for port A (parallel connection)

#### Actuation

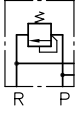



#### Connection block/adaptor plate

- For pipe connection
- For direct mounting at compact hydraulic power packs
- For direct mounting at hydraulic power packs

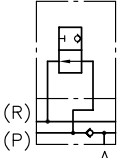
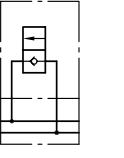
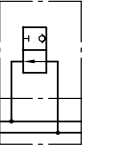
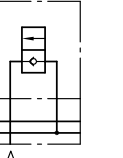
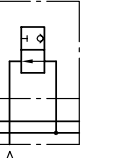
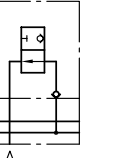
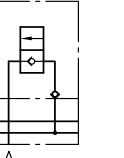
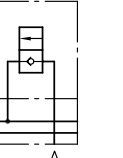
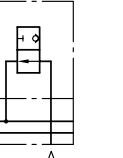
**Basic type, size** Type VB, size 01, 12, 21, 31, 41

## Function

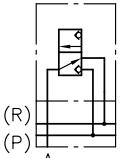
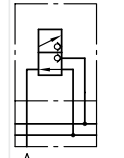
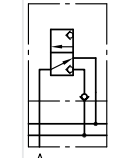
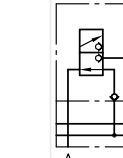
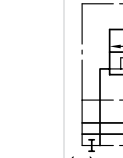
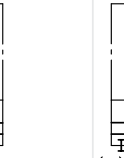
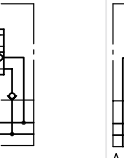
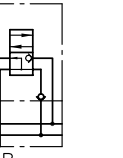
### Connection blocks:

<p><b>A -1/..</b></p>  <p>For pipe connection, with fixed pressure limiting valve (/.. - pressure specification in bar)</p>	<p><b>C, D, E</b></p>  <p>For mounting onto hydraulic power packs type R, Z and RZ, depending on tank and size</p>	<p><b>F</b></p>  <p>For mounting onto compact hydraulic power packs (type KA, HC, MP, MPN, HK)</p>	<p><b>G</b></p> 
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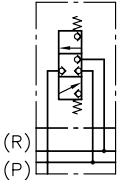
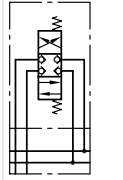
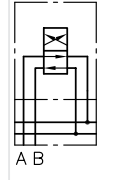
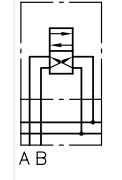
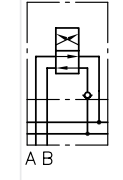
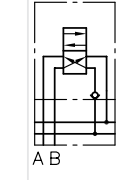
### Valve sections:

<p><b>A</b></p> 	<p><b>D</b></p> 	<p><b>F</b></p> 	<p><b>B</b></p> 	<p><b>C</b></p> 	<p><b>E</b></p> 	<p><b>Q</b></p> 	<p><b>P</b></p> 	<p><b>O</b></p> 
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- A not for VB 01, VB 11 only with tapped ports G 1/4

<p><b>H</b></p> 	<p><b>L</b></p> 	<p><b>N</b></p> 	<p><b>R</b></p> 	<p><b>Y</b></p> 	<p><b>I</b></p> 	<p><b>S</b></p> 	<p><b>T</b></p> 
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Simplified flow pattern



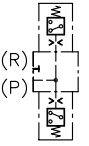
<p><b>J, G39</b></p> 	<p><b>G, G49</b></p> 	<p><b>HX</b></p> 	<p><b>LX</b></p> 	<p><b>NX</b></p> 	<p><b>RX</b></p> 
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Simplified flow pattern

Simplified flow pattern

- J, I, Y, S, T, G39, G49 only available for VB 21, 22
- G not available for VB 41
- HX, LX, NX, RX only available for VB 11

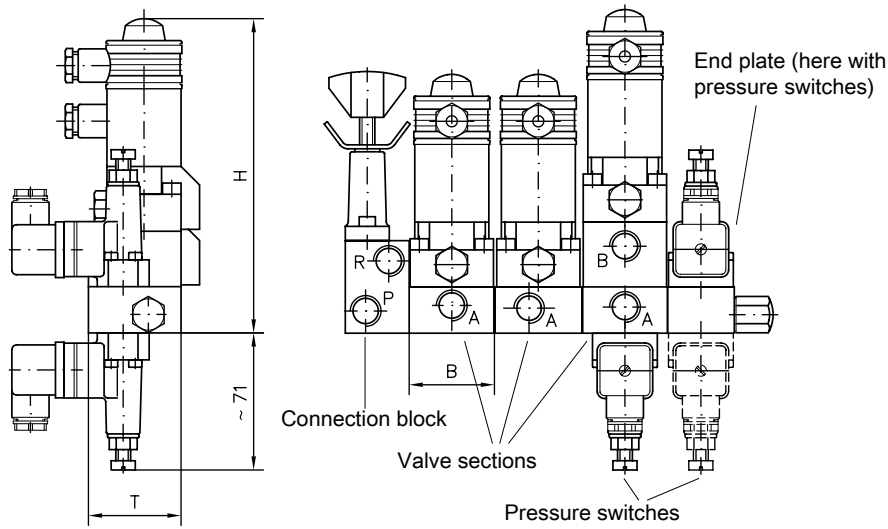
### End plates:

<p><b>/2</b></p>  <p>Standard end plate</p>	<p><b>/2</b></p>  <p>End plate with accumulator drain valve</p>	<p><b>/3 ... /65</b></p>  <p>End plates with one or two pressure switches type DG 3..</p>
---	--	--

- /2, /3 ... /65 only available for VB01 and VB11

## General parameters and dimensions

### VB 01



	$Q_{\max}$ [lpm]	$p_{\max}$ [bar]	Ports (BSPP)				Dimensions [mm]			m [kg] per valve section		
			Solenoid		Pressure		Manual	P, R, A, B	H		B	T
			M	H	P	F						
<b>VB 01</b>	6	300 ... 500	-	500	-	500	G 1/4	110 ... 135	38	40	0.6 ... 1.25	
<b>VB 12</b>	12	350 ... 500 (700)	500 ... 700	400 ... 700	G 1/4 and G 3/8		139 ... 174	46	50	1.1 ... 2.3		
<b>VB 21</b>	25	350 ... 500 (700)	500	400 ... 500	G 3/8 and G 1/2		180 ... 220	58	63	2.0 ... 4.6		
<b>VB 22</b>							172 ... 221	58	70	2.2 - 4.8		
<b>VB 31</b>	65	350 ... 400	400	-	350	G 1/2 and G 3/4	202 ... 252	72	80	4.5 ... 9.1		
<b>VB 41</b>	120	350	-	-		G 3/4 and G 1	265 ... 312	82	100	8.9 ... 14		

**Circuit example:**
**MP24A - H1,39/B5 - A1/300**

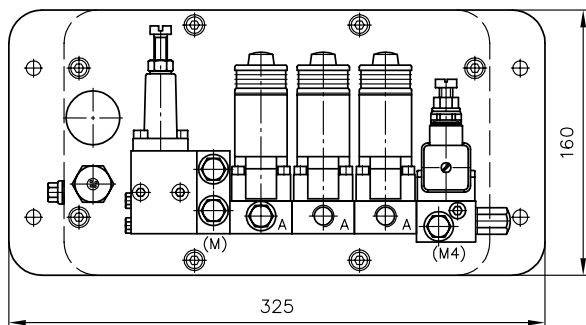
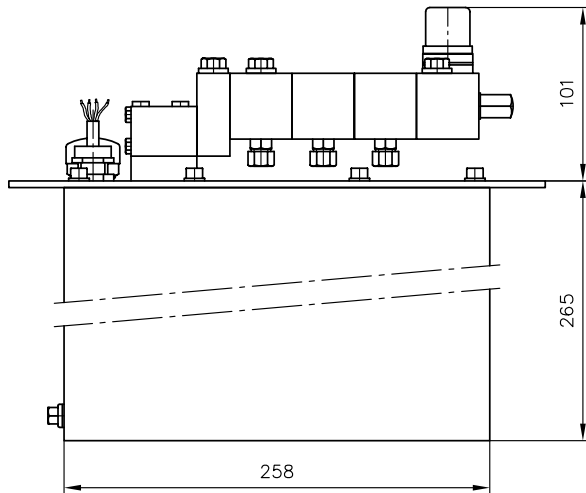
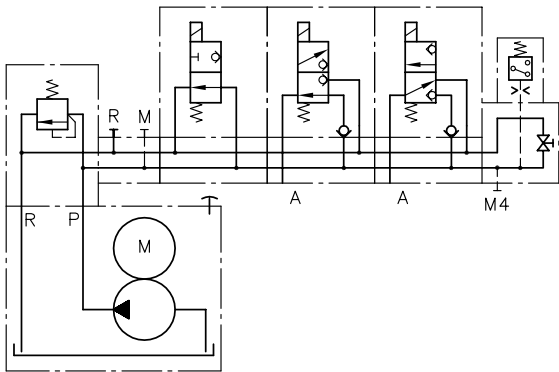
Compact hydraulic power pack type MP size 2, connection block with pressure limiting valve (tool adjustable)

**- VB01FM - FRN/32 - 1 - WG230**

Valve bank type VB size 0 with 3 valves (actuation mode M (solenoid), solenoid voltage 230V 50/60 Hz) and end plate. Here 32 with pressure switch and drain valve

**Parameters of the circuit example:**

- $Q_{pu}$  = approx. 1.39 lpm (at 1450 rpm)
- $p_{max pu}$  = 400 bar
- $p_{system}$  = 300 bar (set pressure of the pressure-limiting valve)
- Tank  $V_{usable}$  = approx. 6 l,  $V_{total}$  = approx. 7.7 l


**Suites compact hydraulic power packs:**

- Type MP, MPN, MPNW, MPW: [Page 54](#)
- Type HC, HCW, HCG: [Page 46](#)
- Type HK, HKF, HKL: [Page 58](#)
- Type NPC: [Page 44](#)
- Type KA, KAW: [Page 50](#)
- Connection blocks type A: [Page 68](#)

**Suites hydraulic power packs:**

- Type R: [Page 62](#)
- Type RZ: [Page 12](#)

**Corresponding pamphlets (data sheets):**

- Valve bank (directional seated valve) type VB: [D 7302](#)

**Suited valves:**

- Directional seated valves with various actuation types: [Page 124](#)

**Accessories:**

- Pressure switches type DG 3.., DG 5 E: [Page 270](#)
- Pressure reducing valves type CDK: [Page 186](#)

**Male connectors:**

- Line connector type MSD and others: [D 7163](#)
- Economy circuit type MSD: [D 7813](#), [D 7833](#)

# Directional seated valves

## 2.2 Directional seated valve type WN and WH

Directional seated valves are a type of directional valve. As ball valves they have zero leakage in the closed state.

The directional seated valves type WN and WH are valves for manifold mounting. 2/2 and 3/2 directional seated valves are available. These are also available combined as 3/3 and 4/3 directional seated valves. The type WH contains internal pressure relief. As a result the permissible operating pressure is higher than the type WN.

Appropriate connection blocks make possible direct pipe connection. The directional seated valves are available as a combination of valves in a valve bank type BWN and BWH.

### Features and benefits:

- Excellent price/performance ratio
- Compact design
- Directional seated valves with zero leakage
- Solenoid version with 8-watt technology

### Intended applications:

- Machines for forestry and agricultural purposes
- Clamping, punching and jigs
- Clamping equipment, punching tools, jigs
- Process engineering systems



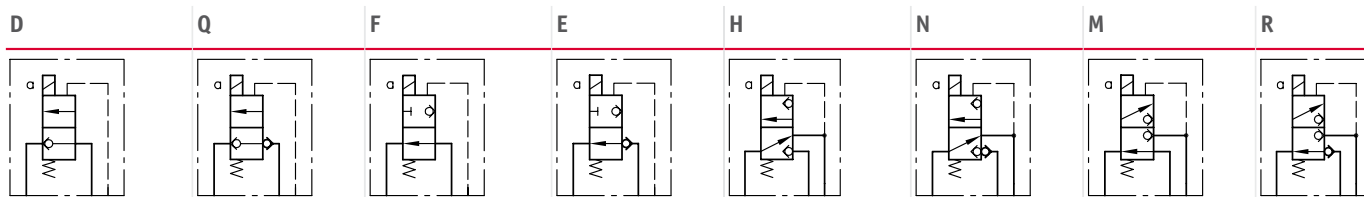
<b>Nomenclature:</b>	Directional seated valve, zero leakage
<b>Design:</b>	Individual valve, manifold mounting combination with connection blocks for pipe connection
<b>Actuation:</b>	Solenoid
<b>p<sub>max</sub>:</b>	350 ... 450 bar
<b>Q<sub>max</sub>:</b>	5 ... 60 lpm

### Design and order coding example

WN1 H 1 - 1/4 - G24

<p><b>Solenoid voltage</b></p> <p><b>Single connection block</b></p> <p><b>Additional elements</b></p> <p><b>Function</b></p> <p><b>Basic type, size</b></p>	<p>12V DC, 24V DC, 110V AC, 230V AC</p> <ul style="list-style-type: none"> <li>▪ Versions with M12-plug and 8-Watt solenoid</li> </ul> <p>Port size G 1/4, G 3/8, G 1/2 (BSPP)</p> <ul style="list-style-type: none"> <li>▪ By-pass check valve or pressure limiting valve between P and R</li> </ul> <ul style="list-style-type: none"> <li>▪ Return pressure stop for port R</li> <li>▪ Check valve insert for port P</li> <li>▪ Pressure limiting valve</li> </ul> <ul style="list-style-type: none"> <li>▪ 2/2-way directional valve (F, D, Q, E)</li> <li>▪ 3/2-way directional valve (H, R, M, N)</li> <li>▪ 3/3-way directional valve (J, U)</li> <li>▪ 4/2-way directional valve (W)</li> </ul> <p>Type WN, size 1 Type WH, size 1 to 4</p>
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## Function

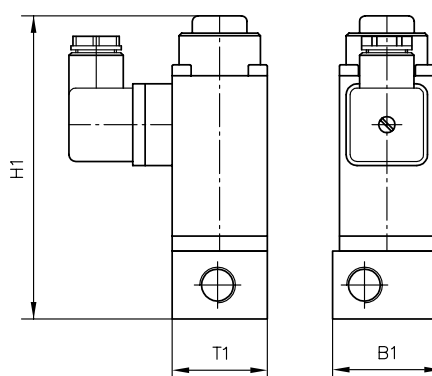
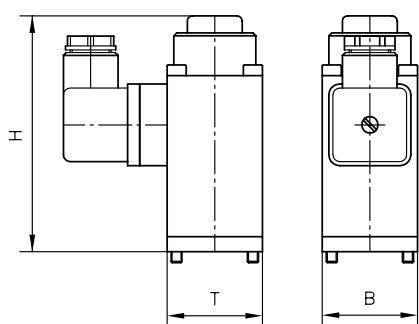


- Symbols show type WH  
View type WH
- Type WN 1 without de-pressuring duct for the solenoid (add. leakage duct is not necessary)  
Type WN1 without solenoid relief (no leakage line)

## General parameters and dimensions

Individual valve

Valve with sub-plate for pipe connection



	$Q_{\max}$ [lpm]	$p_{\max}$ [bar]	Ports (BSPP)	Dimensions (individual valve) [mm]			$m_{\max}$ [kg]	Dimensions (with sub-plate) [mm]			m [kg]
				H	B	T		H1	B1	T1	
WN 1	5	320 ... 350	G 1/4	87	35	35	0.6	112	40	35	0.9
WH 1	8	450	G 1/4	87	35	35	0.6	112	40	35	0.9
WH 2	15	350	G 1/4	95.2 ... 101.7	35	35	0.65 ... 0.7	125.2 ... 131.7	40	40	1.0
WH 3	30	350	G 3/8	93.5 ... 103.5	45	45	1.2 ... 1.3	128.5 ... 138.5	50	50	1.8
WH 4	60	350	G 1/2	118 ... 133	60	60	2.7 ... 3.0	158 ... 173	70	70	3.6 ... 4.0

### Associated technical data sheets:

- [ional seated valve type WN and WH: D 7470 A/1](#)

### Valve banks:

- Type BWN1, BWH: [Page 136](#)

### Male connectors:

- [Line connector type MSD and others: D 7163](#)
- With economy circuit: [D 7813](#), [Economy circuit type MSD 4 P55: D 7833](#)

# Directional seated valves

## 2.2 Valve bank (directional seated valve) type BWN and BWH

A valve bank combines different valves for operating independent consumers.

The valve bank type BWN or BWH comprises several directional seated valves of type WN or WH that are connected in parallel. The directional seated valves as ball valves have zero leakage in the closed state. They are attached to sub-plates. These sub-plates are clamped between the inlet section (P and R port) and the end plate via tension rods. Pressure switches or pressure-limiting valves can be integrated into the pumps and/or consumer lines.

2/2 and 3/2- directional seated valves . Combined these are also available as 3/3 and 4/3 directional seated valves. The valve bank can be attached directly to the compact hydraulic power pack.

### Features and benefits:

- Modular concept
- Adapter plates for flange-mounting on hydraulic power packs or combination with other valve types
- With the valve bank version, option to incorporate additional functions in the sub-plate, such as pressure-limiting valves, pressure switches etc.
- Energy-efficient solutions in connection with hydraulic accumulators

### Intended applications:

- Machine tools (chipping and non-chipping)
- Rubber and plastic machinery
- Mining machinery (incl. oil production)
- Rubber and plastics machinery



<b>Nomenclature:</b>	Directional seated valve, zero leakage
<b>Design:</b>	Valve bank <ul style="list-style-type: none"><li>▪ For pipe connection</li><li>▪ Combination with hydraulic power packs</li></ul>
<b>Actuation:</b>	Solenoid
<b>p<sub>max</sub>:</b>	350 ... 450 bar
<b>Q<sub>max</sub>:</b>	5 ... 30 l/min

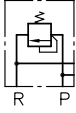




## Design and order coding example

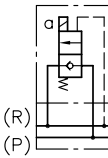
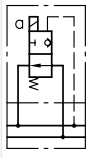
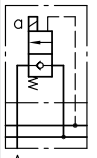
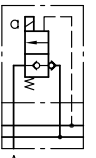
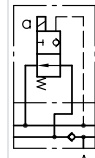
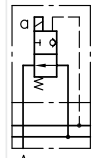
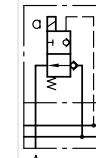
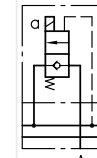
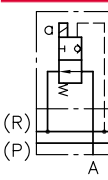
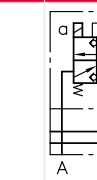


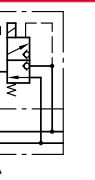
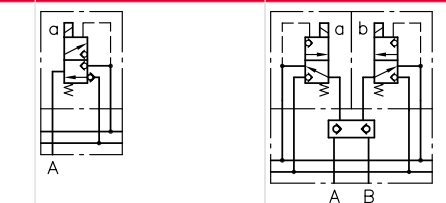
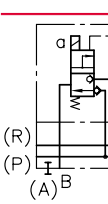
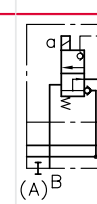
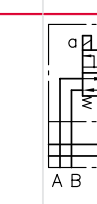
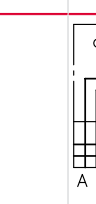


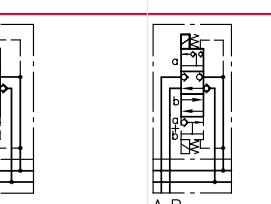
BWH2	A-1/300	- FH5N5	- 1	- 1	- G24
					<p><b>Solenoid voltage</b> 12V DC, 24V DC, 110V AC, 230V AC</p> <ul style="list-style-type: none"> <li>▪ Versions with M12-plug and 8-Watt solenoid</li> </ul> <p><b>Port size</b> G 1/4, G 3/8 (BSPP)</p> <p><b>End plate</b></p> <ul style="list-style-type: none"> <li>▪ With one or two pressure switches</li> <li>▪ With accumulator drain valve</li> <li>▪ With additional pressure limiting valve in gallery P</li> </ul> <p><b>Valve sections</b></p> <ul style="list-style-type: none"> <li>▪ Directional valves type WH or WN</li> <li>▪ Valve section options: <ul style="list-style-type: none"> <li>▪ Return pressure stop</li> <li>▪ Pressure switch for the consumer ports or for gallery P</li> <li>▪ Pressure limiting valves at the consumer port</li> <li>▪ Pressure reducing valve reducing the pressure in the downstream P gallery</li> </ul> </li> <li>▪ Additional sections: <ul style="list-style-type: none"> <li>▪ Pressure reducing valve</li> <li>▪ Indiv. sub-plate with pressure switch</li> <li>▪ Separation plate for gallery P</li> </ul> </li> </ul> <p><b>Connection block/adaptor plates</b></p> <ul style="list-style-type: none"> <li>▪ For pipe connection, with/without pressure limiting valve, manually or fixed, with/without prop. pressure limiting valve</li> <li>▪ For direct mounting at compact hydraulic power packs</li> <li>▪ For direct mounting at hydraulic power packs</li> <li>▪ Adapter plates for combination with directional valves type BVZP or SWR/SWP</li> </ul>
<b>Basic type, size</b>	Type BWN, size 1 and type BWH, size 1 to 3				

## Function

### Connection blocks/adaptor plates:

<p><b>A-1/...</b></p>  <p>For pipe connection, with fixed pressure-limiting valve (/...- pressure specification in bar)</p>	<p><b>C</b></p>  <p>For mounting onto hydraulic power packs</p>	<p><b>F</b></p>  <p>For mounting on compact hydraulic power packs with connection block (type KA, HC, MP, MPN and HK)</p>
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
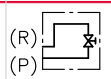
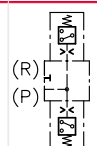
### Valve sections:

<p><b>D</b></p> 	<p><b>F</b></p> 	<p><b>B</b></p> 	<p><b>Q</b></p> 	<p><b>A</b></p> 	<p><b>C</b></p> 	<p><b>E</b></p> 	<p><b>D</b></p> 
<p><b>O</b></p> 	<p><b>H</b></p> 	<p><b>N</b></p> 	<p><b>M</b></p> 	<p><b>R</b></p> 	<p><b>K</b></p> 		
<p><b>I</b></p> 	<p><b>Y</b></p> 	<p><b>S</b></p> 	<p><b>T</b></p> 	<p><b>J</b></p> 	<p><b>U</b></p> 	<p><b>L</b></p> 	

Additional options for the valve sections:

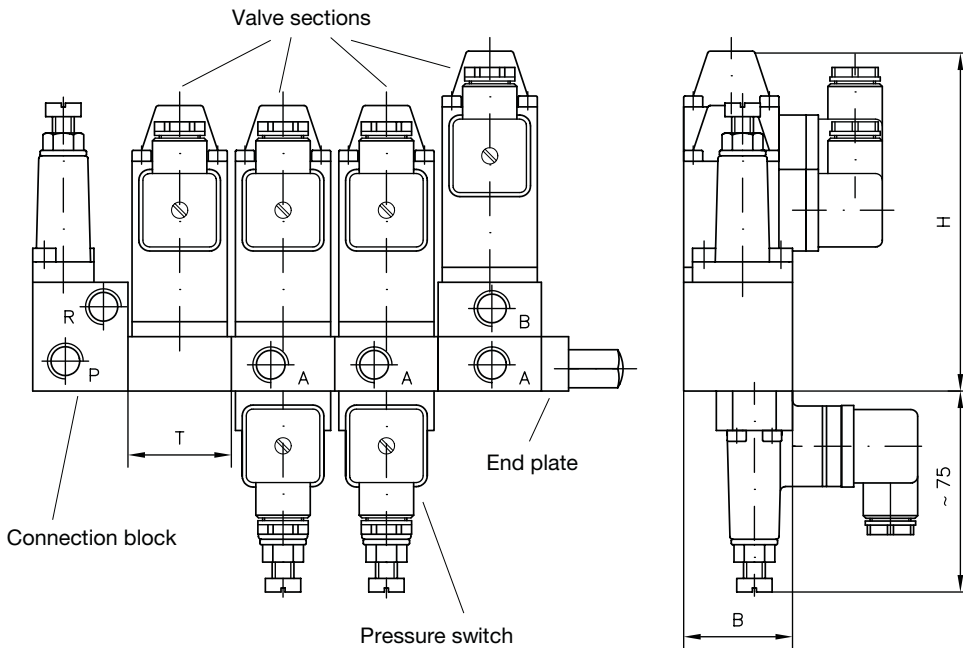
- Pressure switches in the consumer or pump channel. The pressure switches (type DG 3..) are directly flange-mounted to the sub-plate.
- Pressure-limiting valves in the consumer channel (for 3/2- or 3/3-way directional valves, for size 1). The pressure-limiting valve is directly incorporated in the sub-plate.
- Pressure-reducing valves for pressure reduction in the subsequent pump channel.

### End plates:

<p><b>1</b></p>  <p>Standard end plate</p>	<p><b>2</b></p>  <p>End plate with accumulator drain valve</p>	<p><b>3../3..</b></p>  <p>End plate with one or two pressure switches connected to the P gallery</p>
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**General parameters and dimensions**
**BWH**

For pipe connection:



	$Q_{max}$ [lpm]	$p_{max}$ [bar]	Ports P, R, A, B (BSPP)	Dimensions [mm]			m [kg]
				H	T	B	
<b>BWN 1</b>	5	350	G 1/4	116.5 ... 131.5	38	40	0.8 ... 0.9
<b>BWH 1</b>	8	450	G 1/4	116.5 ... 131.5	38	40	0.8 ... 0.9
<b>BWH 2</b>	15	350	G 1/4	122 ... 157.5	38	50	0.9 ... 1.1
<b>BWH 3</b>	30	350	G 3/8	155.5 ... 168	50	60	1.9 ... 2.4

- Weight m [kg] per individual element: + 0.3 kg per pressure switch fitted

**Associated publications:**

- Valve bank (directional seated valve) type BWN and BWH: D 7470 B/1
- ionally seated valve type WN and WH: D 7470 A/1

**Connection block:**

- Type A: [Page 68](#)

**Compact hydraulic power packs:**

- Type HC, HCW, HCG: [Page 46](#)
- Type HK, HKF, HKL: [Page 58](#)

- Type NPC: [Page 44](#)
- Type KA, KAW: [Page 50](#)

**Hydraulic power packs:**

- Type R: [Page 62](#)

**Hydraulic accessories:**

- Pressure switches type DG 3.., DG 5E: [Page 270](#)
- Pressure reducing valves type CDK: [Page 186](#)

# Directional seated valves

## 2.2 Directional seated valve type EM and EMP

Directional seated valves are a type of directional valve. As cone valves they are tightly sealed without leakage in the closed state.

The directional seated valves type EM and EMP are screw-in valves. 2/2-way directional seated valves with direct or pilot-controlled electromagnetic actuation are available. The directional seated valve type EM is available as a directional. Type EMP is a proportionally switching directional seated valve.

Appropriate connection blocks make possible direct pipe connection or manifold mounting. You can obtain additional components, e.g. a drain valve, bypass throttle valve, pressure switch or flow control valve.

### Features and benefits:

- Zero leakage in blocked state
- Directly switching up to approx. 3 lpm and piloted up to 160 lpm
- Minimized flow resistance even at high flow rate
- Long lifetime due to hardened valve seats

### Intended applications:

- Cranes and lifting equipment
- Road construction industry
- Materials handling, industrial trucks etc.
- Handling and assembly robots, etc.

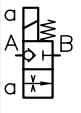
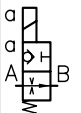
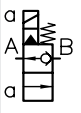
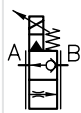
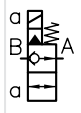
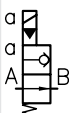
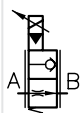
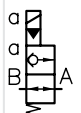


<b>Nomenclature:</b>	Directional seated valve, zero leakage
<b>Design:</b>	Screw-in valve Combination Combination with connection block for pipe connection Combination with connection block for swivel fitting Combination with connection block for manifold mounting
<b>Actuation:</b>	Solenoid
<b>p<sub>max</sub>:</b>	450 bar
<b>Q<sub>max</sub>:</b>	1 ... 160 lpm

### Design and order coding example

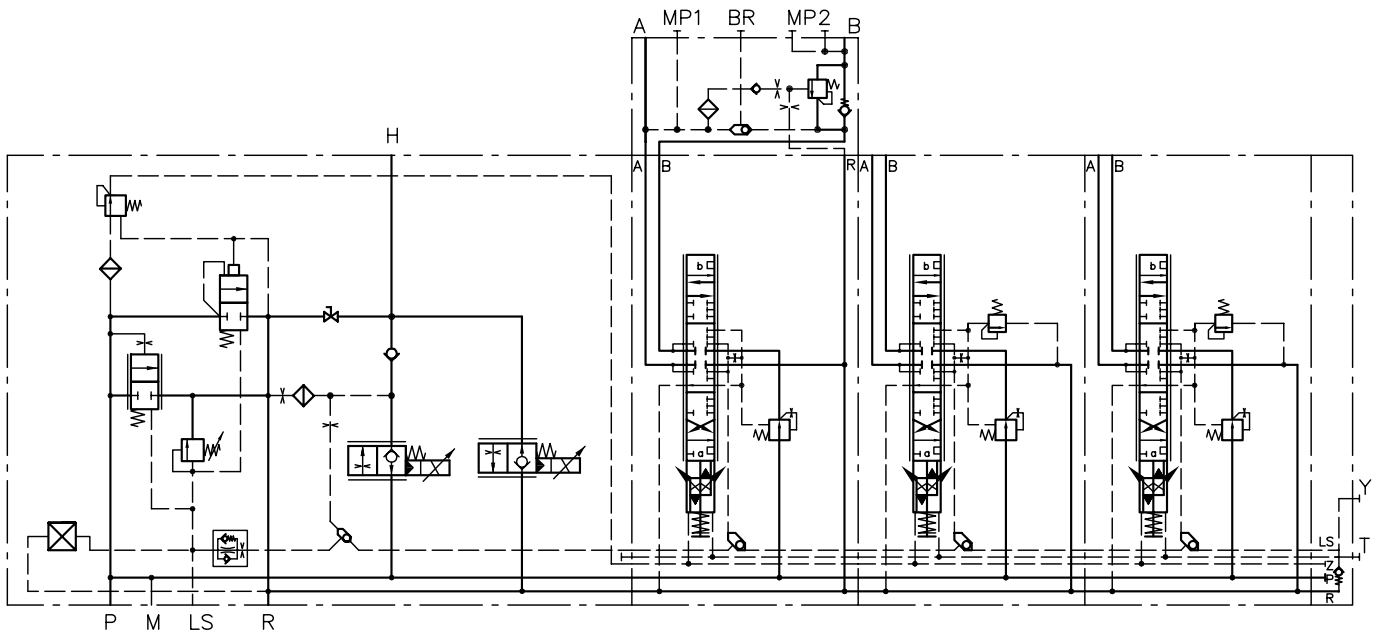
EM 21	V	- 3/8	- G24
		<b>Solenoid voltage</b>	12V DC, 24V DC, 110V AC, 230V AC
		<b>Connection blocks</b>	<b>Versions with</b> <ul style="list-style-type: none"> <li>▪ Versions with M12-plug and 8-Watt solenoid</li> <li>▪ Quarter-turn plug, plugs of Co. KOSTAL or AMP</li> </ul>
		<b>Function</b>	<b>Versions with</b> <ul style="list-style-type: none"> <li>▪ Drain valve</li> <li>▪ Drain valve and drop-rate braking valve</li> <li>▪ Drain valve and by-pass check valve</li> <li>▪ Bypass- throttle</li> <li>▪ Pressure switch</li> <li>▪ 2-way flow controller</li> </ul>
<b>Basic type, size</b>			<ul style="list-style-type: none"> <li>▪ V - 2/2-way valve (NC-type)</li> <li>▪ S - 2/2-way valve (NO-type)</li> </ul>
			<ul style="list-style-type: none"> <li>▪ Type EM: Directional valve, size 1 to 4</li> <li>▪ Type EMP: Prop. valve, size 1 to 4</li> </ul>

**Function**

	Flow in arrowed direction	Arbitrary flow direction	Flow in arrowed direction	Arbitrary flow direction
	Energized open		Energized closed	
<b>Directly actuated</b>	EM .1 D 		EM .1 DS 	
<b>Pilot actuated</b>	EM .1 V 	EMP .1 V 	EM .2 V 	EM .1 S 
			EMP .1 S 	EM .2 S 

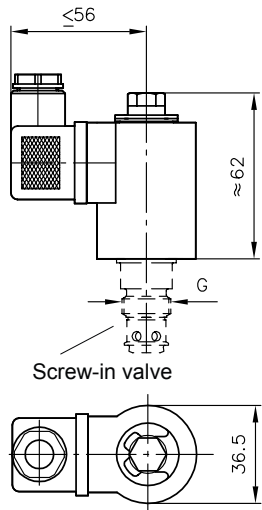
**Example circuit:**

- HMPL 5 US 1/PVPV/250-3
- A2 L 25/25/EI/3 BL 5 D7/120
- 32 L 25/25 C160/EI
- 32 L 63/63 C220/EI
- E4 - AMP 12 K4

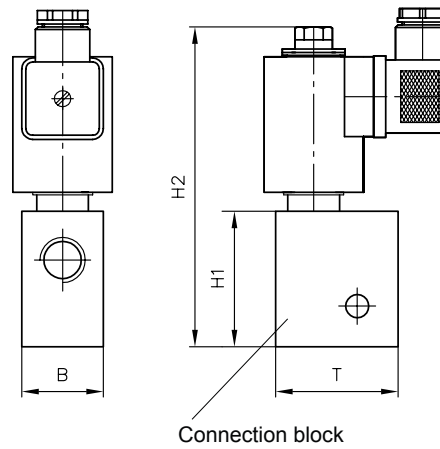


## General parameters and dimensions

Screw-in valve



Valve compl. with connection block for pipe connection



	$Q_{\max}$ [lpm]	$p_{\max}$ [bar]	Screw-in valve		Valve with connection block					m [kg]
			G	m [kg]	Ports (BSPP)	Dimensions [mm]				
						H1	H2	B	T	
<b>EM 11 (D, DS)</b>	5	450	M 14 x 1.5	0.3	G 1/4	40	approx. 120	20	35	0.6
<b>EM 21 (D, DS)</b>	3	400	M 18 x 1.5	0.35	G 1/4	50	approx. 120	30	45	0.7
<b>EM 1.. (V, S)</b>	20	450	M 14 x 1.5	0.3	G 1/4	40	approx. 120	20	35	0.6
					G 3/8			25	45	
<b>EM/EMP 2.. (V, S)</b>	40	400	M 18 x 1.5	0.35	G 3/8	50	approx. 120	30	45	0.7
					G 1/2				50	
<b>EM/EMP 3.. (V, S)</b>	80	400	M 18 x 1.5	0.4	G 1/2	60	approx. 133	40	55	1.0
					G 3/4				60	
<b>EM/EMP 4.. (V, S)</b>	160	400	M 33 x 2	0.6	G 3/4	70	approx. 150	40	65	1.2
					G 1				70	

- Pressure above 300 bar only with manifolds made of steel. Pay attention to the possibly reduced rigidity of the thread with other materials (e.g. cast, aluminium).

**Example circuit:**

KA 442 LFK/HH 13.1/13.1

-SS-A 1 F 3/200

-BA 2

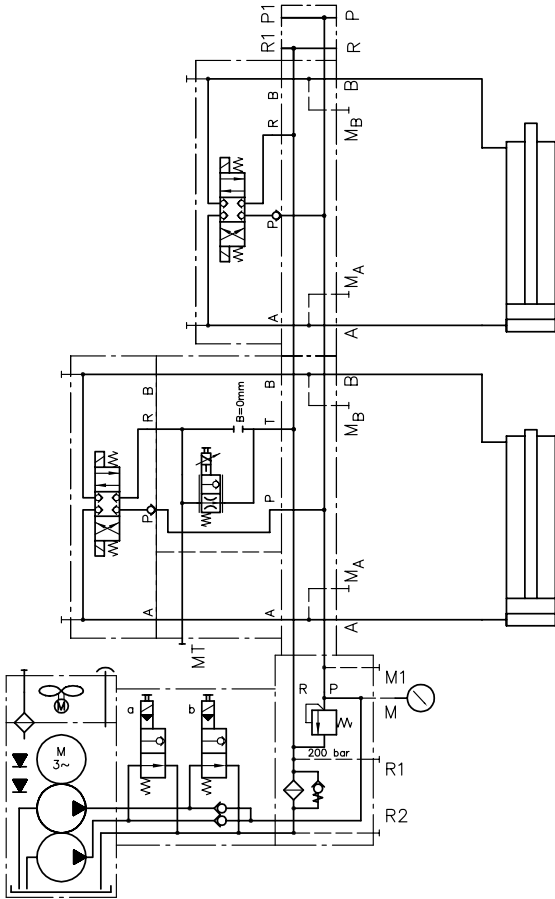
-NBVP 16 G/R-GM/NZP 16 TSPG/TB 0/3

-NBVP 16 G/R-GM/3

-2-G 24

-X 84 G-9/250

-3 x 400/230V 50 Hz-4.0 kW/24V DC



**Suitable products:**

- Intermediate plates NG 6 type NZP: [D 7788 Z](#)
- Connection blocks types HMPL and HMPV: [Page 106](#)
- Lifting/lowering valves type HSV: [Page 152](#)
- Lifting modules type HST, HMT, etc.: [Page 156](#)

**Associated technical data sheets:**

- Directional seated valves type EM, EMP: [D 7490/1](#), [D 7490/1 E](#)

**Accessories:**

- Pressure switches type DG 3.., DG 5E: [Page 270](#)
- Drop-rate braking valves type SB, SQ, SJ: [Page 216](#)
- Suitable proportional amplifier: [Page 278](#)

**Male connectors:**

- Line connector type MSD and others: [D 7163](#)
- With economy circuit: [D 7813](#), [D 7833](#)

# Directional seated valves

## 2.2 Directional seated valve type BVG, BVP and NBVP

Directional seated valves are a type of directional valve. As cone valves they are tightly sealed without leakage in the closed state.

The directional seated valve type BVG is installed directly in the pipe. The valves type BVP and NBVP are valves for manifold mounting. The type NBVP has the standard connection pattern nominal size NG 6. 2/2, 3/2, 3/3 and 4/3 directional seated valves are available with different types of actuation. All connections can be subjected to the same pressures. Depending on the functional requirement, e.g. a check valve, a (consumer-side) restrictor and/or restrictor check valves is/are integrated into the type NBVP. The type NBVP is used together with other valves in the valve bank type BA to completely control the hydraulics.

**Features and benefits:**

- Explosion-proof design
- 4th switching position on 4/3 directional valves
- 8-Watt solenoid

**Intended applications:**

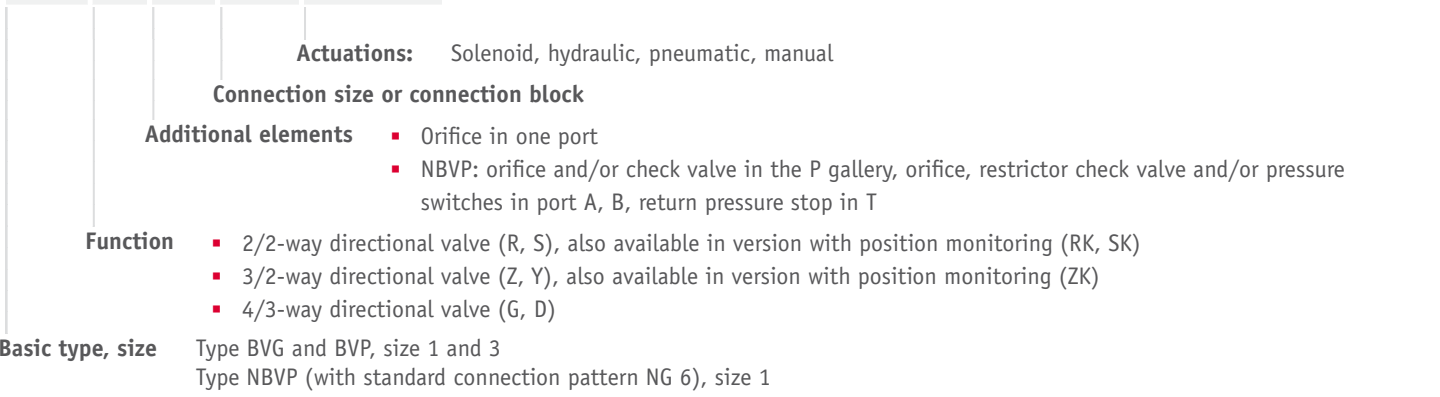
- Machine tools
- Woodworking and processing machinery
- Testing machinery
- Jig construction



<b>Nomenclature:</b>	Directional seated valve, zero leakage
<b>Design:</b>	Individual valve for pipe connection Individual valve, Manifold mounting
<b>Actuation:</b>	Solenoid Hydraulic Pneumatic Manual
<b>p<sub>max</sub>:</b>	400 bar
<b>Q<sub>max</sub>:</b>	20 l/min

### Design and order coding example

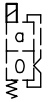
BVG1 - R /B2 - 1/4 - WGM 230





**Actuations:**

**Solenoid**



Solenoid voltages: 12V DC, 24V DC, 110V AC, 230V AC

- BVP 1, NBVP16 also available in ATEX-compliant version
- Version with M12 plug and 8-watt solenoid

**Pneumatic**



Control pressure:

$p_{\text{contr. min}} = 2 \dots 3.5 \text{ bar}$

$p_{\text{contr. max}} = 15 \text{ bar}$

**Hydraulic**



Control pressure:

$p_{\text{contr. min}} = 24 \text{ bar}$

$p_{\text{contr. max}} = 320 \text{ bar}$

**Manual**

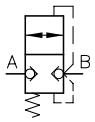


Actuation torque:

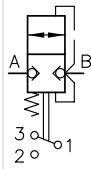
approx. 1.5 ... 3 Nm

**Function**

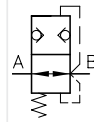
**R**



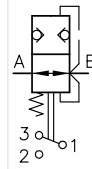
**RK**



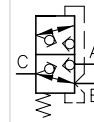
**S**



**SK**

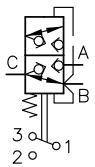


**Z**

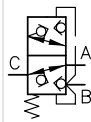


- Further circuit symbols available

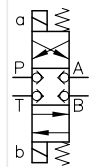
**ZK**



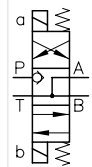
**Y**



**G**

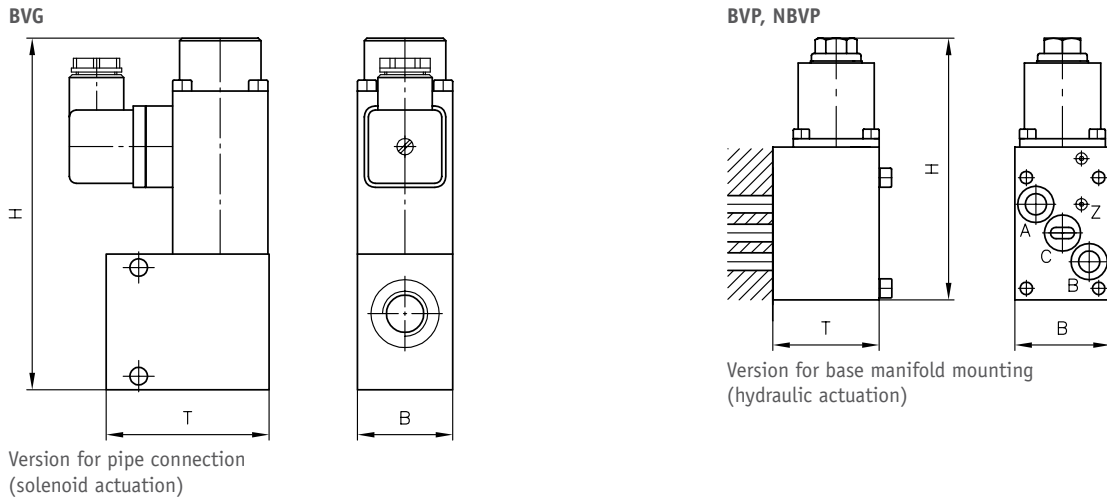


**D**



- additional switching symbols available
- **G, D:** only for type NBVP16

## General parameters and dimensions



	$Q_{max}$ [lpm]	$p_{max}$ [bar]	Ports (BSPP) A, B, C	Dimensions [mm]			$m_{max}$ [kg]
				$H_{max}$	$B_{max}$	$T_{max}$	
<b>BVG 1</b>	20	400/250 <sup>1)</sup>	G 1/4, G 3/8	115 (130)	60	40	1.6
<b>BVP 1</b>					35	39	1.0
<b>NBVP 16</b>	20	400/250 <sup>1)</sup>	NG 6	230	45	45	2.1
<b>BVG 3</b>	50	320	G 1/2	145	80	50	3.3
<b>BVP 3</b>					50	76	2.4

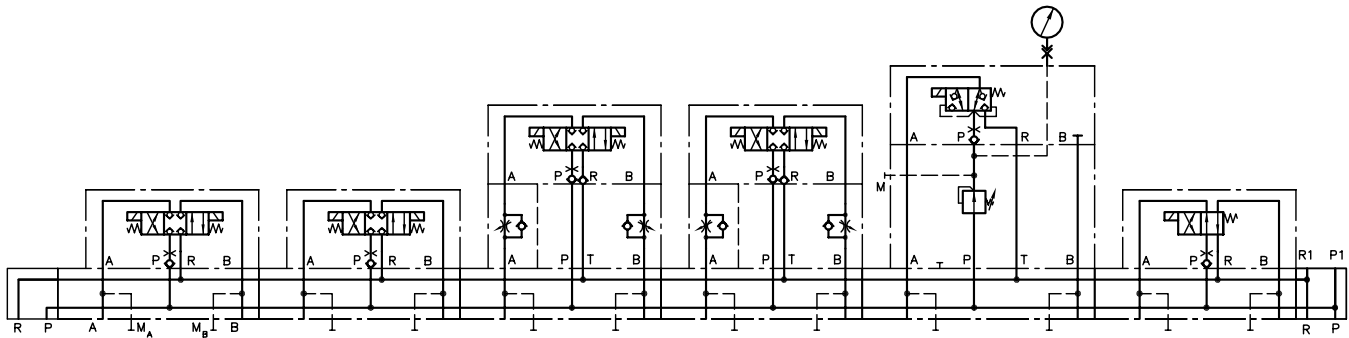
<sup>1)</sup> with solenoid actuation GM.. and WGM

- BVE: screw-in valve, also available with connection block for pipe connection

**Example circuit:**

BA2A5

- NBVP16G/B2.0R/3
- NBVP16G/B2.0R/3
- NBVP16G/R/S/NZP16Q22/3
- NBVP16G/R/S/NZP16Q22/3
- NBVP16Y/B2.0R/2/NZP16CZ5/50/3 - X84V - 9/100A
- NBVP16W/B2.0R/3
- 2 - LM24


**Associated technical data sheets:**
**Directional seated valves**

- [Directional seated valve type BVG 1 and BVP 1: D 7765](#)
- [Directional seated valve type NBVP 16: D 7765 N](#)

**Products:**

- Type BA: [Page 70](#)
- Type NZP: [Page 70](#)
- Type BVH: [Page 76](#)

**Male connectors:**

- [Line connector type MSD and others: D 7163](#)
- With economy circuit: [D 7813](#), [D 7833](#)

# Directional seated valves

## 2.2 Directional seated valve type BVE

Directional seated valves are a type of directional valve. As cone valves they are tightly sealed without leakage in the closed state.

The directional seated valve type BVE is a screw-in valve. 2/2 and 3/2 directional seated valves are available. All connections can be subjected to the same pressures.

Optionally a version for highly viscous media (e.g. lubricating grease) is available.

Appropriate connection blocks make possible direct pipe connection or manifold mounting.

### Features and benefits:

- Any flow direction
- No interaction between actuation elements and medium
- No resinification or sticking as a result of increased temperatures is possible.
- For highly viscous media (e.g. lubricating grease)

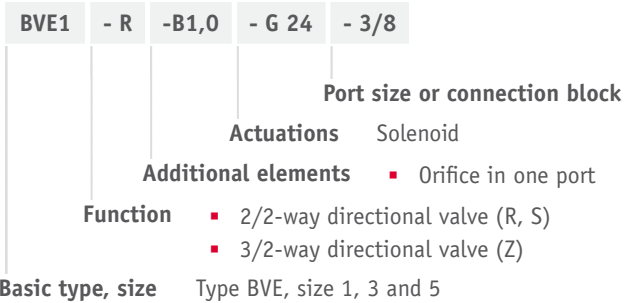
### Intended applications:

- Lubrication systems
- Mining machinery
- Construction and construction material machinery
- Handling and mounting technology



<b>Nomenclature:</b>	Directional seated valve, zero leakage
<b>Design:</b>	Individual valve for pipe connection Individual valve for manifold mounting
<b>Actuation:</b>	Solenoid
<b>P<sub>max</sub>:</b>	500 bar
<b>Q<sub>max</sub>:</b>	20 ... 300 lpm

### Design and order coding example

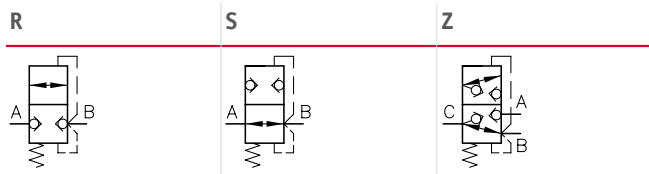
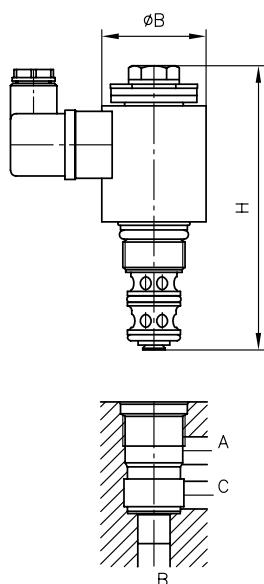


### Actuations:

Solenoid



Solenoid voltages: 12V DC, 24V DC, 110V AC, 230V AC

**Function**

**General parameters and dimensions**
**BVE**


	$Q_{\max}$ [lpm]	$p_{\max}$ [bar]	Dimensions [mm]		$m_{\max}$ [kg]
			$H_{\max}$	$B_{\max}$	
<b>BVE 1</b>	20	500	121	37	0,4
<b>BVE 3</b>	70	400	122,5	45	0,7
<b>BVE 5</b>	300	400	206,5	72	1,5

**Associated technical data sheets:**
**Directional seated valves**

- [Directional seated valve type BVE: D 7921](#)

**Similar products**

- Type BA: [Page 70](#)
- Type NZP: [Page 70](#)
- Type BVH: [Page 76](#)
- Type BVG, BVP, NBVP: [Page 144](#)

**Suitable male connectors:**

- [Line connector type MSD and others: D 7163](#)
- With economy circuit: [D 7813](#), [D 7833](#)

# Directional seated valves

## 2.2 Directional seated valve type VP

Directional seated valves are a type of directional valve. As cone valves they are tightly sealed without leakage in the closed state.

The directional seated valve type VP is a valve for manifold mounting. 2/2, 3/2 and 4/2 directional seated valves with different types of actuation are available. All connections can be subjected to the same pressures.

The directional seated valve type VP is suitable above all for highly viscous media (e.g. lubricating grease). Appropriate connection blocks make possible direct pipe connection.

### Features and benefits:

- Any flow direction
- No interaction between actuation elements and medium
- No sticking or resinification as a result of increased temperatures is possible.
- Suitable for highly viscous media (e.g. lubricating grease)
- Explosion-proof version

### Intended applications:

- Lubricating systems
- Mining machinery
- Construction and construction materials machinery
- Handling and assembly technology



<b>Nomenclature:</b>	Directional seated valve, zero leakage
<b>Design:</b>	Manifold mounting
<b>Actuation:</b>	Solenoid Hydraulic Pneumatic
<b>p<sub>max</sub>:</b>	400 bar
<b>Q<sub>max</sub>:</b>	15 lpm

### Design and order coding example

<b>VP1</b>	<b>- R</b>	<b>- 3/4</b>	<b>- G24</b>
			<b>Actuation</b>
			<ul style="list-style-type: none"> <li>▪ Solenoid</li> <li>▪ Mechanical: roller, feeler</li> <li>▪ Manual: lever, turn-knob</li> </ul>
			<b>Optional connection block</b> For direct pipe connection
	<b>Function</b>	2/2-way directional seated valve (R, S) 3/2-way directional seated valve (Z) 4/2-way directional seated valve (W, G)	
<b>Basic type, size</b>	Type VP, size 1		
	<ul style="list-style-type: none"> <li>▪ Versions conforming ATEX</li> </ul>		

### Actuation:

#### Solenoid



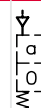
Solenoid voltage:  
12V DC; 24V DC; 110V AC, 230V AC

#### Hydraulic



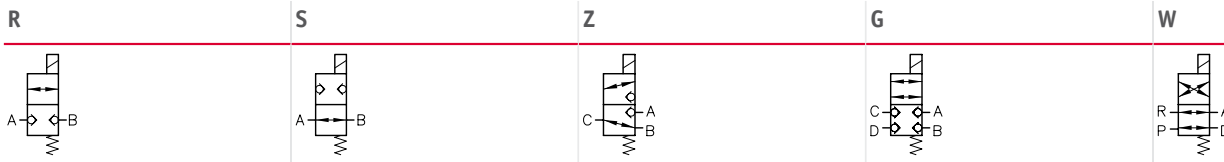
Control pressure:  
p<sub>control min</sub> = 24 bar  
p<sub>control max</sub> = 320 bar

#### Pneumatic



Control pressure:  
p<sub>control min</sub> = 2 ... 3.5 bar  
p<sub>control max</sub> = 15 bar

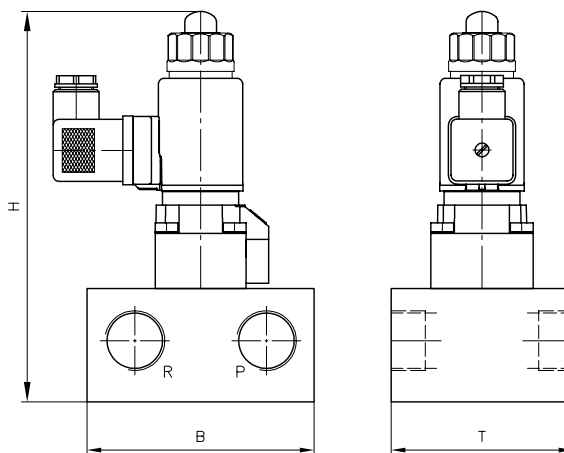
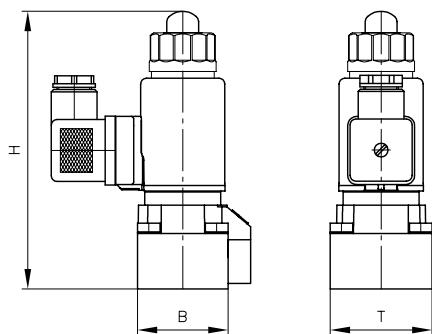
**Function**



**General parameters and dimensions**

Individual valve  
Example: VP1R-G24

Valve with sub-plate  
Example: VP1W-3/4-WG 230



	$Q_{max}$ [lpm]	$p_{max}$ [bar]	Ports (BSPP)	Dimensions [mm]			$m_{max}$ [kg]
				$H_{max}$	$B_{max}$	$T_{max}$	
VP 1	15	400	A, B, C G 1/4, G 3/8, G 3/4	127	40	50	1.0
VP 1 with sub-plate				147 ... 177	50 ... 100	45 ... 80	1.5 ... 2.2

-  $H_{max}$ : Values apply for electro-magnetic actuation

**Associated technical data sheets:**

- [Directional seated valve type VP: D 7915](#)

**Similar products:**

- Directional seated valve type BVG1, BVP1, NBVP16:  
[Page 144](#)
- Directional seated valve type BVE:  
[Page 148](#)

**Male connectors:**

- [Line connector type MSD and others: D 7163](#)
- With economy circuit: [D 7813](#), [D 7833](#)

# Directional seated valves

## 2.2 Lifting/lowering valve type HSV

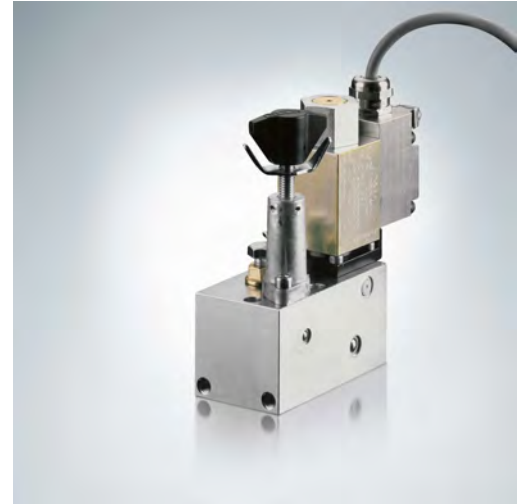
Lifting-lowering valves are a combination of directional valves and metering valves. The valve block type HSV provides the function of a 2/2-way directional seated valve with electrical actuation for lowering the load. Adjustable throttle valves or flow control valves independent of the load control the lowering speed. An integrated pressure-limiting valve limits the permissible load. The lifting/lowering valve type HSV is used to control lifting equipment with single-acting cylinders.

### Features and benefits:

- Optimal control of lifting and lowering function
- High pressures up to 400 bar
- Zero leakage to prevent unwanted lowering of loads and platforms
- Integrated overpressure protection

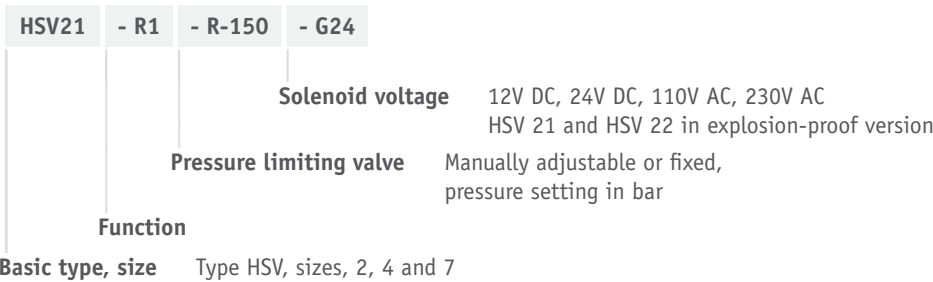
### Intended applications:

- Cranes and lifting equipment
- Materials handling
- Road vehicle
- Mining machinery



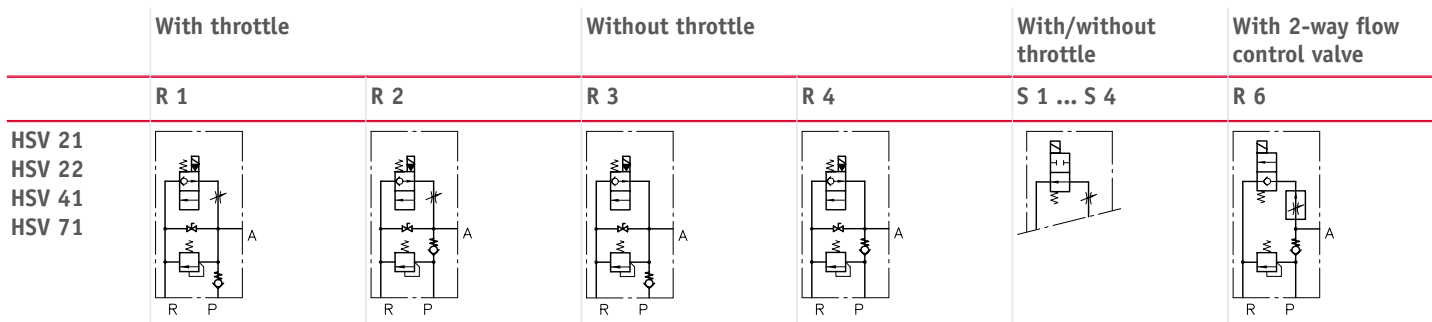
<b>Nomenclature:</b>	Valve combination consisting of: <ul style="list-style-type: none"> <li>▪ 2/2-way directional seated valve, solenoid actuated</li> <li>▪ Pressure-limiting valve</li> <li>▪ Check valve optional</li> <li>▪ Throttle or 2-way flow control valve</li> </ul>
<b>Design:</b>	Individual valve for pipe connection
<b>Actuation:</b>	Solenoid
<b>p<sub>max</sub>:</b>	315 ... 400 bar
<b>Q<sub>max</sub>:</b>	20 ... 120 lpm

### Design and order coding example



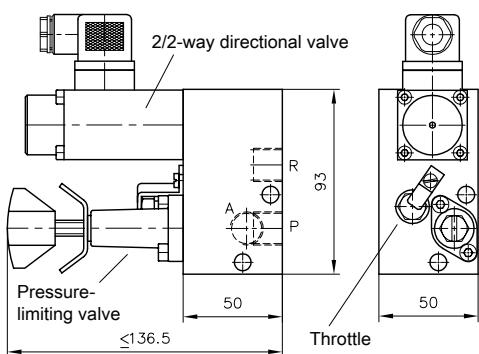


**Function**

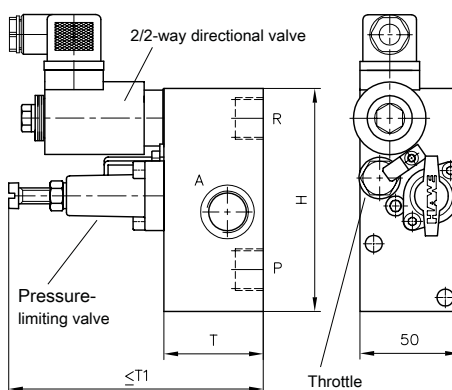


**General parameters and dimensions**

**HSV 21 and HSV 22**



**HSV 41 and HSV 71**



	$Q_{max}$ [lpm]	$p_{max}$ [bar]	Ports (BSPP)		Dimensions [mm]			m [kg]
			P	A, R	H	T	T1	
HSV 21	20	315	G 3/8	G 3/8	see illustration			2.2
HSV 22	30	315	G 3/8	G 1/2	see illustration			2.2
HSV 41	40	400	G 1/2	G 1/2	112	50	140	2.2
HSV 71	120	315	G 3/4	G 3/4	100	80	160	3.1

**Associated technical data sheets:**

- [Lifting/lowering valve type HSV: D 7032](#)

**Male connectors:**

- [Line connector type MSD and others: D 7163](#)
- [With economy circuit: D 7813, D 7833](#)

# Directional seated valves

## 2.2 Switch unit type CR

Switch units combine the function of a directional seated valve with a pressure valve and check valve. They control dual stage pumps, a combination of high-pressure pump and low-pressure pump, in bottom and top ram presses. The low-pressure circuit and the high-pressure circuit are combined for rapid movement.

If the low-pressure value is reached or exceeded, the switch unit type CR switches the low-pressure circuit to circulation. The high-pressure pump carries out the pressing action. The switch unit hydraulic release acts automatically. It initiates surge-free decompression that relieves the press. In the closed state the switch unit has zero leakage.

The switch unit type CR can be attached directly to hydraulic power packs type MPN and RZ.

### Features and benefits:

- Special valve for controlling upstroke presses
- Smooth, gentle switching
- No pressure drop during press operation due to zero leakage
- Fully automatic switching of the low-pressure pump to circulation

### Intended applications:

- Machine tools (presses)
- Woodworking and processing machinery
- Printing and paper technology
- Foodstuff and packaging machinery



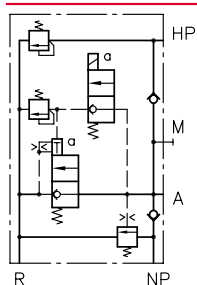
<b>Nomenclature:</b>	Valve combination consisting of: <ul style="list-style-type: none"> <li>▪ 2/2-directional seated valve</li> <li>▪ Ball-type check valve</li> <li>▪ Pressure valve</li> </ul>
<b>Design:</b>	Individual valve for pipe connection
<b>Actuation:</b>	Solenoid Manual
<b>p<sub>max</sub>:</b>	HP 400 bar NP (0) ... 60 bar
<b>Q<sub>max</sub>:</b>	HP 8... 20 lpm NP 80 ... 160 lpm A → R 200 ... 300 lpm

### Design and order coding example

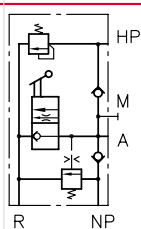
CR4	M-WG230	- 400/60
		Pressure settings [bar] High-/low pressure
	Actuation mode	<ul style="list-style-type: none"> <li>▪ Solenoid Voltage of the actuation solenoids 24V DC, 230V AC 50/60 Hz</li> <li>▪ Manually</li> </ul>
Basic type, size	Type CR, size 4 and 5	

**Function**

CR 4M and CR 5M



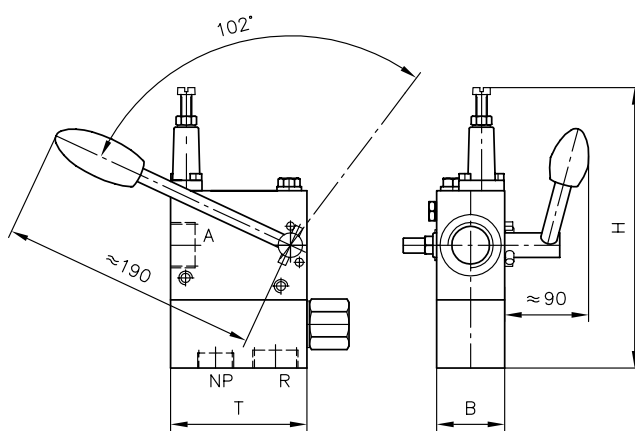
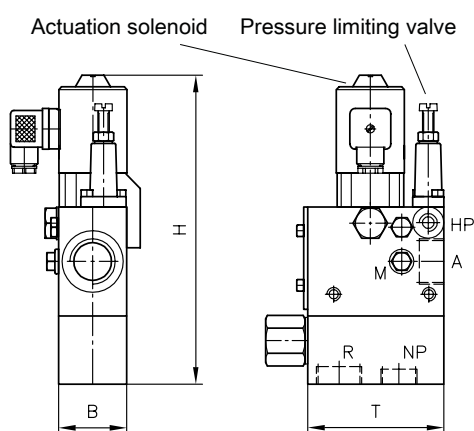
CR 4H



**General parameters and dimensions**

CR 4M

CR 4H



	Q <sub>max</sub> [lpm]			p <sub>max</sub> [bar]		Ports (BSPP)			Dimensions [mm]				m [kg]
	HP	NP	A→R	HP	NP	A and R	HP	NP	M	H	B	T	
CR 4M	8	80	200	400	(0) ... 60	G 1	G 1/4	G 3/4	G 1/4	max. 247.5	50	100	5.2
CR 4H	8	80	200	400	(0) ... 60	G 1	G 1/4	G 3/4	G 1/4	max. 202	50	100	4.7
CR 5M	20	160	300	400	(0) ... 60	G 1 1/4	G 3/8	G 1	G 1/4	max 277.5	63	135	10.0

**Associated technical data sheets:**

- [Switch unit type CR: D 7150](#)

**Similar products:**

- Two-stage valves type NE: [Page 198](#)

**Hydraulic power packs:**

- Hydraulic power packs type RZ: [Page 62](#)
- Compact hydraulic power packs type MP, MPN, MPNW, MPW: [Page 54](#)

**Male connectors:**

- [Line connector type MSD and others: D 7163](#)

# Directional seated valves

## 2.2 Lifting module type HMT and HST

Lifting modules or hoist control valves are a combination of directional valves and pressure control valves. They are used to control a lifting function. The flow rate is controlled or limited proportionally both on lifting and also on lowering.

In the lifting module type HMT and HST directional seated valves are used that ensure the load is held securely. 2-way pressure control valves are used to limit the maximum volumetric flow.

Valve sections of type SWS can be attached space-savingly to the lifting module to control additional functions. The lifting module type HMT and HST is suitable for use in industrial trucks and agricultural machinery.

### Features and benefits:

- Flexible design for fixed or variable displacement pump systems
- Low spatial requirements due to steel design
- Flexible combination with directional valves

### Intended applications:

- Materials handling (industrial trucks etc.)
- Cranes and lifting equipment
- Road vehicle



<b>Nomenclature:</b>	Valve combination according to type consisting of: <ul style="list-style-type: none"> <li>▪ 2-way flow control valves</li> <li>▪ 2-way seated valves</li> <li>▪ Directional spool functions</li> </ul>
<b>Design:</b>	Valve bank
<b>Actuation:</b>	Solenoid
<b>p<sub>max</sub>:</b>	315 bar
<b>Q<sub>max</sub>:</b>	120 lpm

### Design and order coding example

HMT34D - 1/250 - G/MP/0/2 - 31EP - G 24

<b>End plate</b>	<ul style="list-style-type: none"> <li>▪ With two P ports and one R port</li> <li>▪ With prop. idle circulation valve</li> <li>▪ With solenoid valve for the parking brake</li> </ul>
<b>Valve sections, ancillary- and intermediate blocks</b>	<ul style="list-style-type: none"> <li>Various intermediate blocks for mast tilting, mast shifting, auxiliary hydraulics</li> <li>Directional valve sections type SWR 1 with additional functions</li> <li>Directional valve sections type SWS 2</li> </ul>
<b>Connection block</b>	<ul style="list-style-type: none"> <li>Pressure setting [bar] of the pressure limiting valve</li> </ul>
<b>Additional versions</b>	<ul style="list-style-type: none"> <li>▪ Connection blocks type SWR, SWS                     <ul style="list-style-type: none"> <li>▪ With flow divider</li> <li>▪ With/without pressure limiting valve</li> <li>▪ With shut-off valve for P and H (lift)</li> </ul> </li> </ul>
<b>Basic type</b>	Lifting modules and hoist control valves

**Drive concept an field of application:**

	Drive concept		Application					
	1	2	Scissor lift	Miniature stacker, Walkie stacker	Counter balance truck	Reach truck	Order picker (warehouse)	
							no man aloft	man aloft
HST	x	x	x	x	x	x	x	x
HMT		x			x	x	x	(x)

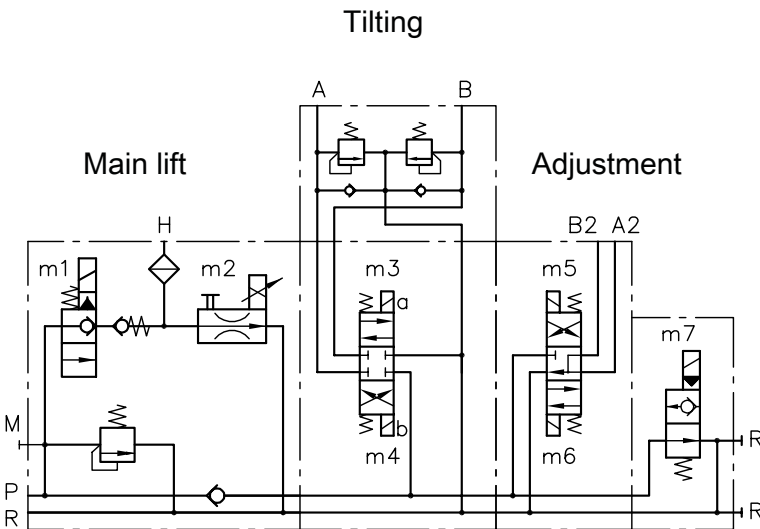
**Drive concept:**

- 1: Constant delivery pump, lifting/lowering via flow controller (throttle)
- 2: Lifting via speed controlled pump, lowering via flow controller (throttle)

**Circuit examples:**

HMT 34-1/200-70F  
 -G/M/0/2 AN40 BN130  
 -D/M/0/02  
 -31E-P12/G 24

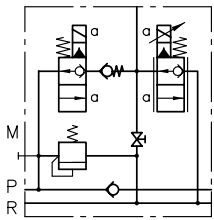
Lifting module type HMT, size 3, connection size 4 with pressure-limiting valve (set to 200 bar), output controller with 70 l control orifice closed in normal position; segment G with shock and servo-suction valves (set values 40 and 130 bar) in ancillary block; end plate with idle circulation valve open in neutral position, proportional solenoid voltage for flow control valves 12V DC, solenoid voltage for directional spool valve and directional seated valves 24V DC



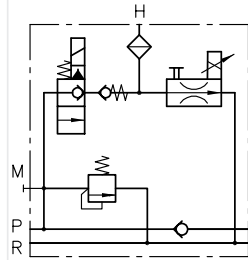
## Function

### Lifting modules and connection blocks:

HST



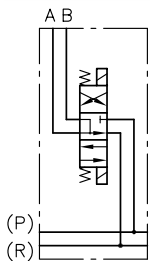
HMT



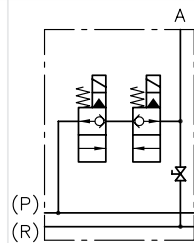
### Intermediate blocks (main and initial lift):

Size 2

D

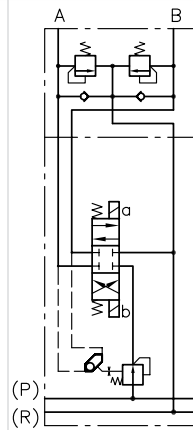


T2

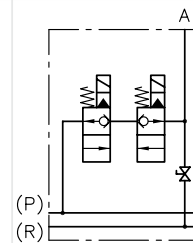


Size 3

G/M/DW/2 AN... BN...



T2



- Size 2: Hole pattern SWR 1, size 3: Hole pattern SWR 2/SWS 2

### End plates:

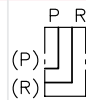
Size 2 and 3

1



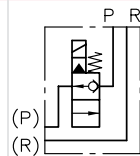
Size 2 and 3

2



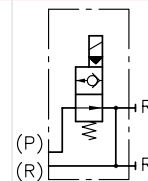
Size 3

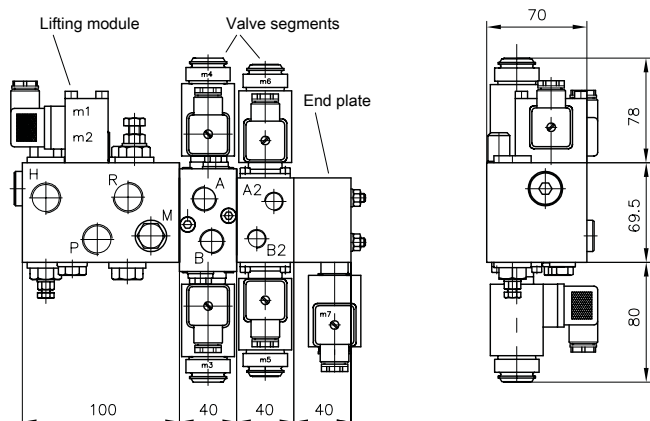
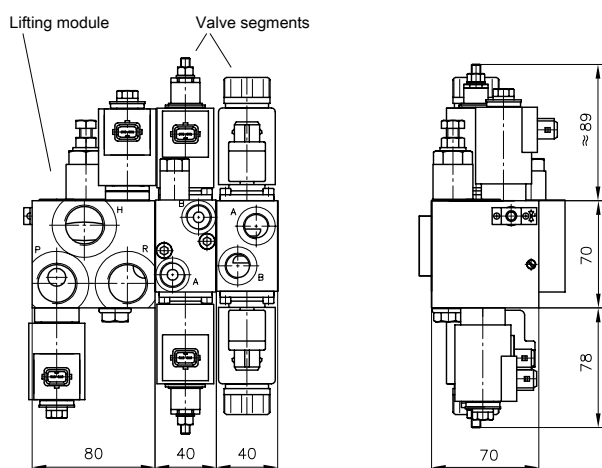
21E



Size 3

31E



**General parameters and dimensions**
**HMT 34 ...**

**HST 3 ...**


	$Q_{max}$ [lpm]	$p_{max}$ (bar)	Note	Ports (BSPP)
HST 2	20 - 40	315	Connection blocks of lifting module Add-on components: - SWR/SWS-Valve sections - Intermediate blocks - End plates	P, R, H = G 1/2; M = G 3/8
HST 3	30 - 60			P, R, H = G 3/4; M = G 3/8
HMT 3	70 - 90			H, P, R = G 1/2; M = G 3/8
HMT 34	70 - 90			H = G 3/4; P, R = G 1/2; M = G 3/8

**Associated technical data sheets:**

- Type HMT: **Sk 7758 HMT ff**
- Type HST: **Sk 7650 HST ff**

**Information on additional lifting modules on inquiry**
**Similar products:**

- Directional spool valves type SWR, SWS 2: [Page 92](#)
- Connection blocks type HMPL and HMPV: [Page 106](#)

**Male connectors:**

- [Line connector type MSD and others: D 7163](#)
- With economy circuit: [D 7813](#), [D 7833](#)

# Directional seated valves

## 2.2 Directional seated valve type VH, VHR, and VHP

Directional seated valves are a type of directional valve. As ball valves they have zero leakage in the closed state.

A hand lever operates the eccentric shaft that controls the plunger for opening or closing the valve seats. The actuation via the hand lever is undertaken with automatic centring in the neutral position or with a notch. The directional seated valve type VH is suitable for pipe connection. The directional seated valve bank type VHR comprises several valves of type VH that have been clamped together connected in parallel via a tension rod to form a valve bank. The directional seated valve type VHP is available as a valve for manifold mounting.

### Features and benefits:

- Pressures up to 700 bar manually switchable
- Actuation using hand lever with automatic centring in zero position or with notch
- Different arrangements in valve bank possible
- Leakage-free seated valve technology

### Intended applications:

- Construction and construction materials machinery
- Offshore and marine technology
- Process engineering systems
- Oil hydraulics and pneumatics



<b>Nomenclature:</b>	Directional seated valve, zero leakage
<b>Design:</b>	Individual valve for pipe connection Individual valve, manifold mounting, bankable
<b>Actuation:</b>	Manual
<b>p<sub>max</sub>:</b>	500 ... 700 bar
<b>Q<sub>max</sub>:</b>	12 ... 25 lpm

### Design and order coding example

VH 1	H1
VHR 1	G1/N1/E2

**Function/valve sections with actuation** Hand lever with automatic return (1) or detent (2)

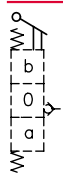
### Additional versions:

- Actuation with contact switch for neutral position monitoring (K), optionally for single valves and valve banks

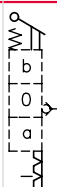
**Basic type, size** Type VH (Individual valve for pipe connection)  
Type VHP (Individual valve, manifold mounting)  
Type VHR (Valve bank)  
Size 1 and 2

### Actuation:

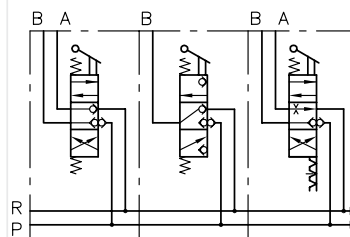
**Return spring**



**Detent**



Symbol type VHR..



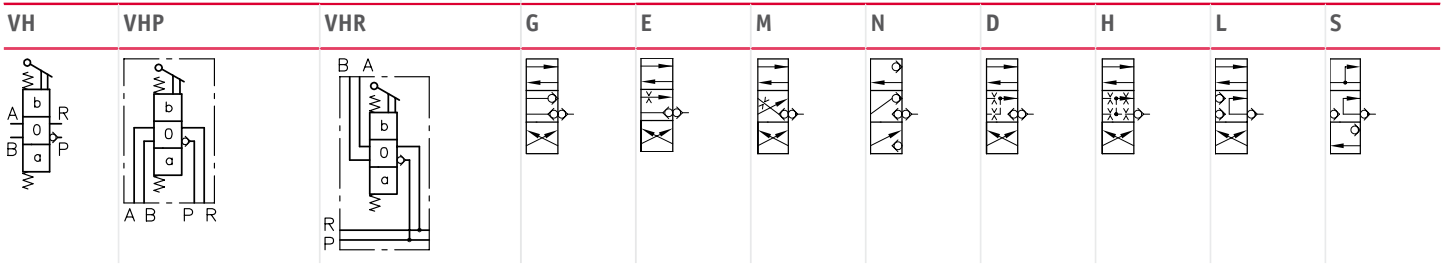
- Return spring : automatic return to neutral position only up to approx. 50 bar. At pressures over 50 ... 700 bar the lever must be reset manually.



**Function**

**Basic symbols**

**Symbol**

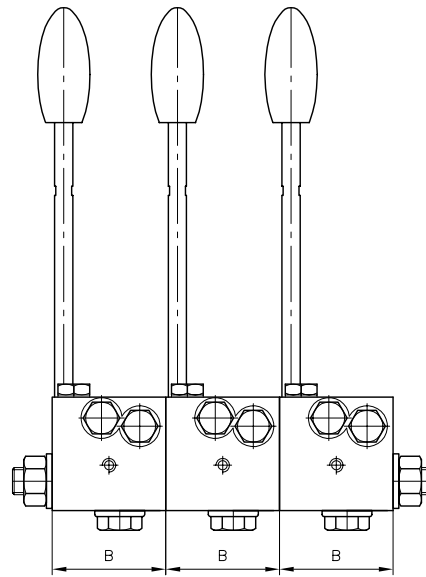
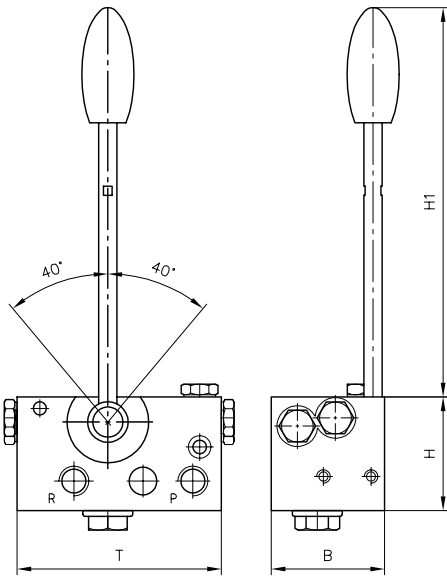


- On type VHR max. 7 or 5 valves (size 1 or 2) can be combined
- Type H, L and S only as single valve, not for type VHR

**General parameters and dimensions**

**Individual valve VH..**

**Valve bank VHR..**



	Q <sub>max</sub> [lpm]	p <sub>max</sub> [bar]	Ports	Dimensions [mm]				m [kg]
				H	H1	B	T	Valve section
VH 1, VHP 1, VHR 1	12	700	G 1/4	50	approx. 172	50	90	1.6
VH 2, VHR 2	25	500	G 3/8	60	approx. 162	60	120	3

**Associated technical data sheets:**

- [Directional seated valve type VH, VHP and VHR: D 7647](#)

**Similar products:**

- Directional seated valves type BVG 1, BVP 1: "[Directional seated valve type BVG, BVP and NBVP](#)"
- [Directional seated valve type NBVP 16: D 7765 N](#)

# Directional seated valves

## 2.2 Directional seated valve type VZP

The seated valve type VZP is a manifold mounting valve that is designed as a zero-leakage, cone-seated valve in one size.

The twin layout of the 3/2 and 2/2-way directional seated valves means that all functional elements for valve function and actuation share one housing, making them very compact. Depending on pairing, these valves can fulfil either one 4/4, 4/3 or 3/3-way function, or two independent 3/2 and 2/2-way individual functions. Compared with individual valves for manifold mounting of conventional layout, the advantages are lower spatial requirements and the possibility of directly mounting pressure switches for monitoring the consumer pressure. A particularly compact option is to combine several valves connected in parallel in one valve bank (type BVZP).

### Features and benefits:

- Good price-performance ratio
- Max. operating pressures up to 450 bar
- Adapter plates for flange-mounting on compact hydraulic power packs
- Option to incorporate additional functions in the sub-plate, such as pressure switches, throttle and check valve combinations etc.

### Intended applications:

- Machine tools (cutting and non-cutting)
- Mining machinery (incl. oil production)
- Clamping equipment, punching tools, jigs
- Rubber and plastics machinery



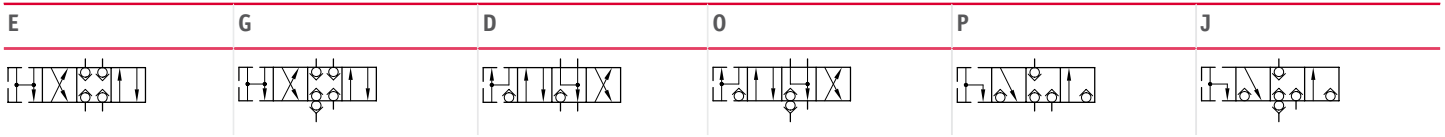
<b>Nomenclature:</b>	Directional seated valve, zero leakage
<b>Design:</b>	Individual valve, manifold mounting
<b>Actuation:</b>	Solenoid
<b>p<sub>max</sub>:</b>	250 ... 450 bar
<b>Q<sub>max</sub>:</b>	5 ... 15 lpm

### Design and order coding example

<b>VZP1</b>	<b>H</b>	<b>12B1,0</b>	<b>- G12</b>
			<b>Solenoid voltage</b> 12V DC, 24V DC, 110V AC, 230V AC
			▪ Versions with M12-plug and 8-Watt solenoid
		<b>Additional elements</b>	▪ Indiv. valves with check valve insert in gallery P ▪ Indiv. valves with return pressure stop in gallery R ▪ Pressure switch for the consumer ports
	<b>Function</b>		▪ 4/2-way functions via directional spool valve ▪ 4/3-way directional seated valve (G, D, E, O) ▪ 3/3-way directional seated valve (J, P) ▪ 2/2- and 3/2-way directional seated valve (F, D - H, M, N, R)
<b>Basic type, size</b>		Twin valve type VZP, size 1	▪ Connection blocks for pipe connection

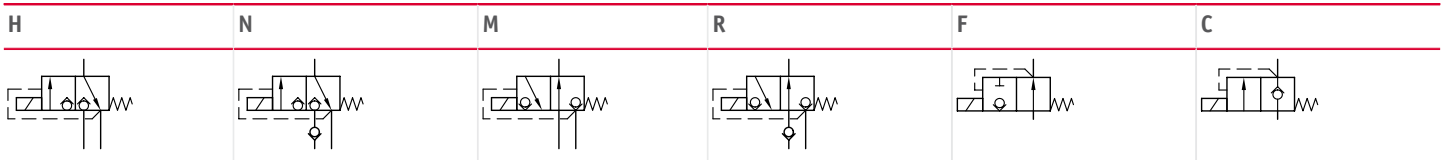
**Function**

Cone seated valves with 4/3- (4/4-) or 3/3- (3/4-) way functions up to 400 bar



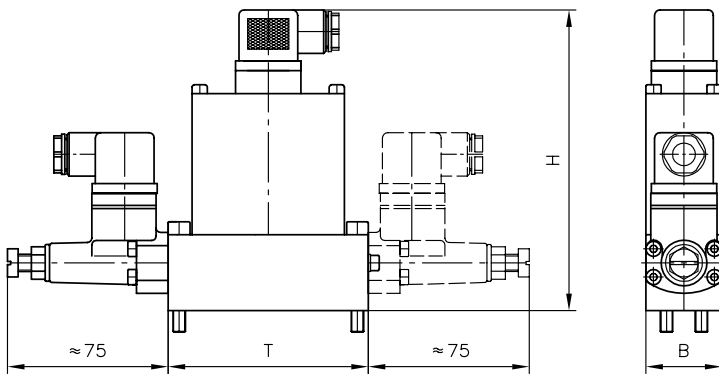
- 4. Switching position when both solenoids are energized simultaneously

Ball seated valves with 3/2- (2/2-) way functions up to 450 bar (always two valve functions in one valve body)



**General parameters and dimensions**

VZP 1 (example with mounted pressure switches)



	$Q_{max}$ [lpm]	$p_{max}$ [bar]	Dimensions [mm]			m [kg]
			H	B	T	
<b>VZP 1</b>	5... 15	250... 450	137... 142	35... 39	92	1.9... 2.2

- Weight m [kg] +0.3 kg per mounted pressure switch

**Associated technical data sheets:**

- [Directional seated valve type VZP: D 7785 A](#)

**Accessories:**

- Pressure switches type DG 3..., DG 5E: [Page 270](#)

**Male connectors:**

- [Line connector type MSD and others: D 7163](#)

## 2.3 Pressure valves

Pressure-limiting valve type MV, SV and DMV	168
Pressure control valve type CMV, CMVZ, CSV and CSVZ	172
Pressure-limiting valve, pilot-controlled type DV, AS etc.	174
Sequence valves with check valve type VR	176
Proportional pressure-limiting valve type PMV and PDV	178
Pressure-reducing valve type ADC, ADM, ADME and AM	180
Pressure-reducing valve type ADM and VDM	182
Pressure-reducing valve type CDK, CLK, DK, DLZ and DZ	186
Proportional pressure-reducing valve type PM and PMZ	190
Proportional pressure-reducing valve type PDM	192
Proportional pressure-reducing valve type KFB and FB	194
Pressure-controlled shut-off valve type CNE	196
Two-stage valve type NE	198
Shut-off valve type LV and ALZ	200
Pressure-dependent shut-off valve type DSV and CDSV	202
Load-holding valve type LHK, LHDV and LHT	204



*Directly controlled pressure-limiting and sequence valves type MV, SV*



*Proportional pressure-limiting valves type PMV and PDV*

### Pressure-limiting and sequence valves (also proportional)

Type	Design	Adjustability	$p_{max}$ (bar)	$Q_{max}$ (lpm)
<b>MV, SV, DMV</b>	<ul style="list-style-type: none"> <li>▪ Individual valve for pipe connection or manifold mounting</li> <li>▪ Screw-in valve, assembly kit</li> </ul>	<ul style="list-style-type: none"> <li>- fixed</li> <li>- Manually adjustable</li> </ul>	MVG - 13: 700	MVG - 13: 8
			MVG - 14: 700	MVG - 14: 8
<b>CMV(Z), CSV(Z)</b>	<ul style="list-style-type: none"> <li>▪ Screw-in valve</li> <li>▪ Directly controlled</li> </ul>	<ul style="list-style-type: none"> <li>- fixed</li> <li>- Manually adjustable</li> </ul>	MV, SV - 4: 700	MV, SV - 4: 20
			MV, SV - 5: 700	MV, SV - 5: 40
			MV, SV - 6: 700	MV, SV - 6: 70
			MV, SV - 8: 700	MV, SV - 8: 160
			DMV - 4: 350	DMV - 4: 20
			DMV - 5: 350	DMV - 5: 40
			DMV - 6: 350	DMV - 6: 75
			DMV - 8: 315	DMV - 8: 160
			CMV - 1: 500	CMV - 1: 20
			CMV - 2: 500	CMV - 2: 40
CMV - 3: 500	CMV - 3: 60			
<b>DV, AS</b>	<ul style="list-style-type: none"> <li>▪ Individual valve for pipe connection or manifold mounting</li> </ul>	<ul style="list-style-type: none"> <li>- fixed</li> <li>- Manually adjustable</li> </ul>	CSV - 2: 315	CSV - 2: 40
			CSV - 3: 315	CSV - 3: 60
			CSVZ - 2: 315	CSVZ - 2: 40
			CMVZ - 2: 500	CMVZ - 2: 40
			DV - 3: 420	DV - 3: 40
			DV - 4: 420	DV - 4: 80
			DV - 5: 420	DV - 5: 120
			AS - 3: 350	AS - 3: 50
			AS - 4: 350	AS - 4: 80
			AS - 5: 350	AS - 5: 120
<b>VR</b>	<ul style="list-style-type: none"> <li>▪ Insert valve</li> <li>▪ Version with housing</li> </ul>	<ul style="list-style-type: none"> <li>- fixed</li> </ul>	1: 315	1: 15
			2: 315	2: 40
			3: 315	3: 65
			4: 315	4: 120
<b>PMV, PDV</b>	<ul style="list-style-type: none"> <li>▪ Individual valve for pipe connection or manifold mounting</li> </ul>	<ul style="list-style-type: none"> <li>- Electro-proportional</li> </ul>	PMV - 4: 700	PMV - 4: 16
			PMV - 5: 450	PMV - 5: 60
			PMV - 6: 320	PMV - 6: 75
			PMV - 8: 180	PMV - 8: 120
			PDV - 3: 350	PDV - 3: 40
			PDV - 4: 350	PDV - 4: 80
			PDV - 5: 350	PDV - 5: 120

## Pressure-reducing valves (also proportional)

Type	Design	Adjustability	$p_{\max}/p_A$ (bar)	$Q_{\max}$ (lpm)
ADC, ADM, ADME, AM	<ul style="list-style-type: none"> <li>Screw-in valve</li> <li>for pipe connection</li> </ul>	- fixed	ADC 1: 300/25	ADC 1: 2
			ADM 1: 315/70	ADM 1: 10
			ADME 1: 315/70	ADME 1: 8
			AM 1: 400/100	AM 1: 2
ADM, VDM	<ul style="list-style-type: none"> <li>Individual valve for pipe connection or manifold mounting</li> <li>Directly controlled or piloted</li> </ul>	- fixed - Manually adjustable	ADM 1: 315/70	ADM 1: 10
			ADM 11: 320/250	ADM 11: 12
			ADM 21: 320/250	ADM 21: 25
			ADM 22: 320/250	ADM 22: 25
			ADM 32: 320/250	ADM 32: 60
			ADM 33: 320/250	ADM 33: 60
			VDM 3: 400/300	VDM 3: 40
			VDM 4: 400/300	VDM 4: 70
			VDM 5: 400/300	VDM 5: 120
CDK, CLK, DK, DLZ, DZ	<ul style="list-style-type: none"> <li>Screw-in valve (2-way principle)</li> <li>Combination with connection block</li> </ul>	- fixed - Manually adjustable	CDK - 3: 500/450	CDK - 3: 22
			CLK - 3: 500/450	CLK - 3: 22
			DLZ - 3: 400/380	DLZ - 3: 22
			DK - 3: 500/450	DK - 3: 22
			DZ - 3: 500/450	DZ - 3: 22
PM, PMZ	<ul style="list-style-type: none"> <li>Assembly kit</li> <li>Individual valve for manifold mounting</li> </ul>	- Electro-proportional	PM - 1: 40/30	PM - 1: 2
			PM - 11: 40/30	PM - 11: 2
			PM - 12: 40/30	PM - 12: 2
			PM - 22: 40/30	PM - 22: 2
			PMZ - 1: 40/30	PMZ - 1: 2
PDM	<ul style="list-style-type: none"> <li>Individual valve for pipe connection or manifold mounting</li> </ul>	- Electro-proportional	11: 320/320	11: 12
			12: 320/320	12: 12
			21: 320/180	21: 20
			22: 320/180	22: 20
			3: 350/350	3: 40
			4: 350/350	4: 80
			5: 350/350	5: 120
KFB, FB	<ul style="list-style-type: none"> <li>Individual valve for pipe connection</li> </ul>	- Manual	01: 120/30	01: 2

### Externally pressure-controlled relief valves (switch-off, follow-up valves)

Type	Nomenclature/Design	Adjustability	$p_{max}$ (bar)	$Q_{max}$ (lpm)
CNE	<ul style="list-style-type: none"> <li>2-way idle circulation valve</li> <li>Screw-in valve</li> </ul>	- fixed	CNE - 2: 500 CNE - 21: 500 CNE - 22: 420 CNE - 23: 500	CNE - 2: 30 CNE - 21: 30 CNE - 22: 30 CNE - 23: 30
NE	<ul style="list-style-type: none"> <li>Two-stage valve (high-pressure/low-pressure stage)</li> <li>Individual valve for pipe connection</li> </ul>	- fixed	HP/LP: 20, 21: 700/55 70: 500/60 80: 500/30	HP/LP: 20, 21: 10/40 70: 16/100 80: 25/180
LV, ALZ	<ul style="list-style-type: none"> <li>Shut-off valve (idle circulation valve, directly controlled or piloted)</li> <li>Individual valve for pipe connection or manifold mounting</li> </ul>	- fixed - Manually adjustable	LV - 10: 350 LV - 20: 350 LV - 25: 350  ALZ - 3: 350 ALZ - 4: 350 ALZ - 5: 350	LV - 10: 12 LV - 20: 25 LV - 25: 25  ALZ - 3: 50 ALZ - 4: 80 ALZ - 5: 120
DSV, CDSV	<ul style="list-style-type: none"> <li>Individual valve for pipe connection or manifold mounting</li> <li>Screw-in valve</li> </ul>	- fixed - Manually adjustable	CDSV - 1: 600  DSV - 21-1: 400 DSV - 2-2: 400 DSV - 2-3: 400	CDSV - 1: 8  DSV - 21-1: 20 DSV - 2-2: 40 DSV - 2-3: 60

### Load-holding valves

Type	Nomenclature/Design	Adjustability	$p_{max}$ (bar)	$Q_{max}$ (lpm)
LHK, LHDV, LHT	<p><b>Load-holding valve, over centre valve</b></p> <ul style="list-style-type: none"> <li>Individual valve for pipe connection or manifold mounting</li> <li>Screw-in valve, version for banjo bolt mounting</li> </ul>	- fixed - Manually adjustable	LHK - 2: 400 LHK - 3: 360 LHK - 4: 350  LHDV - 33: 420  LHT - 2: 400 LHT - 3: 420 LHT - 5: 400	LHK - 2: 20 LHK - 3: 60 LHK - 4: 100  LHDV - 33: 80  LHT - 2: 28 LHT - 3: 130 LHT - 5: 250

# Pressure valves

## 2.3 Pressure-limiting valve type MV, SV and DMV

Pressure-limiting valves and sequence valves are types of pressure control valves. Pressure-limiting valves safeguard the system against excessive system pressure or limit the operation pressure. Sequence valves generate a constant pressure difference between the inlet and outlet flow.

Type MV and SV is a directly controlled valve that is damped as standard. Versions that correspond to the Pressure Equipment Directive are also available.

### Features and benefits:

- Operating pressures up to 700 bar
- Various adjustment options
- Numerous configurations

### Intended applications:

- General hydraulic systems
- Test benches
- Hydraulic tools



<b>Nomenclature:</b>	Pressure limiting valve, sequence valves (directly controlled)
<b>Design:</b>	Individual valve for pipe connection Screw-in valve Individual manifold mounting valve Assembly kit
<b>Adjustment:</b>	Fixed Manually adjustable
<b>p<sub>max</sub>:</b>	700 bar
<b>Q<sub>max</sub>:</b>	5 ... 160 l/min

### Design and order coding example

MVS 52 B R X - 650

Pressure setting ]

Optionally without dampening (X)

Adjustability (while pressurized)

- fixed
- Manually adjustable
- Adjustable with turn knob (self-locking/lockable)

Pressure range and volumetric flow

Pressure ranges A, B, C, E and F

Basic type, size

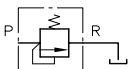

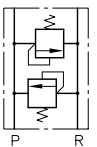
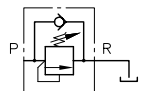

Type MV.., DMV.. and SV..

### Additional versions

- Multiple pressure limiting valves (2, 3, 4, 5 valves in parallel)
- Pressure-limiting valves with unit approval (TÜV valves) (type MVX, MVSX, MVEX, MVPX, SVX, size 4, 5 and 6)
- Various actuations: ball head for controls via cam, lever etc. (type MVG and MVP only)

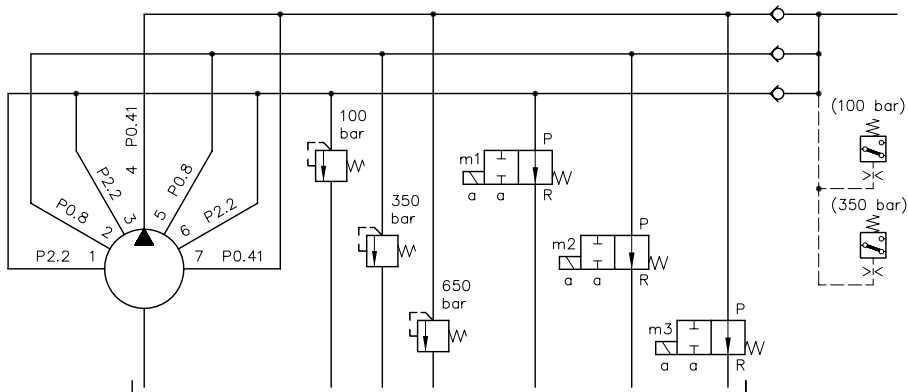


## Function

	MV <sup>1)</sup>	MVS MVG	MVE	SV	MVP	DMV	MVCS MVGC	SVC	MVB
									
<b>Function</b>	Pressure limiting valve	Pressure limiting valve and differential pressure regulators				Pressure limiting valve	Pressure-limiting valve with free reflux R→P via a bypass check valve		Pressure limiting valve and differential pressure regulators
<b>Brief description</b>	Corner valve for pipe connection	Corner valve for pipe connection	Screw-in valve	Straight-way valve for straight pipe installation	Manifold mounting valve	Twin valve as shock valve for hydraulic motors	Corner valve for pipe connection	Straight-way valve for straight pipe installation	Assembly kit
<b>Size</b>	4, 5, 6	13, 14, 4, 5, 6, 8	13, 14, 4, 5, 6, 8	4, 5, 6, 8	13, 14, 4, 5, 6, 8	4, 5, 6, 8	13, 14, 4, 5, 6	4, 5, 6	4, 5, 6, 8
<b>p<sub>perm R</sub> [bar]</b>	20	500	500	500	500	350	500	500	200

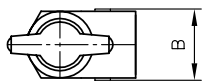
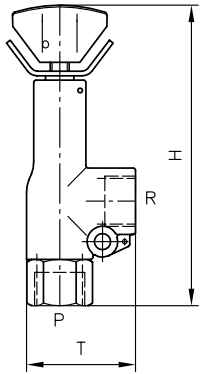
1) Only size 4, 5, 6, and 8  
Type MVG and MVGC only size 13 and 14

## Example circuit:

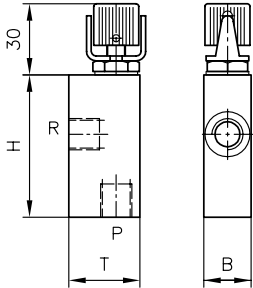


**General parameters and dimensions**

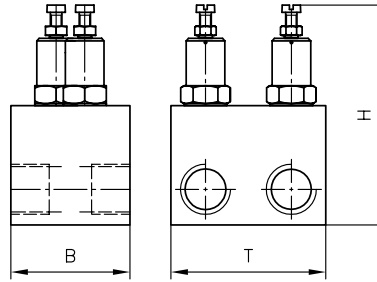
**MV, MVS**



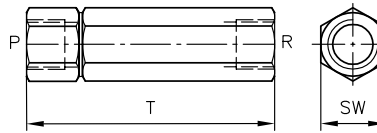
**MVG**



**DMV**



**SV, SVC**



See following table for dimensions

	Size	Dimensions [mm]			m [kg]	Size	Pressure range/Flow	Ports (BSP) <sup>1)</sup>
		H <sub>max</sub>	B/SW	T <sub>max</sub>				
MV, MVS, MVCS, MVE	4	126	24	48	0.3	4	F: 80/20 E: 160/20 C: 315/20 B: 500/20 A: 700/12	G 1/4, G 3/8
	5	142	29	60	0.4			
	6	164	36	70	0.7			
	8	208	40	60	2.0			
DMV	4	107	40	52	0.7	5	F: 80/40 E: 160/40 C: 315/40 B: 500/40 A: 700/20	G 3/8, G 1/2
	5	123	50	65	1.3			
	6	142.5	60	75	1.8			
	8	192	80	96	4.5			
MVP	4	102	28	35	0.3	6	F: 80/75 E: 160/75 C: 315/75 B: 500/75 A: 700/40	G 1/2 G 3/4
	5	113	32	40	0.5			
	6	133	35	50	0.8			
	8	172	50	60	1.6			
	13, 14	82	29	50	0.3			
MVE	13, 14	75	SW 27	-	0.1	8	E: 160/160 C: 315/160 Bi: 500/160 A: 700/75	G 3/4, G 1
MVG, MVGC	13, 14	94	20	42	0.3	13	H: 700/5	G 1/4
SV, SVC	4	-	SW 22	87	0.2	14	N: 50/8 M: 200/8 H: 400/8	G 1/4
	5	-	SW 27	108	0.4			
	6	-	SW 32	132	0.9			
SV	8	-	SW 41	157	0.9			

1) For pipe connection versions only

#### Associated technical data sheets:

- [Pressure-limiting valve type MV, SV and DMV: D 7000/1](#)
- [Pressure-limiting valve and pre-load valve type MVG, MVE, and MVP: D 3726](#)
- [Pressure-limiting valve \(installation kit\) type MVF etc.: D 7000 E/1](#)
- [Multiple pressure-limiting valve type MV: D 7000 M](#)
- [Pressure-limiting valve, with unit approval type MV .X: D 7000 TUV](#)

#### Similar products:

- Pressure control valves for screwing in type CMV, CSV: [Page 172](#)
- Pilot-controlled pressure control valves type DV: [Page 174](#)
- Pilot-controlled pressure control valves type A: [Page 174](#)

# Pressure valves

## 2.3 Pressure control valve type CMV, CMVZ, CSV and CSVZ

Pressure-limiting valves and sequence valves are types of pressure control valves. Pressure-limiting valves safeguard the system against excessive system pressure or limit the operation pressure. Sequence valves generate a constant pressure difference between the inlet and outlet flow.

Type CMV and CSV is a directly controlled valve that is damped as standard. Versions that correspond to the Pressure Equipment Directive are also available. Type CMVZ and CSVZ is not influenced by the pressure conditions downstream and is therefore suitable for use in loss-free sequence control systems.

Valve type CMV and CSV can be screwed-in and can be integrated into control blocks. The necessary mounting holes are straightforward to make.

### Features and benefits:

- Operating pressures up to 500 bar
- Various adjustment options
- Easily produced mounting hole

### Intended applications:

- General hydraulic systems
- Test benches
- Hydraulic tools



<b>Nomenclature:</b>	Pressure limiting valve, sequence valves (directly controlled)
<b>Design:</b>	Screw-in valve
<b>Adjustment:</b>	Fixed Manually adjustable
<b>p<sub>max</sub>:</b>	500 bar
<b>Q<sub>max</sub>:</b>	60 lpm

### Design and order coding example

CMV 3 F R - 200 - 1/4

Single connection block for pipe connection

Pressure setting [bar]

Adjustability (while pressurized) fixed or manually adjustable

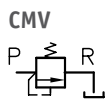
Pressure range Pressure ranges B, C, E and F

Basic type, size Type CMV (pressure limiting valve), size 1 to 3  
Type CSV (pressure difference valve), size 2 to 3

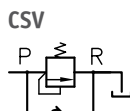
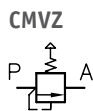
**Additional versions:**

- Sequence valves CMVZ or CSVZ
- Version with unit approval type CMVX
- Undamped version (CMV)

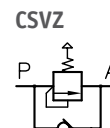
## Function



Pressure limiting valve (port R pressure resistant)

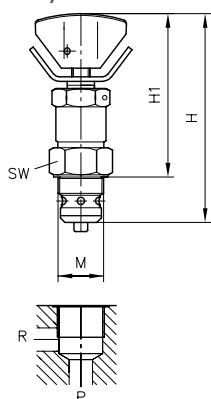


Sequence valves with by-pass check valve

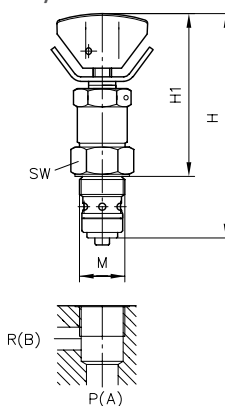


## General parameters and dimensions

CMV/CMVZ



CSV/CSVZ



	Size	Q <sub>max</sub> [lpm]	Pressure range p <sub>max</sub> [bar]	M	SW = a/f	Dimensions [mm]		m [g]
						H <sub>max</sub>	H1 <sub>max</sub>	
CMV, CMVZ	1	20	F: 80	M 16 x 1.5	SW 22	78	57	90
	2	40	E: 160	M 20 x 1.5	SW 24	94	72	160
	3	60	C: 315 B: 500	M 24 x 1.5	SW 30	114	83	275
CSV, CSVZ	2	40		M 20 x 1.5	SW 24	104	73	150
	3	60		M 24 x 1.5	SW 30	122	82	300

### Associated technical data sheets:

- Pressure control valve type CMV, CMVZ, CSV and CSVZ: [D 7710 MV](#)
- Pressure-limiting valve, with unit approval type CMVX: [D 7710 TUV](#)

- Pilot-controlled pressure control valves type DV: [Page 174](#)
- Pilot-controlled pressure control valves type AS: [Page 174](#)

### Similar products:

- Pressure-limiting valves type MV, SV, etc.: [Page 168](#)
- Miniature pressure-limiting valves type MVG and others: [Page 168](#)

# Pressure valves

## 2.3 Pressure-limiting valve, pilot-controlled type DV, AS etc.

Pressure-limiting valves are a type of pressure control valve. They safeguard the system against excessive system pressure or limit the operation pressure.

The pressure-limiting valve type DV and AS is pilot-controlled. Type AS also has an additional check valve in the consumer port.

### Features and benefits:

- Various adjustment options
- Various additional functions

### Intended applications:

- General hydraulic systems
- Test benches



<b>Nomenclature:</b>	Pressure limiting valve Sequence valve Follow-up valve (piloted)
<b>Design:</b>	Individual valve for pipe connection Individual valve manifold mounting
<b>Adjustment:</b>	Fixed Manually adjustable
<b>p<sub>max</sub>:</b>	420 bar
<b>Q<sub>max</sub>:</b>	120 lpm

### Design and order coding example

DV3 G H R - WN 1F- 24 - 200

Pressure setting [bar]

2/2-way directional seated valve    Optionally with mounted 2/2-way directional seated valve for arbitrary idle circulation

Adjustability in operation    fixed or manually adjustable (R)

- Various actuations for the pilot valve: ball head for controls via cam, lever etc. (type DV, DVE)

Pressure range    ▪ N: 2 to 100 bar  
                          ▪ H: 5 to 420 bar

Line connection    Pipe connection or manifold mounting

Basic type, size    Type DV (internal control oil drain),  
                          Type DVE (external control oil drain),  
                          Type DF (valve for remote control), size 3 to 5  
                          Type AS (additional check valve), size 3 to 5  
                          Type AE (release valve), size 3 to 5

### Additional versions:

- Additional switching combinations with the types AS and AE

**Function**

**DV**



Pressure limiting, sequence valve

**DVE**



Follow-up valve

**DF**



Pressure limiting, sequence valve, follow-up valve or 2/2-way directional valve (remote controlled, depending on the kind of valve connected to port X)

**AS**



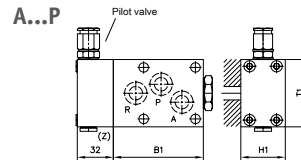
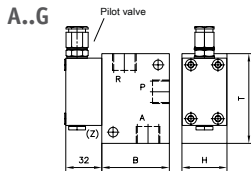
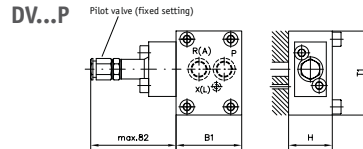
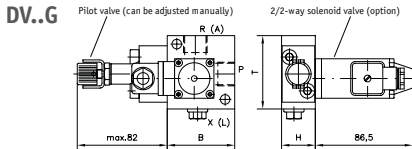
Pressure limiting valve

**AE**



Release valve (remote controlled), combined function as pressure limiting valve possible (type ASE)

**General parameters and dimensions**



Type, size	Q <sub>max</sub> [lpm]	Pressure range: p <sub>max</sub> [bar]	Ports (BSPP)	Dimensions [mm]					m [kg]
				H	B	B1	T	T1	
DV, DVE, DF									
3	50	N: 100 H: 420	G 1/2	30	60	-	66	-	1,1 / -
4	80		G 3/4	40	65	60	71	78	1,5 / 2,0
5	120		G 1	50	80	88	73	81	2,0 / 2,5

Type, size	Q <sub>max</sub> [lpm]	Pressure range: p <sub>max</sub> [bar]	Ports (BSPP)	Dimensions [mm]					m [kg] <sup>1)</sup>	
				H	H1	B	B1	T		T1
AS, ASE, AE										
3	50	M: 200 H: 350/300 (type AE)	G 1/2	40	-	60	-	80	-	1,8
4	80		G 3/4	40	40	70	80	94	60	2,2
5	120		G 1	6,3	40	100	94	85	80	4,1

1) Versions for pipe connection/manifold mounting (with installed solenoid valve + 0.6 kg)

**Associated technical data sheets:**

- Pressure-limiting valve, pilot-controlled type DV, DVE and DF: [D 4350](#)
- Pressure valve with check valve type AL, AE and AS: [D 6170](#)

**Similar products:**

- Pressure-limiting valves type MV, SV, etc.: [Page 168](#)
- Miniature pressure-limiting valves type MVG and others: [Page 168](#)
- Pressure-limiting valves type CMV(Z): [Page 172](#)

# Pressure valves

## 2.3 Sequence valves with check valve type VR

Pre-load valves, also called sequence valves are a type of pressure control valve. They generate a largely constant pressure drop between the inlet and outlet on the valve. In the opposite direction the flow can pass freely. In the normal position the valve has minor leakage.

The sequence valve type VR is available as a screw-in valve and in a housing version for in-line installation.

The primary application area is in return lines for oscillation damping, mainly in lifting equipment, lifting platforms, handling systems and in lifting gantries as fall protection.

**Features and benefits:**

- Compact screw-in valve

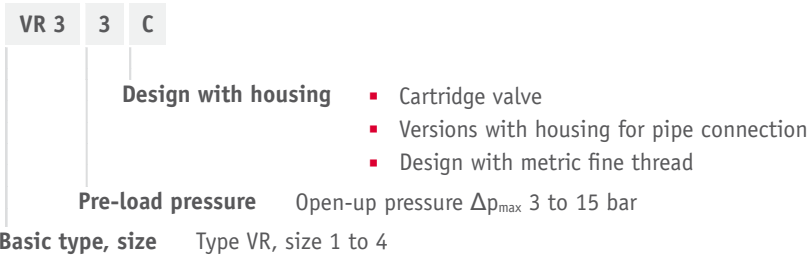
**Intended applications:**

- Lifting equipment
- Lifting platforms
- Handling technology

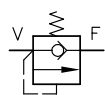


<b>Nomenclature:</b>	Sequence valve
<b>Design:</b>	Screw-in valve Combination with housing for pipe connection
<b>Adjustment:</b>	Fixed (non-adjustable)
<b>p<sub>max</sub>:</b>	315 bar
<b>Δp<sub>max</sub>:</b>	15 bar
<b>Q<sub>max</sub>:</b>	120 lpm

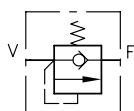
### Design and order coding example





**Function**
**VR**


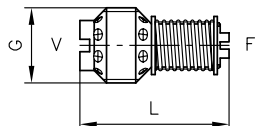
Screw-in valve



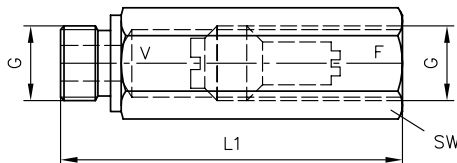
Version with housing for pipe connection

**General parameters and dimensions**
**VR 3 3 C**

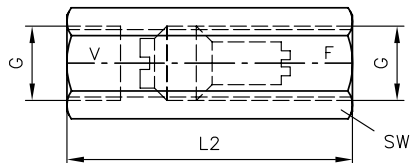
Insert valve


**VR 4 9 E**

Version with housing


**VR 1 15 G**

Version with housing



	$Q_{\max}$ [lpm]	$\Delta p_{\max}$ [bar] <sup>1)</sup>	Dimensions [mm]					m [g] <sup>2)</sup>
			G (BSPP)	L	L1	L2	SW = a/f	
<b>VR 1</b>	15	3, 5, 7, 9, 12, 15	G 1/4 (A)	31	78	66	SW 19	15/120
<b>VR 2</b>	40	3, 5, 7, 9, 12, 15	G 3/8 (A)	36	82	70	SW 22	25/160
<b>VR 3</b>	65	3, 5, 7, 9, 12	G 1/2 (A)	42	96	80	SW 27	40/270
<b>VR 4</b>	120	3, 5, 7, 9, 12	G 3/4 (A)	54	106	100	SW 32	80/400

1) The selected pre-load pressure e.g. opening pressure cannot be altered

2) Individual valve/design with housing

**Associated technical data sheets:**

- [Sequence valves with check valve type VR: D 7340](#)

**Similar products:**

- Pressure-limiting valves type MV, SV, etc.: [Page 168](#)
- Miniature pressure-limiting valves type MVG and others: [Page 168](#)
- Pilot-controlled pressure control valves type DV: [Page 174](#)
- Pressure-limiting valves type CMV: [Page 172](#)

# Pressure valves

## 2.3 Proportional pressure-limiting valve type PMV and PDV

Proportional pressure-limiting valves are a type of pressure control valve. They remotely control the pressure in hydraulic systems continuously and electrically.

The pressure-limiting valve type PMV is a directly actuated valve in a spring-loaded ball version. The pressure can be set to up to 700 bar. The pressure-limiting valve type PDV is a pilot valve in a piston version, where pressures up to 350 bar can be set. The pressure-limiting valve type PMV and PDV is available as a single valve for pipe connection or as a manifold mounting valve.

The proportional pressure-limiting valve is particularly suitable for maximum pressure limitation in hydraulic systems.

### Features and benefits:

- Max. operating pressure 700 bar
- Precise control

### Intended applications:

- General hydraulics
- Test benches
- Mining machinery



<b>Nomenclature:</b>	Prop. pressure-limiting valve (directly controlled or piloted)
<b>Design:</b>	Individual valve for pipe connection Individual valve Manifold mounting
<b>Adjustment:</b>	Electro-proportional
<b>p<sub>max</sub>:</b>	700 bar
<b>Q<sub>max</sub>:</b>	120 lpm

### Design and order coding example

PDV4G	H	- G24
PMVP4	- 44	- G24

- Solenoid voltage** Prop. solenoid
- 12V DC, 24V DC
  - Control using proportional amplifier or PLVC

**Pressure range [bar]**

- Basic type, port size, size** Type PMV (pipe connection), type PMVP (manifold mounting)
- Optionally with separate control oil supply, i.e. pressure reduction right above 0 bar, zero-leakage in the main pump circuit (type PMVS, PMVPS)
- Type PDV.G (pipe connection), type PDV.P (manifold mounting)
- Additionally with 2/2-way solenoid valves for arbitrary idle circulation

### Function

#### PMV, PDV



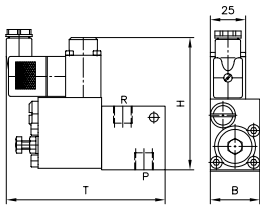
Pipe connection



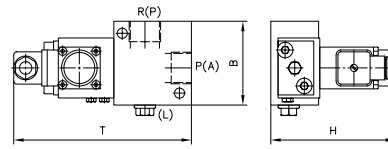
Manifold mounting valve

## General parameters and dimensions

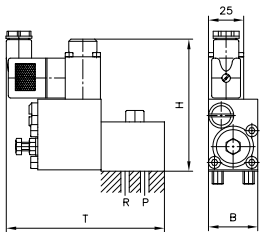
PMV



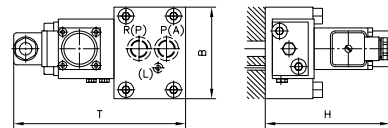
PDV..G



PMVP



PDV..P



	Size	Q <sub>max</sub> [lpm]	Pressure range p <sub>max</sub> [bar]	Ports (BSPP) <sup>1)</sup>	Dimensions [mm]			m [kg]
					H	B	T	
PMV/PMVP	4	16	41: 180 42: 290 43: 440 44: 700	G 1/4, G 3/8	97/95	35	135	1,2 / 1,1
	5	16... 60	41: 110 42: 180 43: 270 44: 450	G 1/4, G 3/8, G 1/2	98/95	35/40	140	1.2
	6	60... 75	41: 80 42: 130 43: 190 44: 320	G 3/8, G 1/2, G 3/4	102/95	40/50	150/140	1,5/1,3
	8	120	41: 45 42: 70 43: 110 44: 180	G 3/4, G 1	107/97	45/60	160/150	1,9/1,7
PDV.G/PDV.P	3	40	N: 130 M: 200 H: 350	G 1/2	96	66	150	1.8
	4	80		G 3/4	99.5	71/78	155/150	2,2/2,7
	5	120		G 1	104.5	73/81	170/178	2.7/3.2

1) For pipe connection versions only

### Associated technical data sheets:

- Proportional pressure-limiting valve type PMV and PMVP: [D 7485/1](#)
- Proportional pressure-limiting valve type PDV and PDM: [D 7486](#)
- Proportional pressure-limiting valve type NPMVP: [D 7485 N](#)
- Intermediate plate type NZP: [D 7788 Z](#)

### Additional electrical components:

- Proportional amplifier: [Page 278](#)
- Programmable logic valve control type PLVC: [Page 280](#)
- CAN node type CAN-IO: [Page 282](#)
- Other electronic accessories [See "Electronics"](#)

# Pressure valves

## 2.3 Pressure-reducing valve type ADC, ADM, ADME and AM

Pressure reducing valves are a type of pressure control valve. They maintain a largely constant outlet pressure even at a higher and changing inlet pressure.

The pressure reducing valve type ADC and AM is suitable for the supply of control circuits with low oil consumption. These valves feature an override compensation, i.e. acting like a pressure-limiting valve if the secondary pressure exceeds the set pressure e.g. due to external forces. There is a design-related leakage flow.

### Features and benefits:

- Compact design
- Numerous configurations

### Intended applications:

- For control oil supply in pilot circuits



<b>Nomenclature:</b>	Pressure reducing valve
<b>Design:</b>	Screw-in valve Valve for pipe connection
<b>Adjustment:</b>	Fixed (non-adjustable)
<b><math>p_{\max P}</math>:</b>	300 ... 400 bar
<b><math>p_{\max A}</math>:</b>	15 ... 100 bar
<b><math>Q_{\max}</math>:</b>	2 ... 10 lpm

### Design and order coding example

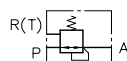
ADC 1	- 25	- 1/4	
			<b>Design</b>
			<ul style="list-style-type: none"> <li>▪ Cartridge valve</li> <li>▪ Design with housing for direct pipe connection</li> <li>▪ Version with housing for manifold mounting (type AM 11)</li> </ul>
			<b>Pressure downstream</b> Pressure at port A [bar]
<b>Basic type</b>	Type ADC, AM		
	Type ADM, ADME		
			<ul style="list-style-type: none"> <li>▪ Type ADM 1 adjustable version available</li> </ul>

### Function

#### ADC, AM, ADM, ADME



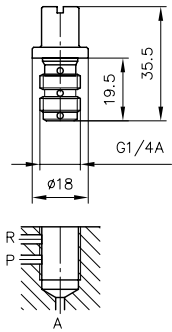
Screw-in valve



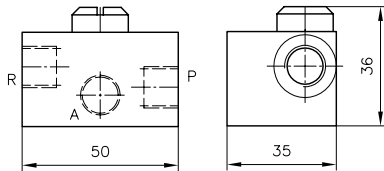
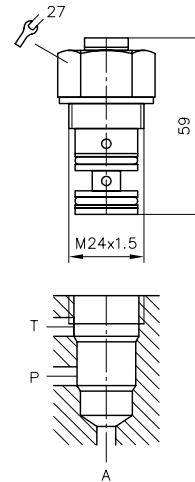
Pipe installation

**General parameters and dimensions**
**ADC 1-.25**

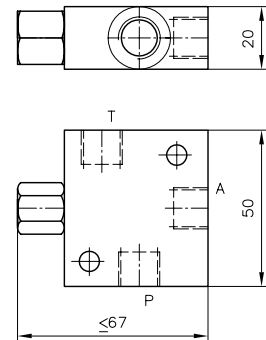
Pressure-reducing valve type ADC 1 as screw-in valve, pressure at A approx. 25 bar


**AM 1 - 20 -1/4**

Pressure-reducing valve type AM 1, version for pipe connection (ports G 1/4 (BSPP)), pressure at A approx. 20 bar


**ADME 1-...**

**ADM 1-70**

Pressure-reducing valve type ADM 1, version for pipe connection, pressure at A approx. 70 bar



	$Q_{max}$ [lpm]	$p_{max}$ [bar]	Outlet pressure [bar] at A	Ports (BSPP) <sup>1)</sup>	$m_{max}$ [kg]	
						Screw-in valve
						Pipe installation
<b>ADC 1</b>	2	300	15, 25	G 1/4	0.03	0.32
<b>AM 1</b>	2	400	20, 30, 40, 100	G 1/4	0.03	0.3
<b>ADM 1</b>	8 ...10	300	15, 20, 30, 70	G 1/4	-	0.34
<b>ADME</b>	8	300	15, 20, 30	-	0.05	-

1) In version for pipe connection only

**Associated technical data sheets:**

▪ [Pressure-reducing valve type ADC, ADM, ADME and AM: D 7458](#)

▪ Prop. pressure reducing valves type PDM: [Page 192](#)

▪ Miniature prop. pressure reducing valves type PM, PMZ: [Page 190](#)

**Similar products:**

▪ Pressure reducing valves type ADM, VDM: [Page 182](#)

▪ Pressure reducing valves type CDK: [Page 186](#)

# Pressure valves

## 2.3 Pressure-reducing valve type ADM and VDM

Pressure reducing valves are a type of pressure control valve. They maintain a largely constant outlet pressure even at a higher and changing inlet pressure.

The pressure reducing valve type ADM is directly controlled, the type VDM is hydraulically pilot-controlled. These valves feature an override compensation, i.e. acting like a pressure-limiting valve if the secondary pressure exceeds the set pressure e.g. due to external forces. There is a design-related leakage flow.

### Features and benefits:

- With safety valve function
- Various adjustment options
- Various additional functions

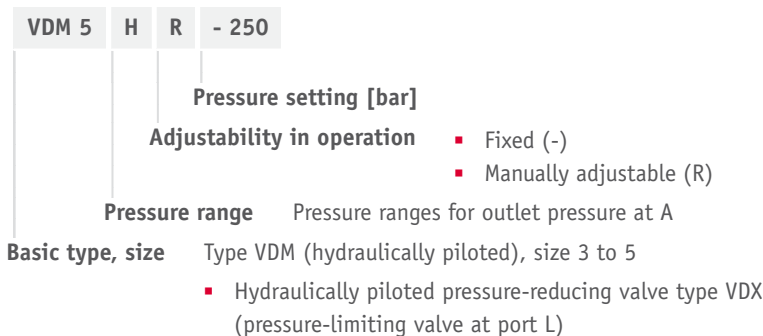
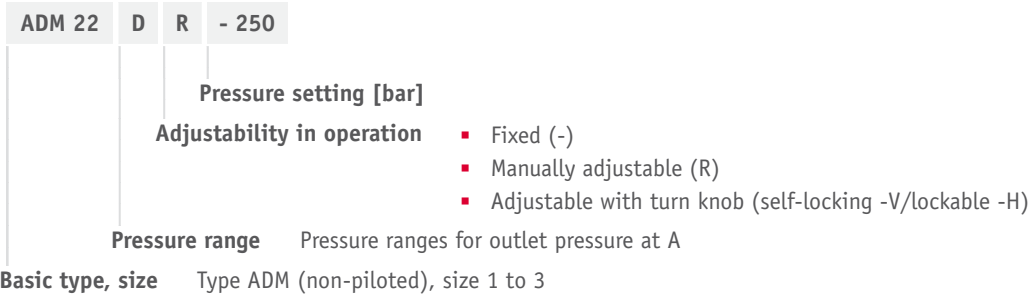
### Intended applications:

- General hydraulics
- Jigs
- Test benches



<b>Nomenclature:</b>	Pressure-reducing valve (directly controlled or piloted)
<b>Design:</b>	Individual valve for pipe connection Individual valve Manifold mounting
<b>Adjustment:</b>	Fixed Manually adjustable
<b>p<sub>max P</sub>:</b>	400 bar
<b>p<sub>max A</sub>:</b>	300 bar
<b>Q<sub>max</sub>:</b>	120 lpm

### Design and order coding example



## Function

### ADM..



Valve for pipe connection



Manifold mounting valve

### VDM..



Valve for pipe connection



Manifold mounting valve

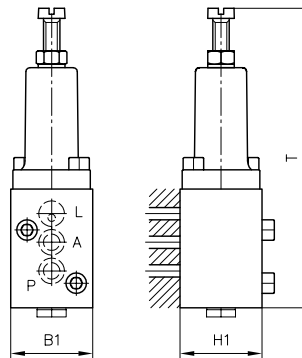
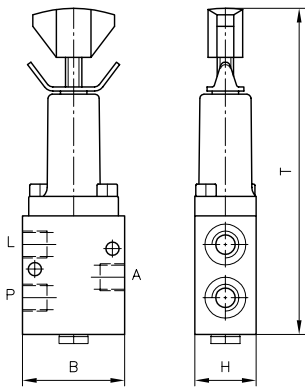
## General parameters and dimensions

### ADM 22 DR

Directly controlled pressure reducing valve type ADM size 2, for pipe connection  
(tapped ports G 3/8 (BSPP), coding 2),  
pressure range 30 to 120 bar (coding D),  
pressure manually adjustable (coding R)

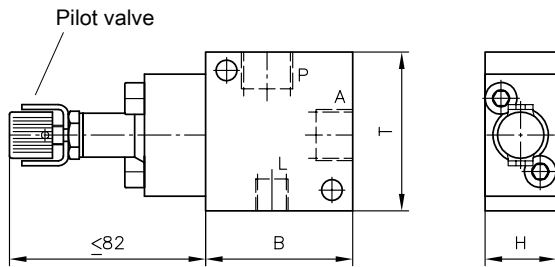
### ADM...P

Manifold mounting valve



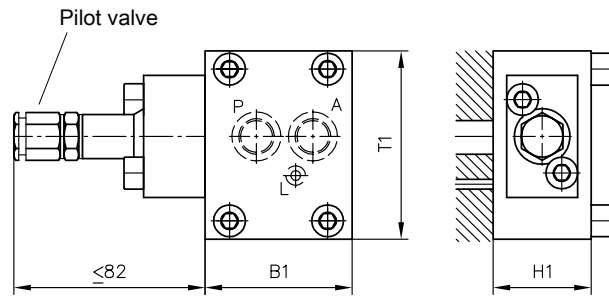
### VDM...G

Valve for pipe connection



### VDM 5 PH - 250

Piloted pressure reducing valve type VDM size 5,  
manifold mounting (coding P),  
pressure range 10 to 400 bar (coding H),  
pressure fixed to 250 bar



	$Q_{\max}$ [lpm]	$p_{\max}$ [bar]	$p_{\max A}$ [bar]	Ports (BSPP) <sup>2)</sup>	Leakage flow $Q_{\text{leak}}$ [lpm]	Dimensions [mm]						$m_{\max}$ [kg] <sup>3)</sup>
						H	H1	B	B1	T	T1	
ADM 1...	12	300	F: 30	G 1/4	approx. <math><0.05</math>	30	35	45	35	141	-	0.6/0.6
ADM 2..	25		D: 120 C: 160 A: 250	G 1/4, G 3/8	approx. <math><0.05</math>	30	40	50	40	162	-	0.7/0.85
ADM 3..	60		F: 25 D: 100 C: 160 A: 250	G 3/8, G 1/2	approx. <math><0.07</math>	30	40	50	40	174	-	1.0/1.1
VDM 3..	40	400	N: 100 H: 400 <sup>1)</sup>	G 1/2	approx. <math><0.4</math>	30	-	60	-	66	-	1.1/--
VDM 4..	70			G 3/4		40	40	65	60	71	78	1.5/2.0
VDM 5..	120			G 1		50	50	80	88	73	81	2.0/2.5

1) Max. pressure difference is 300 bar between inlet and outlet

2) For pipe connection versions

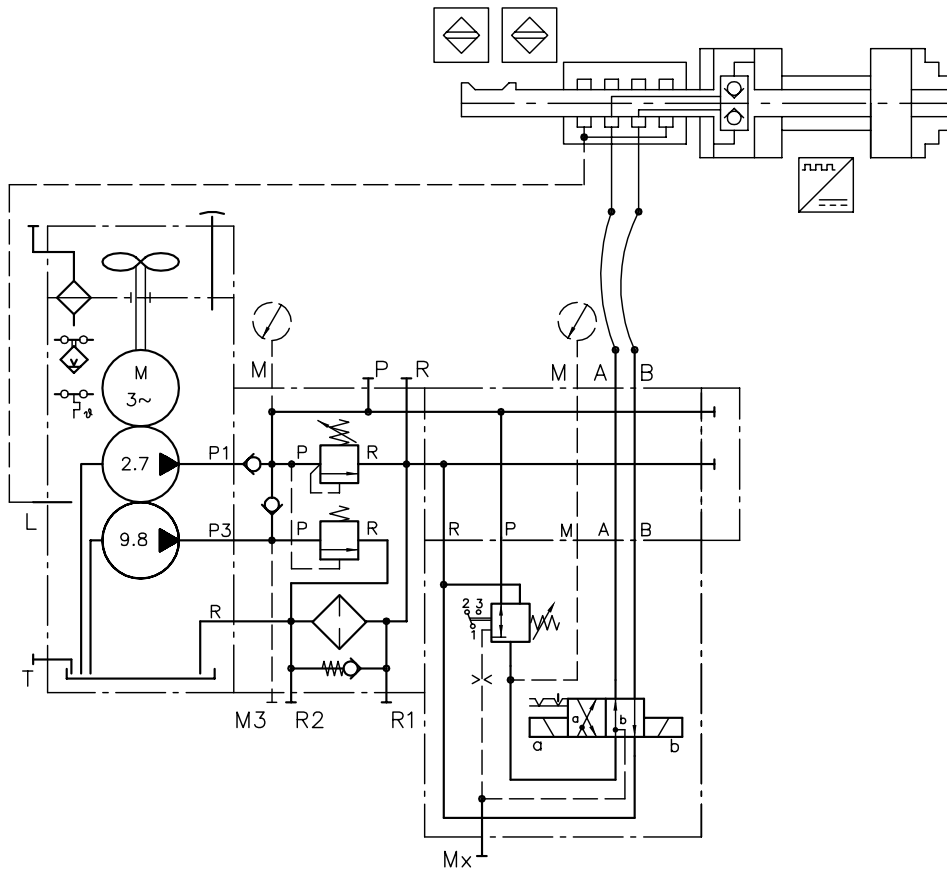
3) Version for pipe connection / manifold mounting



**Example circuit:**

HK 43 LDT/1 M - ZZ 2.7/9.8

-AN 21 F 2-D45-F50  
-BA 2  
-NSMD 2 K/GRK/0  
-1-G 24



**Associated technical data sheets:**

- [Pressure-reducing valve type ADM: D 7120](#)
- [Pressure-reducing valve, pilot-controlled type VDM: D 5579](#)

- Pressure reducing valves type CDK: [Page 186](#)
- Prop. pressure reducing valves type PDM: [Page 192](#)

**Similar products:**

- Miniature pressure reducing valves type ADC and others: [Page 180](#)
- Miniature prop. pressure reducing valves type PM, PMZ: [Page 190](#)

# Pressure valves

## 2.3 Pressure-reducing valve type CDK, CLK, DK, DLZ and DZ

Pressure reducing valves are a type of pressure control valve. They maintain a largely constant outlet pressure even at a higher and changing inlet pressure.

The pressure reducing valve type CLK features an override compensation, i.e. acting like a pressure-limiting valve if the secondary pressure exceeds the set pressure e.g. due to external forces. The pressure reducing valve type DK features a tracked pressure switch, e.g. pressure and switch are set simultaneously with an adjustment device.

All versions have zero leakage when in the closed state. The valve type CDK and CLK can be screwed-in and can be integrated into control blocks. The necessary mounting holes are straightforward to make.

### Features and benefits:

- Zero leakage in closed state

### Intended applications:

- General hydraulic systems
- Jigs
- Test benches



<b>Nomenclature:</b>	Pressure reducing valve (2-way valve)
<b>Design:</b>	Screw-in valve combination with a connection block for <ul style="list-style-type: none"><li>▪ Pipe connection</li><li>▪ Manifold mounting</li></ul>
<b>Adjustment:</b>	Fixed Manually (adjustable)
<b>p<sub>max</sub>:</b>	500 bar
<b>Q<sub>max</sub>:</b>	22 lpm

### Design and order coding example

CDK 3 -2 R - 250

Pressure setting [bar]

- Adjustment
- Fixed (-)
  - Manually adjustable (R)
  - Adjustable with turn knob (self-locking -V/lockable -H)

### Basic type and pressure range

- Type CDK, type CLK (with additional override compensation)
- Screw-in valve
  - Version with connection block for pipe connection with/without pressure-limiting valve
  - Version with connection block for manifold mounting with/without pressure-limiting valve
  - In intermediate plate design NG6 (type NZP)

DK 2 R /160 /4R

Additional elements Orifice/throttle

Pressure setting [bar]

- Adjustment
- Fixed (-)
  - Manually adjustable (R)
  - Adjustable with turn knob (self-locking -V/lockable -H)

- Basic type and pressure range
- Type DK (with tracked pressure switch)
  - Type DZ with type CDK
  - Type DLZ with type CLK
  - With bypass check valve
  - Manifold mounting
  - Version with connection block for pipe connection

**Function**

**CDK**

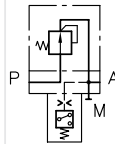


Screw-in valve

**CLK**

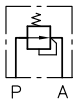


**CDK 3. ...-1/4-DG3.**



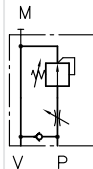
Version for pipe connection, a pressure switch type DG 3. May be installed as option, additional port for pressure gauge

**CDK 3. ...-P**



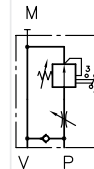
Manifold mounting valve

**DZ, DLZ**



Manifold mounting valve, optional with orifice/throttle and bypass check valve

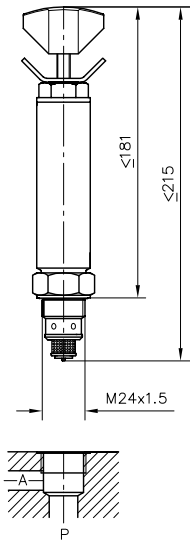
**DK**



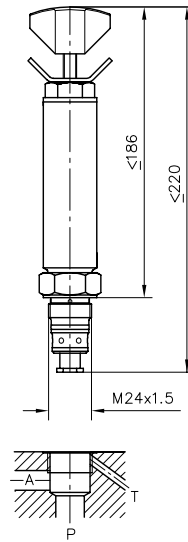
Manifold mounting valve with tracked pressure switch

## General parameters and dimensions

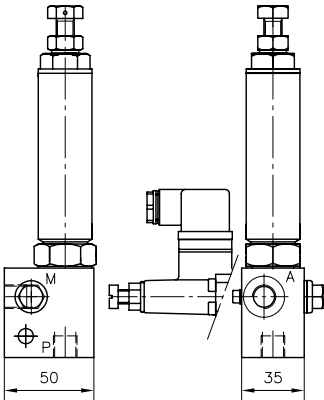
CDK 3..



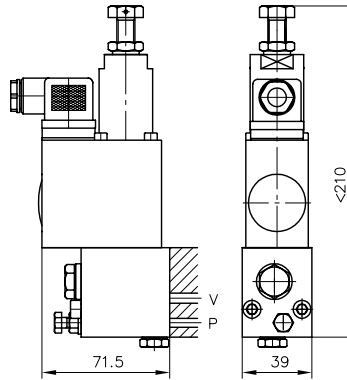
CLK 3..



CDK 3. ...-1/4-DG3.



DK 2.

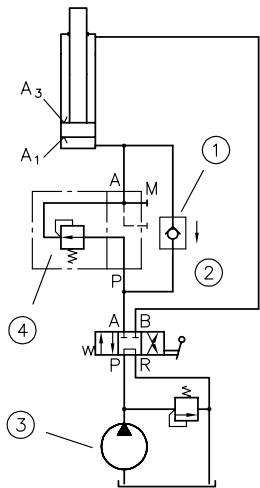


	Q <sub>max</sub> [lpm]	Pressure range p <sub>max</sub> [bar]		Ports (BSPP)	m [kg]
CDK 3.-..., CLK 3.-...	6... 22	..-08: 450 <sup>1)</sup>	..-2: 200..	-	0.7
CDK 3. ...-1/4-DG3.		..-081: 500 <sup>1)</sup>	..-21: 250..	G1/4	1.25
CDK 3. ...-P		..-1: 300..	..-5: 130..	-	1.4
DZ..., DLZ..., DK...		..-11: 380...	..-51: 165	-	

1) Only available as type CDK and DK

**Circuit examples**

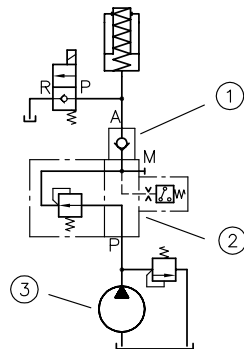
Example of a version with large flow rate  $Q_{A \rightarrow P}$   
Example:  $Q_P = 15 \text{ lpm}$  [formula]



Application example for large flow rate

- 1 e.g. type RK 2G in acc. with D 7445
- 2  $Q_{\text{return}} = 45 \text{ lpm}$
- 3  $Q_P = 15 \text{ lpm}$
- 4 Type CDK 3-2-1/4

Example of a version with undesired return flow

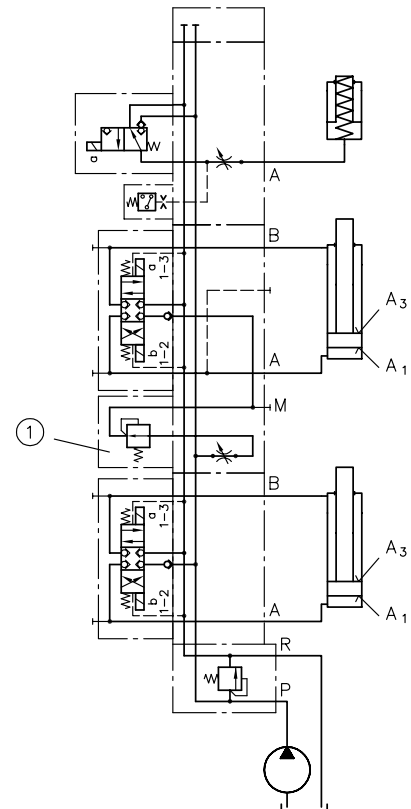


Application example for undesired return flow

- 1 e.g. type RK 1E in acc. with D 7445 (shown here screwed into port A of the CDK 3 valve)
- 2 Type CDK 3- 2-1/4-DG 34

Use in the valve bank, shown here with seated valves type BVZP 1

- BVZP 1 A - 1/300 - G22/0
- G22/CZ2/100/4/2
- WN1H/10/4
- 1 - 1 - G 24



Application example in the valve bank

- 1 Type CDK 3-2-100 shown here incorporated as -/CZ 2/100...

**Associated technical data sheets:**

- Pressure-reducing valve type CDK: D 7745
- Pressure-reducing valve type CLK: D 7745 L
- Pressure-reducing valve type DK, DZ and DLZ: D 7941

**Similar products:**

- Pressure reducing valves type ADM, VDM, VDX: [Page 182](#)
- Miniature pressure reducing valves type ADC and others: [Page 180](#)
- Prop. pressure reducing valves type PDM: [Page 192](#)

**Intermediate plates:**

- Intermediate plate type NZP: D 7788 Z

**Accessories:**

- Pressure switches Typ DG 3., DG 5 E: [Page 270](#)

# Pressure valves

## 2.3 Proportional pressure-reducing valve type PM and PMZ

Proportional pressure-reducing valves are a type of pressure control valve. They remotely control the pressure in hydraulic systems continually and electrically.

The proportional pressure-reducing valve type PM and PMZ is a directly actuated valve with a piston and is controlled electro-proportionally. It continuously maintains a constant pressure on the secondary pressure side, independently of the inlet side. The proportional pressure-reducing valve type PM is available as a single valve. The proportional pressure-reducing valve type PMZ is a twin valve.

The proportional pressure-reducing valve type PM and PMZ is particularly suitable for use as a pilot valve for actuators.

### Features and benefits:

- Compact design
- Numerous configurations
- Explosion-proof versions

### Intended applications:

- For control oil supply in pilot circuits



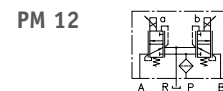
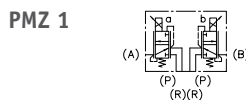
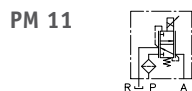
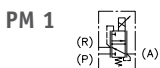
<b>Nomenclature:</b>	Prop. pressure reducing valve
<b>Design:</b>	Assembly kit Individual valve Manifold mounting
<b>Adjustment:</b>	Electro-proportional
<b>p<sub>max P</sub>:</b>	40 bar
<b>p<sub>max A</sub>:</b>	30 bar
<b>Q<sub>max</sub>:</b>	approx.. 2 lpm

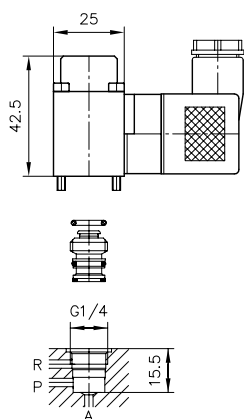
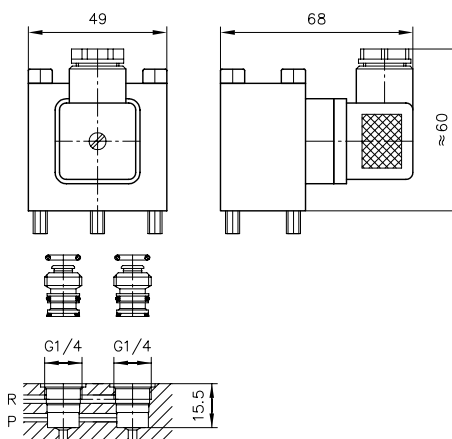
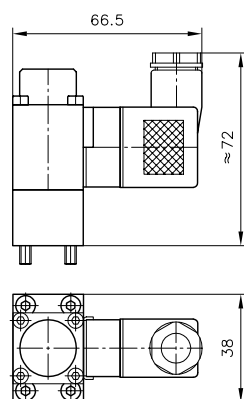
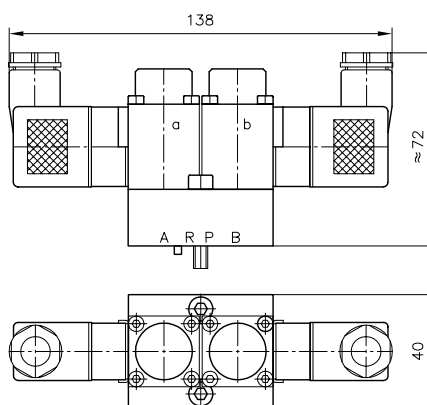
### Design and order coding example

PM 1	- 11	B 0,6	- G24	- NBR
			<b>Seals</b>	Different materials NGR, FKM, EPDM
			<b>Solenoid voltage</b>	Prop. solenoid <ul style="list-style-type: none"> <li>▪ 12V DC, 24V DC</li> <li>▪ Control using proportional amplifier or PLVC</li> </ul> Type PMZ also in an explosion-proof version
			<b>Additional elements</b>	<ul style="list-style-type: none"> <li>▪ Orifice for oscillation damping in A and B</li> <li>▪ Return pressure stop in R</li> </ul>
			<b>Prop. adjustable nominal pressure difference [bar]</b>	

- Basic type**
- Type PM
  - Type PMZ
    - Assembly kit (type PM 1, PMZ 01, PMZ 11)
    - For manifold mounting (type PM 11, PM 12)
    - Version in valve bank (type PMZ) with up to 10 prop. pressure-reducing valve sections

### Function



**General parameters and dimensions**
**PM 1**

**PMZ 1**

**PM 11**

**PM 12**


	Design		Pressure range (prop. adjustable nom. pressure difference $\Delta p = p_A - p_R$ ) [bar]
<b>PM 1</b>	Assembly kit	Individual valve	0 ... 30
<b>PMZ 1, PMZ 01</b>		Twin valve	0 ... 30
<b>PM 11</b>	Valve for manifold mounting	Individual valve	0 ... 30
<b>PM 12</b>		Twin valve	0 ... 30

**Associated technical data sheets:**

- Proportional pressure-reducing valve type PM and PMZ: [D 7625](#)

**Additional electrical components:**

- Proportional amplifier: [Page 278](#)
- Programmable logic valve control type PLVC: [Page 280](#)
- CAN node type CAN-IO: [Page 282](#)
- Other electronic accessories [See "Electronics"](#)

# Pressure valves

## 2.3 Proportional pressure-reducing valve type PDM

Proportional pressure-reducing valves are a type of pressure control valve. They remotely control the pressure in hydraulic systems continually and electrically.

The proportional pressure-reducing valve type PDM is a piloted valve with a piston and is controlled electro-proportionally. The valve has an external control oil drain. It continuously maintains a constant pressure on the secondary pressure side, independently of the inlet side. The pressure reducing valve is available as a single valve for pipe connection or as a manifold mounting valve.

The proportional pressure-reducing valve PDM is particularly suitable for dynamic control of the pressure level in hydraulic systems.

### Features and benefits:

- Integrated overpressure function

### Intended applications:

- General hydraulic systems
- Equipment
- Test benches
- Hydraulic tools



<b>Nomenclature:</b>	Prop. pressure-reducing valve (directly controlled or piloted)
<b>Design:</b>	Individual valve for pipe connection Individual valve Manifold mounting
<b>Adjustment:</b>	Electro-proportional
<b>p<sub>max P</sub>:</b>	400 bar
<b>p<sub>max A</sub>:</b>	5 ... 350 bar
<b>Q<sub>max</sub>:</b>	120 lpm

### Design and order coding example

PDMP 2  
PDM 4 G - 43 - G24

#### Solenoid voltage

Prop. solenoid

- 12V DC, 24V DC
- Control using proportional amplifier or PLVC

#### Pressure range

Pressure ranges for pressure downstream at A

#### Basic type, size, design

Type PDM (pipe connection), size 11, 21, 22  
Type PDMP (manifold mounting), size 11, 22  
Type PDM, size 3 to 5  
Pipe connection (G), manifold mounting (P)

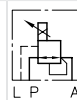
### Function

#### PDM

Valve for pipe connection:



Manifold mounting valve:

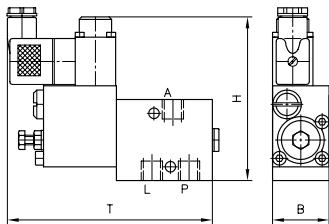




## General parameters and dimensions

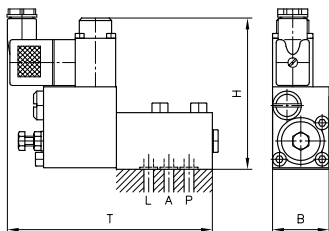
### PDM 11, PDM 21, PDM 22

Valve for pipe connection

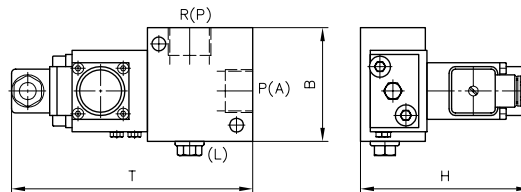


### PDMP 11 and PDMP 22

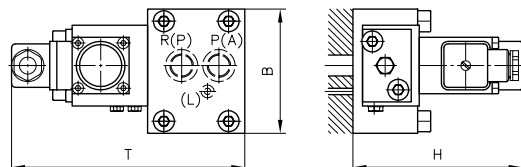
Manifold mounting valve



### PDM 3 to 5



### PDM 4P and PDM 5P



		$Q_{max}$ [lpm]	Pressure range $p_{max A}$ [bar]	Ports (BSPP) <sup>1)</sup>	Leakage flow $Q_{leak}$ [lpm]	Dimensions [mm]			m [kg]
						H	B	T	
<b>PDM 11</b>	Directly controlled	12	41: 80	G 1/4	< 0.5	101	33	150	1.5
<b>PDMP 11</b>			42: 130 43: 200 44: 320	-		93,5	35	150	1.4
<b>PDM 21/22</b>		20	41: 45	G 1/4, G 3/8	< 0.5	101	38	157	1.6
<b>PDMP 22</b>			42: 70 43: 110 44: 180	-		96	40	157	1.3
<b>PDM 3 G</b>	Piloted	40	N: 130	G 1/2	< 0.8	100	65	150	1.8
<b>PDM 4 G</b>		80	M: 200	G 3/4		99.5	71	155	2.2
<b>PDM 5 G</b>		120	H: 350	G 1		104.5	73	170	2.7
<b>PDM 4 P</b>		80	-	-		99.5	78	150	2.7
<b>PDM 5 P</b>		120	-	-		104.5	81	178	3.2

1) For pipe connection versions

#### Associated technical data sheets:

- Prop. pressure reducing valves type PDM: [D 7486](#), [D 7584/1](#)

#### Additional electrical components:

- Proportional amplifier: [Page 278](#)
- Programmable logic valve control type PLVC: [Page 280](#)
- CAN node type CAN-IO: [Page 282](#)
- Other electronic accessories [See "Electronics"](#)

# Pressure valves

## 2.3 Proportional pressure-reducing valve type KFB and FB

Proportional pressure-reducing valves are a type of pressure control valve. They manually and continuously operate hydraulic actuators at a distance.

The proportional pressure-reducing valve type FB is available as a single valve for pipe connection. Type KFB is a valve bank and combines several valves.

The proportional pressure-reducing valve type FB and KFB is primarily used for remote control of the directional spool valve type PSL or PSV.

**Features and benefits:**

- Sturdy design
- Precise control

**Intended applications:**

- For control oil supply in pilot circuits

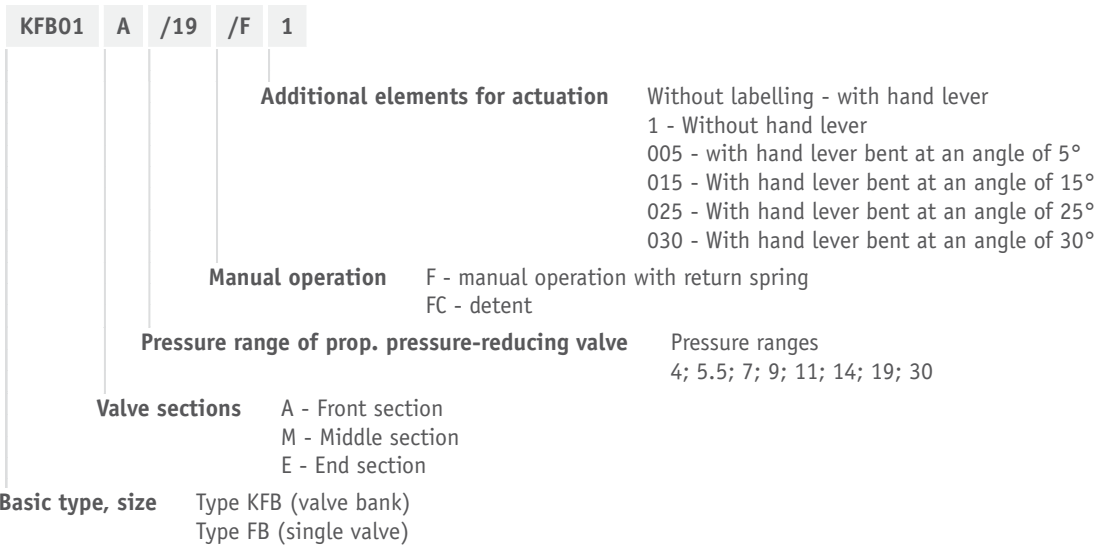
**Additional versions:**

- With UNF thread



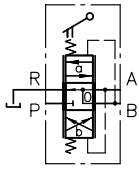
<b>Nomenclature:</b>	Proportional pressure-reducing valve Hydraulic joystick
<b>Design:</b>	Single valve / Valve bank in pipe connection
<b>p<sub>max</sub>:</b>	30 bar
<b>Q<sub>max</sub>:</b>	2 l/min

### Design and order coding example

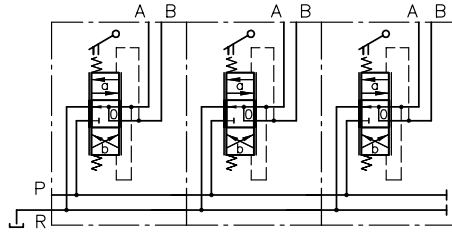


**Function**

Single valve



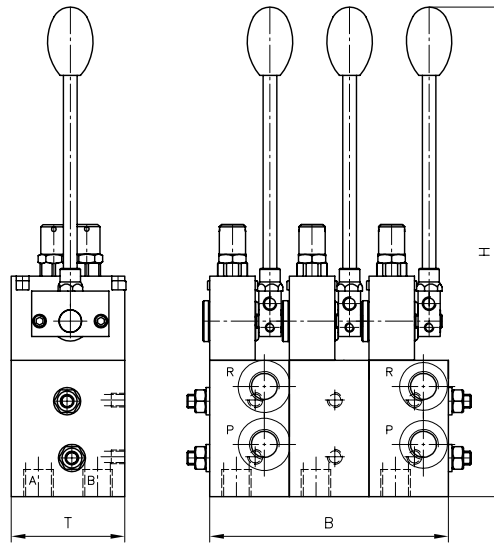
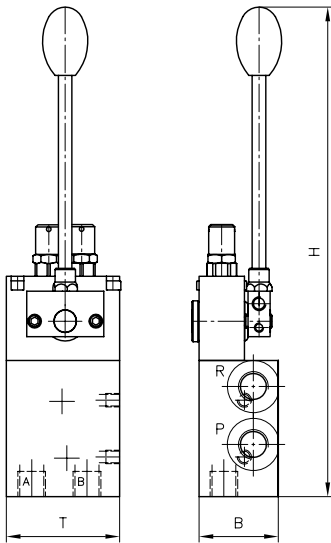
Valve bank



**General parameters and dimensions**

FB 01

KFB 01



	$Q_{max}$ [lpm]	Pressure range $p_{max}$ [bar]	Ports	Dimensions [mm]		
				H	B	T
FB 01	2	30	G 1/4	215,45	35	50
KFB 01	2	30	G 1/4	215,45	x · 35	50

**Associated technical data sheets:**

- Proportional pressure-reducing valve type KFB 01 and FB 01:  
[D 6600-01](#)

# Pressure valves

## 2.3 Pressure-controlled shut-off valve type CNE

Shut-off valves or accumulator charging valves are a type of pressure control valve. They switch the delivery flow of a pump to unpressurised circulation if the pressure value set is reached. During this process the consumer side is separated from the idle circulation by a zero-leakage check valve. If the pressure drops in the consumer side, the idle circulation is interrupted and the oil fed to the consumer again.

Via a control line the higher pressure holds open the pressure-controlled 2 directional valve type CNE and with it the idle circulation. In the low-pressure circuit the valve acts simultaneously as a pressure-limiting valve.

The valve type CNE can be screwed-in and can be integrated into manifolds. The necessary mounting holes are straightforward to make.

### Features and benefits:

- Compact design
- Easily produced mounting hole

### Intended applications:

- Accumulator systems
- Fixtures



<b>Nomenclature:</b>	2-way circulation valve
<b>Design:</b>	Screw-in valve
<b>Adjustment:</b>	Fixed
<b><math>p_{max}</math>:</b>	500 bar
<b><math>p_{max\ adjust}</math>:</b>	450 bar
<b><math>Q_{max}</math>:</b>	30 lpm

### Design and order coding example

CNE 2 C - 50

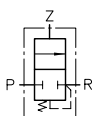
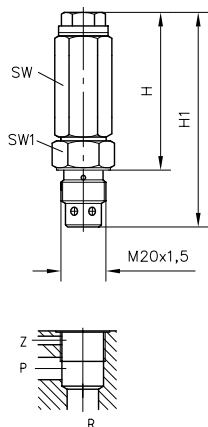
Pressure setting [bar]

Pressure range

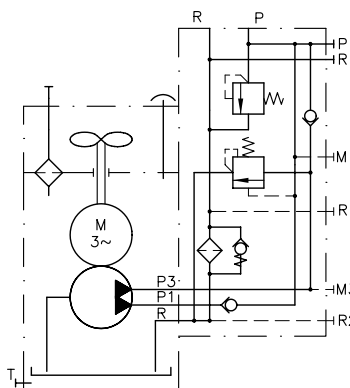
Basic type, size Pressure controlled 2-way valve type CNE

### Additional versions:

- Additionally sealed tapped journal to minimize the internal leakage loss (type CNE 21)
- Additionally sealed tapped journal and piston to minimise leakage loss (type CNE 22 and CNE 23)

**Function**
**CNE**

**General parameters and dimensions**
**CNE 2**

**Order example:**
**HK448/1-HH..-AN21F2**

Circulation valve integrated in connection block type AN 21 F2 for compact hydraulic power packs type HK with two pump circuits



	$Q_{\max}$ [lpm]	Oper. pressure $p_{\max}$ [bar] with		Dimensions [mm]			
		P	Z	H	H1	SW = a/f	SW1
CNE 2	30	E: 30	500	70	96	22	24
CNE 21		D: 45					
CNE 23		C: 60					
		B: 75					
		A: 90					
		M: 120					
		L: 150					
CNE 22	30	C: 320	500	120	147	30	27
		B: 450					

**Associated technical data sheets:**

- Pressure-controlled shut-off valve type CNE: D 7710 NE

**Similar products:**

- Two-stage valves type NE: [Page 198](#)
- Switch units type CR: [Page 154](#)
- Shut-off valves type LV, ALZ: [Page 200](#)
- Directional valves type AE: [Page 174](#)

**Connection blocks:**

- Connection blocks type A for hydraulic power packs: D 6905 A/1

# Pressure valves

## 2.3 Two-stage valve type NE

Two-stage valves are a type of pressure control valve. They are used in hydraulic systems that are supplied by dual stage pumps, a combination of high-pressure pump and low-pressure pump.

The two-stage valve type NE combines the two pump delivery flows into a common volumetric flow. It switches the low-pressure pump to unpressurised circulation if the pressure value set is reached. It protects both pumps against exceeding the high or low-pressure value set.

The two-stage valve type NE is used with directional valves to control double-acting hydraulic cylinders.

### Features and benefits:

- Operating pressures up to 700 bar
- Direct mounting on hydraulic power packs
- Direct combination with valve control

### Intended applications:

- Presses
- Test benches
- Hydraulic tools



<b>Nomenclature:</b>	Two stage valve (high pressure (HP) / low pressure (LP) stage)
<b>Design:</b>	Individual valve for pipe connection
<b>Adjustment:</b>	Fixed
<b>p<sub>max</sub>:</b>	500 ... 700 (HD) / 16 ... 80 (ND) bar
<b>Q<sub>max</sub>:</b>	25 (HP) / 180 (LP) lpm

### Design and order coding example

NE 20 - 650/20

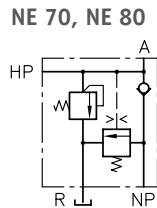
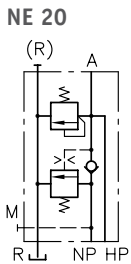
Pressure setting [bar] High- /low pressure

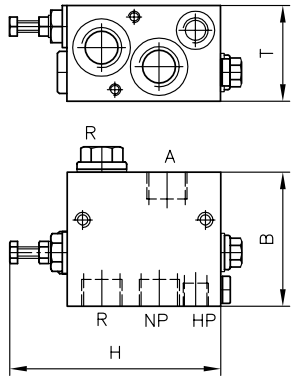
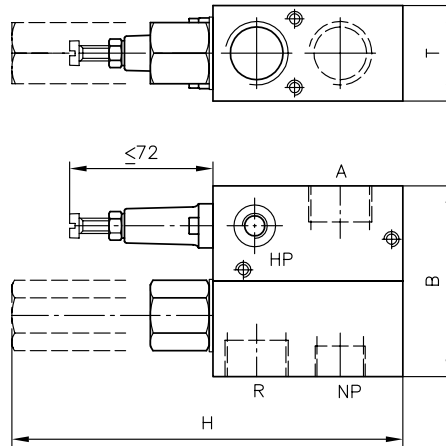
Basic type NE 20, 70 and 80

### Additional versions:

- Direct mounting at hydraulic power packs type MP and RZ
- Valve banks type BV can be directly mounted (type NE 21)

### Function



**General parameters and dimensions**
**NE 20**

**NE 70, NE 80**


	$Q_{\max}$ [lpm]		$p_{\max}$ [bar]		Ports (BSPP)			Dimensions [mm]			m [kg]
	HD	ND	HD	ND	A, R	HP	NP	H	B	T	
<b>NE 20</b>	10	40	20 ... 700	16 ... 80	G 1/2	G 1/4	G 1/2	110	70	50	2.1
<b>NE 70</b>	16	100	(0) ... 500	(0) ... 60	G 1	G 1/4	G 3/4	131	100	50	3.4
<b>NE 80</b>	25	180	(0) ... 500	(0) ... 30	G 1 1/4	G 3/8	G 1	259	120	60	7.0

**Associated technical data sheets:**

- Two-stage valve type NE: [D 7161](#)

**Pumps:**

- Compact hydraulic power packs type MP, MPN, MPW, MPNW: [Page 54](#)
- Dual-stage pump type RZ: [Page 62](#)

**Similar products:**

- Idle circulation valves type CNE: [Page 196](#)
- (Press) switch units type CR: [Page 154](#)
- Directional seated valves type VB: [Page 130](#)

# Pressure valves

## 2.3 Shut-off valve type LV and ALZ

Shut-off valves or accumulator charging valves are a type of pressure control valve. They switch the delivery flow of a pump to unpressurised circulation if the pressure value set is reached. During this process the consumer side is separated from the idle circulation by a zero-leakage check valve. If the pressure drops in the consumer side, the idle circulation is interrupted and the oil fed to the consumer again.

### Features and benefits:

- Various adjustment options
- Various additional functions

### Intended applications:

- General hydraulic systems
- Test benches



<b>Nomenclature:</b>	Shut-off valve (idle circulation valve, direct controlled or piloted)
<b>Design:</b>	Individual valve for pipe connection Individual valve Manifold mounting
<b>Adjustment:</b>	Fixed manually adjustable
<b>p<sub>max</sub>:</b>	350 bar
<b>Q<sub>max</sub>:</b>	120 lpm

### Design and order coding example

LV 10 P	D	- 180
ALZ 3 G	CR	- 250

#### Pressure setting [bar]

- Pressure range
- Fixed (-)
  - Manually adjustable (R)

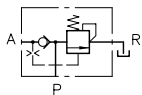
#### Basic type, size, design

- Type LV, size 10, 20, 25
- Pipe connection (-)
  - Manifold mounting (P)
  - Design with low switching hysteresis (type LV 25)
- Type ALZ, size 3 to 5
- Pipe connection (G)
  - Manifold mounting (P)

### Function

#### LV, ALZ

For pipe connection:



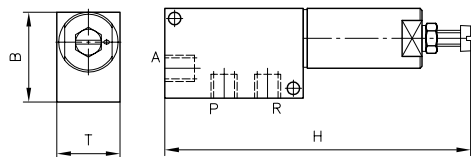
Manifold mounting valve:





## General parameters and dimensions

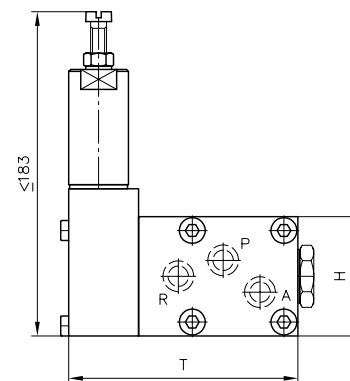
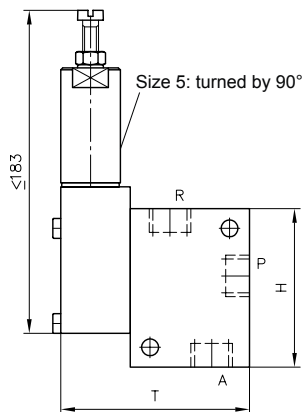
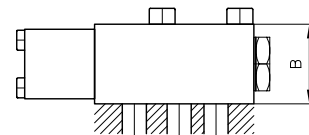
LV..



ALZ..G..



ALZ..P..



	Control	$Q_{max}$ [lpm]	Pressure range: $p_{max}$ [bar]	Ports (BSPP) <sup>1)</sup>	Dimensions [mm]			m [kg]
					H	B	T	
LV 10	Direct	12	F: 60 E: 140 D: 240 C: 350	G 1/4	155	45	32	0.9
LV 20, LV 25		25	F: 80 E: 140 D: 220 C: 350	G 3/8	205	50	32	1.2
ALZ 3 G	Piloted	50	F: 60 E: 140 D: 240 C: 350	G 1/2	80	40	99	2.0
ALZ 4 G				G 3/4	94	40	109	2.4
ALZ 5 G				G 1	105	63	135	4.3
ALZ 4 P		80	G 3/4	60	40	119	2.1	
ALZ 5 P			120	G 1	80	40	133	4.3

1) For pipe connection versions only

### Associated technical data sheets:

- [Shut-off valve type LV: D 7529](#)
- [Shut-off valve type ALZ: D 6170 ALZ](#)
- [Pressure valve with check valve type AL, AE and AS: D 6170](#)

### Similar products:

- Release valves type AE: [Page 174](#)
- Connection blocks type AL: [Page 68](#)

# Pressure valves

## 2.3 Pressure-dependent shut-off valve type DSV and CDSV

Pressure-dependent shut-off valves are a type of pressure control valve. When a set pressure value is reached and exceeded, they block the flow to consumer line B with zero leakage. The valves will open again if the pressure on inflow side A falls below the set value defined by the spring tension.

The pressure-dependent shut-off valve type DSV and CDSV is used as a safeguard pressure gauge, for example.

### Features and benefits:

- Various adjustment options
- Various additional functions

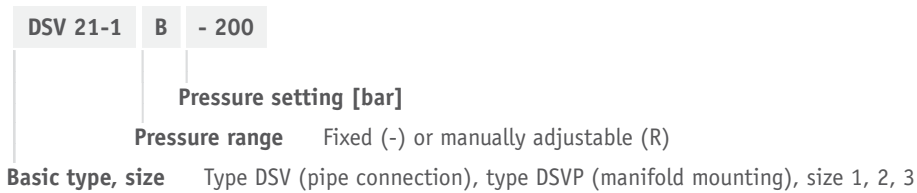
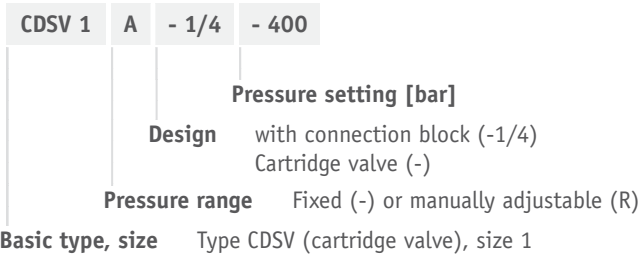
### Intended applications:

- General hydraulic systems
- Test benches
- (Pressure gauge) protection valve



<b>Nomenclature:</b>	Shut-off valve
<b>Design:</b>	Individual valve for pipe connection Manifold mounting Screw-in valve
<b>Adjustment:</b>	Fixed manually adjustable
<b>p<sub>max</sub>:</b>	600 bar
<b>Q<sub>max</sub>:</b>	60 lpm

### Design and order coding example



**Function**

**CDSV 1, DSV 2**



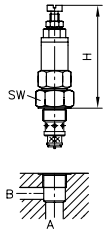
**DSVP 2**



**General parameters and dimensions**

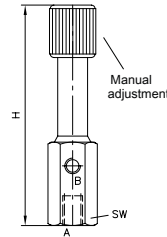
**CDSV 1**

Screw-in valve



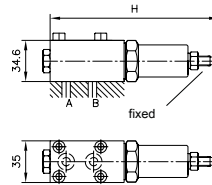
**DSV 2-2**

Version for pipe connection



**DSVP 21-1**

Manifold mounting valve



	Design	Size	Q <sub>max</sub> [lpm]	p <sub>max</sub> [bar]	Ports (BSPP)	H <sub>max</sub> [mm]	SW = a/f	m [kg]
<b>CDSV 1</b>	Screw-in valve	1	10	C: 120 B: 350 A: 600	M 16 x 1.5	69	SW 22	0.13
<b>DSV 2<sup>1)</sup></b>	Version for pipe connection	1	20	D: 40 C: 100 B: 220 A: 600	G 1/4	185	SW 36	0.7
		2	40	D: 20 C: 60 B: 120 A: 400	G 3/8	193	SW 36	0.9
		3	60	D: 20 C: 60 B: 120 A: 400	G 1/2	193	SW 46	1.1
<b>DSVP 2<sup>1)</sup></b>	Manifold mounting valve	1	20	D: 40 C: 100 B: 220 A: 600	G 1/4	181	-	1.1

1) Manifold mounting valve only in size 1

**Associated technical data sheets:**

- [Pressure-dependent shut-off valve type DSV: D 3990](#)
- [Pressure-dependent shut-off valve type CDSV: D 7876](#)

# Pressure valves

## 2.3 Load-holding valve type LHK, LHDV and LHT

Load-holding valves are a type of pressure control valve. They prevent loads on cylinders or motors dropping in an uncontrolled manner. For this purpose they are pre-loaded with a pressure setting that is higher than the largest possible load. A hydraulic piston controls the opening of the valve to achieve the required lowering velocity.

The load-holding valve type LHK and LHT is suitable for applications without a tendency to large fluctuations. The load-holding valve type LHDV has special damping properties. It is used particularly in conjunction with proportional directional spool valves, e.g. type PSL and PSV.

Shock valves and shuttle valves with or without restrictor check valves can be fitted in the load-holding valve type LHK, LHDV and LHT, e.g. to relieve hydraulic brakes with a delay.

### Features and benefits:

- Operating pressures up to 420 bar
- Various adjustment options
- Various configurations

### Intended applications:

- Cranes
- Construction machinery
- Lifting devices



<b>Nomenclature:</b>	Load holding valve (over center valve, for one sided or alternating load direction) Single or twin valve
<b>Design:</b>	Individual or twin valve for pipe connection Individual or twin manifold mounting valve Screw-in valve Version for banjo bolt mounting
<b>p<sub>max</sub>:</b>	450 bar
<b>Q<sub>max</sub>:</b>	250 lpm

### Design and order coding example

LHK44 G - 11 - 160

Pressure setting load-holding pressure [bar]

Design Various housing designs available

Dampening Without/with, or with restrictor check valve

Basic type, size Type LHK (valve only, without shock valve), size 2 to 4

### Additional versions:

- Some available with release ratio 1 : 2 and 1 : 7
- Version available as assembly kit

LHDV33 - 25WD - B 6 -200/200-240/240

**Pressure setting [bar]** Load-holding pressure/load-holding pressure - shock valve pressure/shock valve pressure

**Nozzle** Release ratio may be altered with different orifice combinations in the range between 1 : 1.2 and 1 : 8.9

**volumetric flow**

- Additional elements**
- With shock- and suction valves
  - With shuttle valves for brakes
  - With restrictor check valve

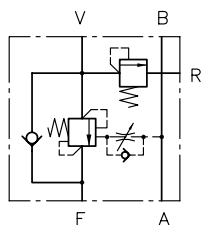
**Basic type, size** Type LHDV (with tailored dampening characteristics), size 3  
Type LHT, size 2, 3 and 5

**Additional versions:**

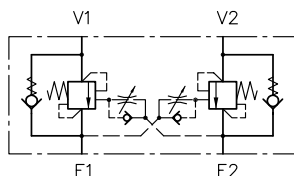
- Cartridge valve versions
- Type LHT
- Type LHTE, with discharge pressure compensation

**Function**

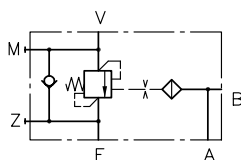
**LHK 33 G-15-...**



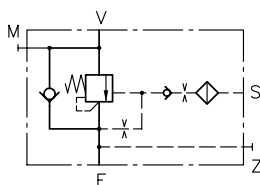
**LHK 44 G-21-...**



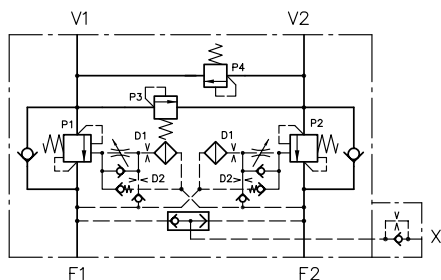
**LHT 21 H-14-...**



**LHT 33 P-11-...**



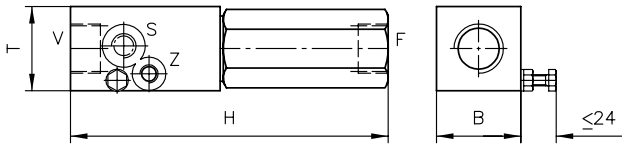
**LHDV 33 G-25WD-...**



## General parameters and dimensions

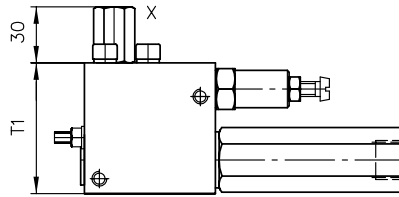
### LHK 44 G - 11 - 160

Individual valve



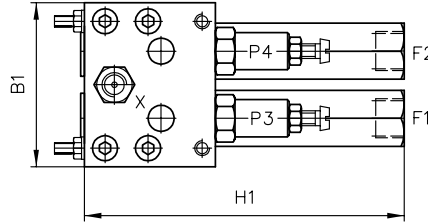
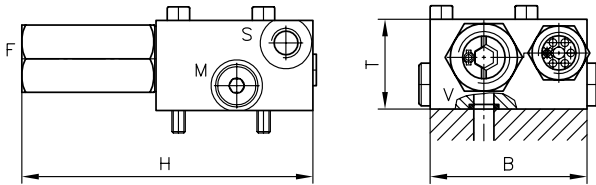
### LHDV 33 - 25 WD - B 6 - 200/200 - 240/240

Twin valve



### LHT 33 P - 15

Individual valve



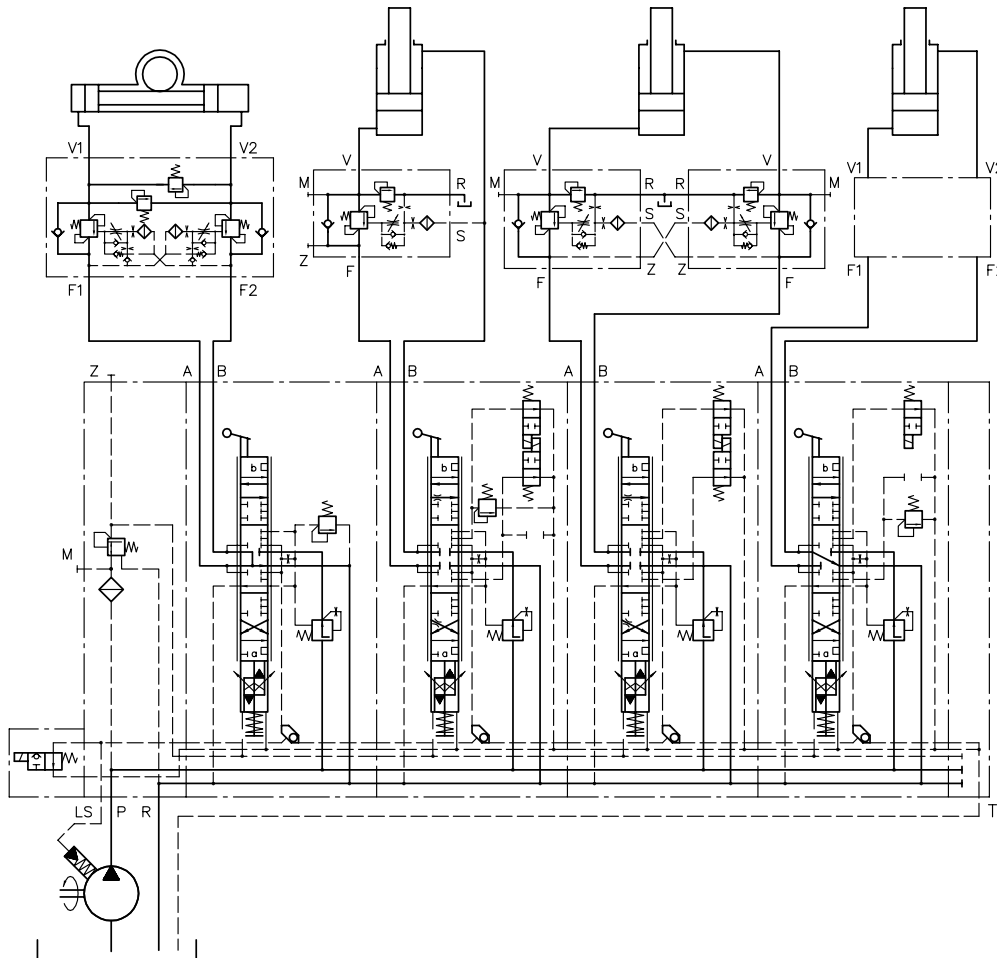
	Design	$Q_{max}$ [lpm]	$p_{max}$ [bar]	Release ratio	Ports (BSPP)	Dimensions [mm]			m [kg]
						H/H1	B/B1	T/T1	
LHK 22	Individual valve	20	400	1 : 4.6	G 3/8	97	32	32	0.5
	Twin valve <sup>2)</sup>					98	60	30	2.7
LHK 33	Individual valve	60	360	1 : 4.4	G 1/2	123	40	40	1.0
	Twin valve <sup>2)</sup>					125...291	80	40...60	2.7
LHK 44	Individual valve	100	350	1 : 4.4	G 3/4	170	45	45	1.6
	Twin valve <sup>2)</sup>					170	90	50	3.5
LHDV 33	Individual valve <sup>2)</sup>	80	420	1 : 8...1 : 1.2 <sup>1)</sup>	G 1/2	170	50	40	1.8
	Twin valve					170	88	70	4.7
LHT 2	Individual valve	25	400	1 : 8, 1 : 4	G 1/4	132	40	24.8	1.2
	Twin valve					132	50	24.8	0.8
LHT 3	Individual valve <sup>2)</sup>	130	450	1 : 7...1 : 0.53 <sup>1)</sup>	G 1/2	128	70	40	1.6
LHT 5	Individual valve <sup>2)</sup>	250	450	1 : 6...1 : 0.79 <sup>1)</sup>	G 1	113	50	50	1.0

1) Release ratio can be altered simply by changing the orifice

2) Note: Design may be significantly different to the illustrated version!

**Example circuit:**

LHDV 33-25-D6-180/180-200/200  
 LHDV 33 P-15-D6-280/300  
 LHDV 33 P-15-D6-280/300  
 LHK 33 G-21-... acc. to D 7100



**Associated technical data sheets:**

- [Load-holding valve type LHK: D 7100](#)
- [Load-holding valve type LHDV: D 7770](#)
- [Load-holding valve type LHT: D 7918](#)

**Additional integrable functions:**

- Proportional directional valves type PSL, PSV, PSLF: [Page 106](#)
- Proportional directional valves type PSLF, PSVF: [Page 112](#)

## 2.4 Flow valves

Flow control valve type SF, SD and SK	212
Flow control valve (lowering brake valve) type SB, SQ, SJ and DSJ	216
Proportional flow control valve type SE and SEH	218
Flow divider type TQ	222
Priority valve type PV	224
Restrictors and restrictor check valve type EB, BE, BC	226
Throttle valve type Q, QR, QV and FG	228
Throttle valve type ED, restrictor check valve type RD and RDF	230
Throttle valve and restrictor check valve type CQ, CQR and CQV	232
Throttle valve and shut-off valve type AV, AVT and CAV	234



*Flow control valves*

*with electro-proportional  
actuation type SE and SEH*



*Throttles  
type Q, QR, QV and FG*



### Flow control valves

Type	Nomenclature/Design	Adjustability	$p_{\max}$ (bar)	$Q_{\max}$ (lpm)
SF, SD, SK	<b>2-way and 3-way flow control valve</b> <ul style="list-style-type: none"> <li>▪ Individual valve for pipe connection</li> <li>▪ Manifold mounting valve</li> </ul>	- Mechanical	SD - 3: 320 SD - 4: 320 SD - 5: 320  SF - 3: 320 SF - 4: 320 SF - 5: 320  SK - 3: 320 SK - 4: 320 SK - 5: 320	SD - 3: 60 SD - 4: 90 SD - 5: 130  SF - 3: 60 SF - 4: 90 SF - 5: 130  SK - 3: 60 SK - 4: 90 SK - 5: 130
SB, SQ, SJ, DSJ	<b>2-way metering valve, lowering brake valve</b> <ul style="list-style-type: none"> <li>▪ Cartridge valve</li> <li>▪ Version with housing for pipe connection</li> </ul>	- fixed	SB - 0: 315 SB - 1: 315 SB - 2: 315 SB - 3: 315 SB - 4: 315 SB - 5: 315  SQ - 0: 315 SQ - 1: 315 SQ - 2: 315 SQ - 3: 315  SJ - 0: 315  DSJ - 1: 315	SB - 0: 15 SB - 1: 35 SB - 2: 67 SB - 3: 150 SB - 4: 250 SB - 5: 400  SQ - 0: 15 SQ - 1: 25 SQ - 2: 67 SQ - 3: 150  SJ - 0: 15  DSJ - 1: 25
SE, SEH	<b>2-way and 3-way flow control valve</b> <ul style="list-style-type: none"> <li>▪ Individual valve for pipe connection</li> <li>▪ Manifold mounting valve</li> </ul>	- Electro-proportional	SE - 3: 320 SE - 4: 320  SEH - 2: 320 SEH - 3: 320 SEH - 4: 320 SEH - 5: 320	SE - 3: 50 SE - 4: 90  SEH - 2: 30 SEH - 3: 50 SEH - 4: 90 SEH - 5: 120

### Flow dividers

Type	Nomenclature/Design	Adjustability	$p_{\max}$ (bar)	$Q_{\max}$ (lpm)
TQ	<b>Flow dividers</b> <ul style="list-style-type: none"> <li>▪ Individual valve for pipe connection</li> <li>▪ Manifold mounting valve</li> </ul>	- Non-adjustable	TQ - 3: 350 TQ - 43: 350 TQ - 54: 350	TQ - 3: 70 TQ - 43: 120 TQ - 54: 200
PV	<b>Priority valve</b> <ul style="list-style-type: none"> <li>▪ Single valve for pump installation</li> </ul>		PV - 5: 250	PV - 5: 120

## Orifices, restrictor check valves

Type	Nomenclature/Design	$p_{\max}$ (bar)	$Q_{\max}$ (lpm)
EB, BE, BC	<b>Orifice, restrictor check valve</b> <ul style="list-style-type: none"> <li>▪ Plug-in valve</li> <li>▪ Screw-in valves</li> <li>▪ Version with housing for pipe connection</li> </ul>	EB - 0: 500	EB - 0: 6
		EB - 1: 500	EB - 1: 12
		EB - 2: 500	EB - 2: 40
		EB - 3: 500	EB - 3: 100
		EB - 4: 500	EB - 4: 120
		BE - 0: 500	BE - 0: 12
		BE - 1: 500	BE - 1: 25
		BE - 2: 500	BE - 2: 40
		BE - 3: 500	BE - 3: 80
		BE - 4: 500	BE - 4: 120
		BC - 1: 700	BC - 1: 20
		BC - 2: 700	BC - 2: 35
		BC - 3: 500	BC - 3: 60

## Throttles and throttle shut-off valves

Type	Nomenclature/Design	Adjustability	p <sub>max</sub> (bar)	Q <sub>max</sub> (lpm)
Q, QR, QV, FG	<b>Throttle, restrictor check valve</b> <ul style="list-style-type: none"> <li>▪ Screw-in valve</li> <li>▪ Individual valve for pipe connection</li> <li>Angle valve</li> <li>Banjo bolt</li> <li>Swivel fitting</li> </ul>	- fixed	Q - 20: 400 Q - 30: 400 Q - 40: 400 Q - 50: 400 Q - 60: 315  QR - 20: 400 QR - 30: 400 QR - 40: 400 QR - 50: 400 QR - 60: 315  QV - 20: 400 QV - 30: 400 QV - 40: 400 QV - 50: 400 QV - 60: 315  FG: 320	Q - 20: 12 Q - 30: 20 Q - 40: 40 Q - 50: 60 Q - 60: 80  QR - 20: 12 QR - 30: 20 QR - 40: 40 QR - 50: 60 QR - 60: 80  QV - 20: 8 QV - 30: 12 QV - 40: 20 QV - 50: 30 QV - 60: 50  FG: 0.8
ED, RD, RDF	<b>Throttle, restrictor check valve</b> <ul style="list-style-type: none"> <li>▪ Individual valve for pipe connection</li> </ul>	- With tool, fixed - Manually adjustable	ED - 11: 500 ED - 21: 500 ED - 31: 500 ED - 41: 500 ED - 51: 500  RD - 11: 500 RD - 21: 500 RD - 31: 500 RD - 41: 500 RD - 51: 500  RDF - 11: 500 RDF - 21: 500 RDF - 31: 500 RDF - 41: 500 RDF - 51: 500	ED - 11: 15 ED - 21: 35 ED - 31: 60 ED - 41: 100 ED - 51: 150  RD - 11: 15 RD - 21: 35 RD - 31: 60 RD - 41: 100 RD - 51: 150  RDF - 11: 15 RDF - 21: 35 RDF - 31: 60 RDF - 41: 100 RDF - 51: 150
CQ, CQR, CQV	<b>Throttle, restrictor check valve</b> <ul style="list-style-type: none"> <li>▪ Screw-in valve</li> </ul>	- fixed	CQ - 2: 700  CQR - 2: 700  CQV - 2: 700	CQ - 2: 50  CQR - 2: 50  CQV - 2: 50
AV, AVT, CAV	<b>Throttle and shut-off valve</b> <ul style="list-style-type: none"> <li>▪ Individual valve for pipe connection</li> <li>▪ Screw-in valve</li> </ul>	- fixed, fixed - Manually adjustable	AV - 2: 500 AV - 3: 400  CAV - 1: 500 CAV - 2: 500  AVT - 6: 630 AVT - 8: 630 AVT - 10: 630 AVT - 12: 630  AVM - 8: 500 AVM - 8L: 315	AV - 2: 40 AV - 3: 100  CAV - 1: 15 CAV - 2: 25

## 2.4 Flow control valve type SF, SD and SK

Flow control valves are a type of flow valve. They generate a set constant flow rate, largely independently of the load.

The flow control valve type SD, SF and SK can be freely adjusted with different mechanical actuations. The flow control valve type SD, SF and SK is available as a 2-way and 3-way flow control valve. For type SD, the adjustment is made using the adjusting knob; for type SF using the adjusting screw; and for type SK using the roller actuation. The flow control valve type SD, SF and SK is available as a single valve for pipe connection or as a manifold mounting valve.

Pressure-limiting valves and randomly switchable idle circulation valves are additional options. The flow control valve type SD, SF and SK controls the operating speed of the hydraulic consumers.

### Features and benefits:

- Various actuation types
- Can also be combined with bypass check valves
- Precise setting

### Intended applications:

- Construction machinery
- Machine tools
- General hydraulic systems



<b>Nomenclature:</b>	2-way flow control valve 3-way flow control valve
<b>Design:</b>	Individual valves for pipe mounting Manifold mounting
<b>Adjustment:</b>	Mechanical <ul style="list-style-type: none"><li>▪ Adjusting knob</li><li>▪ Roller actuation</li><li>▪ Setting screw</li></ul>
<b>p<sub>max</sub>:</b>	315 bar
<b>Q<sub>max</sub>:</b>	6 ... 130 lpm

## Design and order coding example

SF 3 - 3 /15 - S - G24 - 120

Pressure setting [bar] of the pressure limiting valve (S)

Solenoid voltage G 12, G 24, WG 110 and WG 230

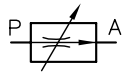
- Mounting and add. valve
- Pipe connection (no coding)
  - Manifold mounting (P)
  - Valve with bypass check valve (R, PR)
  - Check valve bridge circuit (B)
  - Pressure-limiting valve (S)
  - Pressure-limiting and circulation valve (S-WN1F, S-WN1D)

volumetric flow Flow steps via orifices  $Q_{max}$  : 3, 6, 15, 36, 50, 60, 70, 90, 130 lpm

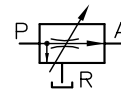
- Basic type, design, size
- Type SF, with lock nut, fixed adjustment
  - Type SD, with adjusting knob actuation
  - Type SK, with roller actuation (open version)
  - Type SKR, with roller actuation (closed version, not for manifold mounting)
  - Version as 2-way (-2) and 3-way (3) flow control valves
  - Size 3 to 5

## Function

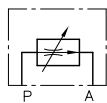
2-way, pipe connection



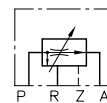
3-way



2-way, manifold mounting valve



3-way



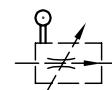
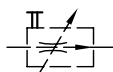
## Actuation:

SF ...

SD ...

SK ...

SKR ...



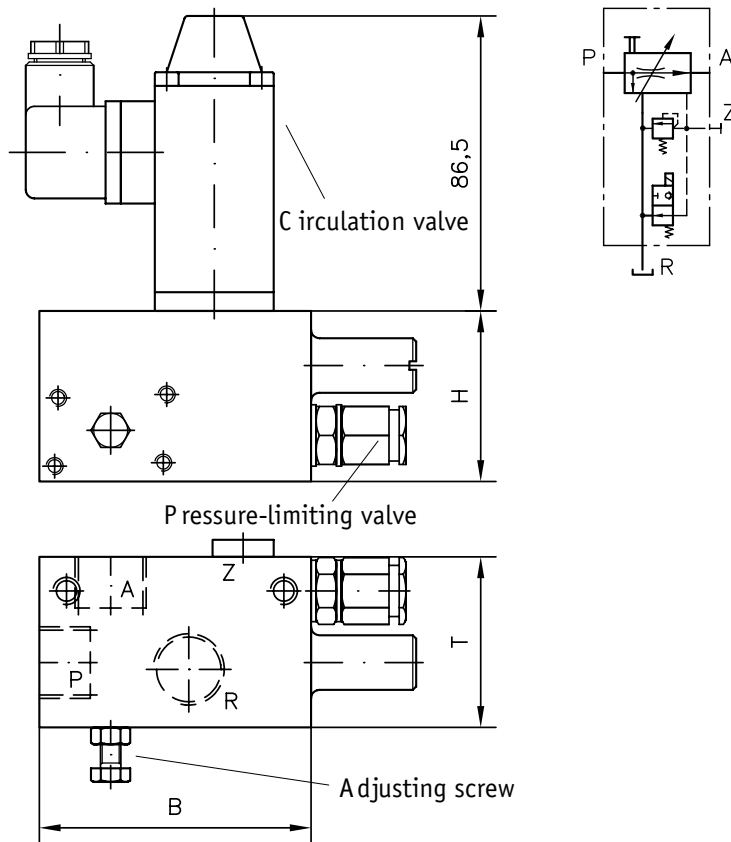
Set screw SW 10  
adjustment travel 5 mm

Adjusting knob,  
adjustment travel  
3.8 turns

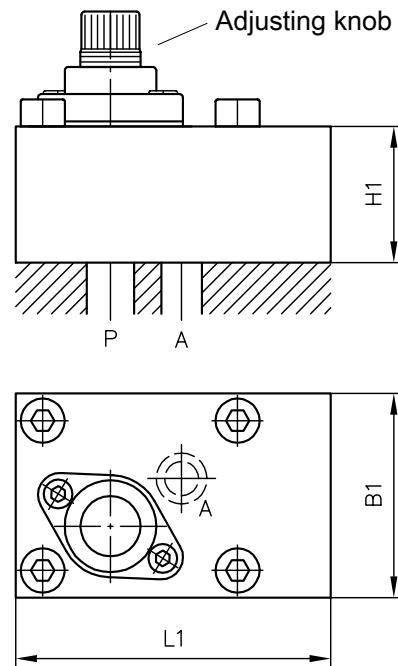
Roller actuation  
Unshielded version (SK), Shielded version (SKR)  
Actuation travel 15,5 ... 17 mm,  
Actuation force 30 ... 70 N

## General parameters and dimensions

### Version for pipe connection



### Manifold mounting valve

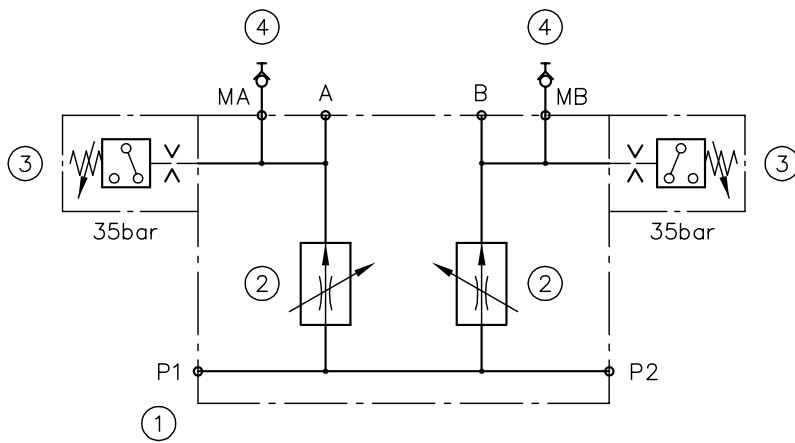


2-way	3-way	Q <sub>max</sub> [lpm] <sup>1)</sup>	Ports (BSPP) <sup>2)</sup>	Dimensions [mm]						m [kg] <sup>3)</sup>
				H	H1	L	L1	B	B1	
S. 2-3		0,3 ... 60	G 1/2	50	40	80	93	50	60	1,4 ... 2,1
	S. 3-3			50	40	80	93	50	60	1,4 ... 2,1
S. 2-4		0,3 ... 90	G 3/4	60	50	85	100	60	70	2
	S. 3-4			60	50	85	100	60	70	2,0 ... 2,6
S. 2-5		1,0 ... 130	G 1	70	50	100	106	70	80	3,1
	S. 3-5			70	50	100	106	70	80	2,8 ... 3,7

- 1) Different Q<sub>max</sub> available, see Design and order coding example: "Orifice steps"
- 2) For pipe connection versions
- 3) Depending on actuators

Circuit example

Position	Number	Designation
4	2	SMK 20-G 1/4-PC
3	2	DG 364-35
2	2	SD 2-3/6P
1	1	20,201 H 00



**Associated technical data sheets:**

- [Flow control valve type SF, SD and SK: D 6233](#)

**Similar products:**

- Drop-rate braking valves type SB, SQ: [Page 216](#)
- Prop. flow control valves type SE, SEH: [Page 218](#)

**Male connectors:**

- [Line connector type MSD and others: D 7163](#)

# Flow valves

## 2.4

## Flow control valve (lowering brake valve) type SB, SQ, SJ and DSJ

Flow control valves are a type of flow valve. They generate a set constant flow rate, largely independently of the load.

The flow control valve type SB and SQ is available as a screw-in cartridge, a housing version with pipe connection or as a banjo screw version. Type SB has a slightly inclined characteristic curve for oscillation damping. Type SQ is largely independent of the load.

The freely movable sliding metering orifice enables greater flow in the opposite flow direction. No bypass check valve is therefore required. The flow control valve type SB and SQ is used to control the lowering speed of single-acting consumers.

### Features and benefits:

- Oscillation damping and load-independent
- Compact screw-in valve

### Intended applications:

- General hydraulic systems
- Industrial trucks
- Lifting equipment



<b>Nomenclature:</b>	2-way flow control valve (drop rate braking valve)
<b>Design:</b>	Screw-in type with housing for in-line installation
<b>Adjustment:</b>	Fixed (pre-set) Tool adjustable from outside
<b>p<sub>max</sub>:</b>	315 bar
<b>Q<sub>max</sub>:</b>	0,25 ... 400 lpm

### Design and order coding example

SB 2 1 C - 30

**Response flow [l/min]** Desired factory set response flow within the respective range

- Design** Adjustable or non adjustable version
- Screw-in version (C)
  - Version with housing for pipe mounting (E, F, G)

### Additional versions

- With metric or UNF-thread
- With thread adaptor
- As banjo bolt and/or with swiveling screw fitting

**Adjustment range** Adjustable response flow

**Basic type, size** Type SB, SQ and SJ, size  
Type DSJ, flow control function in both directions for double-acting consumers



**Function**

SB, SQ



SJ

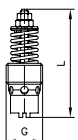


DSJ

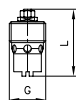

**General parameters and dimensions**

Screw-in valve ...C

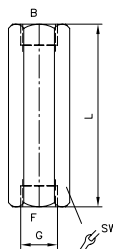
SB, SQ



SJ



With housing...G



Coding for adjustment range of the set response flow from ... to ... [lpm] below

Ports (BSPP)

Dimensions [mm]

m [g]

	Coding for adjustment range of the set response flow from ... to ... [lpm] below						Ports (BSPP)	Dimensions [mm]			m [g]
	1	3	5	7	9	90		L	L1 <sub>max</sub>	SW = a/f	
SB 0	1...1.6	1.6...2.5	2.5...4	4...6.3	6.3...10	10...15	G 1/4 (A)	39	78	19	13
SJ 0 <sup>1)</sup>								24	-	-	35
SB 1	2.5...4	4...6.3	6.3...10	10...16	16...25	25...35	G 3/8 (A)	43	82	22	23
SQ 1											
SB 2	16...21	21...28	28...37	37...50	50...67 <sup>2)</sup>	-	G 1/2 (A)	49	96	27	40
SQ 2											
SB 3	37...50	50...67	67...90	90...120	120...150 <sup>2)</sup>	-	G 3/4 (A)	61	106	32	80
SQ 3											
SB 4	80...100	100...125	125...160	160...200	200...250	-	G 1 (A)	78	145	41	150
SB 5	170...200	200...236	236...280	280...335	335...400	-		G 1 1/4 (A)	94	160	50
DSJ 1	1.0...21.0						G 3/8 (A)	39	78	19	30

1) Type SJ 0 without coding: adjust. range 0.25 ... 1.2 l/min

2) Not for type SQ..

**Associated technical data sheets:**

- [Flow control valve \(lowering brake valve\) type SB and SQ: D 6920](#)
- [Flow control valve type SJ - Screw-in valve: D 7395](#)
- [Flow control valve type CSJ: D 7736](#)
- [Flow control valve type DSJ: D 7825](#)

# Flow valves

## 2.4 Proportional flow control valve type SE and SEH

Proportional flow control valves are a type of flow valve. They generate a constant flow rate independent of the load which can be controlled in an electro-proportional and remote way.

The flow control valve type SE has a directly actuated metering orifice, which has an advantage of approximately  $Q_{min}$  equal to zero in terms of the controllability. The flow control valve type SEH has a piloted metering orifice which is shown to be beneficial in dynamic systems with short reaction times. The flow control valve type SE and SEH is available as a single valve for pipe connection or as a manifold mounting valve. Pressure-limiting valves and randomly switchable idle circulation valves are additional options. The flow control valve type SE and SEH controls the operating speed of hydraulic consumers.

### Features and benefits:

- Electrical control of consumer operating speeds
- Automation of operating cycles

### Intended applications:

- Construction machines
- Machine tools
- General hydraulic systems
- Mining machinery



<b>Nomenclature:</b>	2-way flow control valve 3-way flow control valve
<b>Design:</b>	Individual valve for pipe mounting or Screw-in valve
<b>Adjustment:</b>	Electro-proportional
<b><math>p_{max}</math>:</b>	315 bar
<b><math>Q_{max}</math>:</b>	0,1 ... 120 lpm

### Design and order coding example

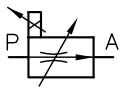
SE 2-3 /30F - P - G24

- Solenoid voltage** Prop. solenoid
  - 12 V DC, 24 V DC
  - Controls via prop. amplifier or PLVC
- Design and port size**
  - Pipe connection
  - Manifold mounting (P)
- Flow [lpm]** Nom. flow of the metering orifice
  - Deenergized open
  - Deenergized closed (coding F)

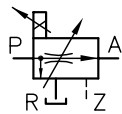
Orifice steps  $Q_{max}$  : 3, 6, 10, 15, 22, 30, 36, 50, 70, 90, 120 lpm
- Basic type, size** Type SE, with non-piloted metering orifice, size 3, 4  
Type SEH, with piloted metering orifice, size 2 to 5
  - Available as 2- and 3-way flow control valve

SE, SEH

2-way  
Pipe connection

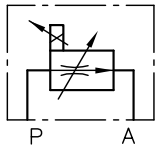


3-way  
Pipe connection

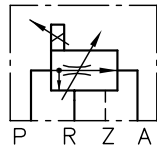


1)

2-way  
Manifold mounting valve



3-way  
Manifold mounting valve



1) No Z port with type SEH 3-2

**Additional functions for flow control valves:**

**2-way flow control valve**

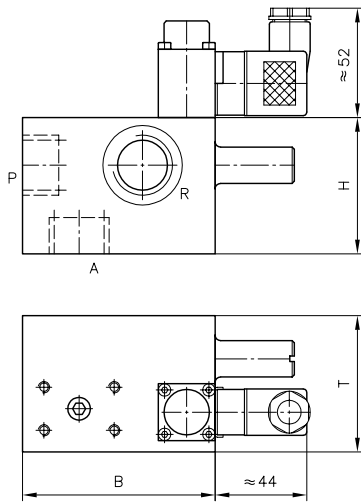
- Version with bypass check valve
- Version with check valve in bridge circuit for free selection of the flow direction

**3-way flow control valve**

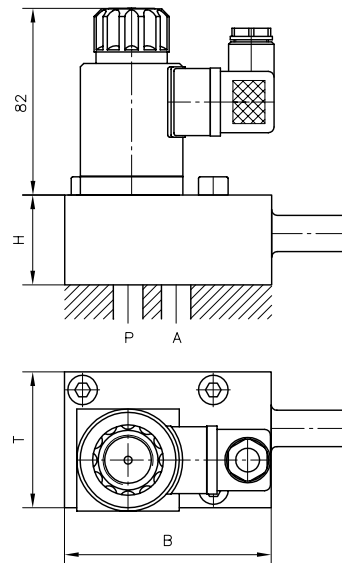
- Version with pressure-limiting valve
- Version with pressure-limiting valve and circulation valve (for pipe connection versions only)
- Version with compulsory closed position of the pressure compensator when not actuated type ...FO
- Version with automatic circulation type ...B 0.6

## General parameters and dimensions

### SEH Version for pipe connection



### SE Manifold mounting valve

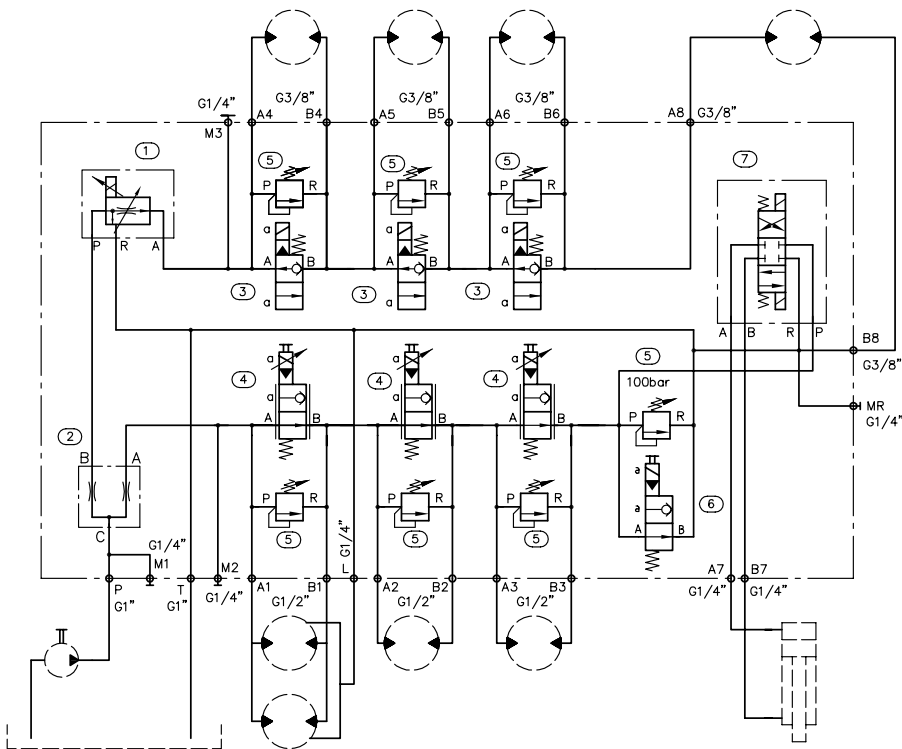


Basic type and size			Q <sub>max</sub> [lpm] <sup>1)</sup>	p <sub>max</sub> [bar]	Ports (BSPP) <sup>2)</sup>	Dimensions [mm]			m <sub>max</sub> [kg]
2-way	3-way					H	B	T	
SE 2-3	SE 3-3	Directly actuated	0,3 ... 50	315	G 1/2	110 ... 120	80 ... 91	50 ... 60	2,2
SE 2-4	SE 3-4		0,6 ... 90	315	G 3/4	120 ... 130	85 ... 100	60 ... 70	2,2
SEH 2-2	SEH 3-2	Hydraulically piloted	0,1 ... 36	315	G 3/8	115	55 ... 70	39	1,6 ... 3,3
SEH 2-3 <sup>3)</sup>	SEH 3-3		0,3 ... 50	315	G 1/2	92,5	80 ... 93	50 ... 60	1,6 ... 3,3
-	SEH 3-4		0,6 ... 90	315	G 3/4	102,5	95 ... 100	60 ... 70	1,6 ... 3,3
-	SEH 3-5		1,0 ... 120	315	G 1	112,5	100	70	1,6 ... 3,3

- 1) Different Q<sub>max</sub> available, see Design and order coding example: "Orifice steps"
- 2) For pipe connection versions
- 3) For manifold mounting versions only

**Circuit example**

- ① SEHD 3-3/30 FP-X 24
- ② TQ 4 P-A 5/2
- ③ EM 31 V-X24
- ④ EMP 31 S-X 24
- ⑤ MVH 6 C
- ⑥ EM 31 S-X24
- ⑦ SWPN 2-G-X24



**Associated technical data sheets:**

- [Proportional flow control valve type SE and SEH: D 7557/1](#)

**Similar products:**

- Flow control valves type SD and others: [Page 212](#)

**Additional electrical components:**

- Proportional amplifier: [Page 278](#)
- Programmable logic valve control type PLVC: [Page 280](#)
- CAN node type CAN-IO: [Page 282](#)
- Other electronic accessories [See "Electronics"](#)

# Flow valves

## 2.4 Flow divider type TQ

Flow dividers are a type of metering valve. They divide or add together a total flow rate either evenly or using a fixed ratio. The consumer pressures have no effect. The flow divider type TQ is, due to its simple design, an economical solution for simple dividing tasks, e.g. if two hydraulic consumers with varying loads supplied from one pump are to be moved simultaneously without interaction. Intended applications include mobile hydraulics and industrial hydraulics.

### Features and benefits:

- Excellent dividing accuracy

### Intended applications:

- Steering systems
- Synchronous cylinders



<b>Nomenclature:</b>	Flow dividers
<b>Design:</b>	Individual valve for pipe mounting Manifold mounting
<b>Adjustment:</b>	Non-adjustable
<b>p<sub>max</sub>:</b>	300 ... 350 bar
<b>Q<sub>max</sub>:</b>	7,5 ... 200 lpm (nom. total flow)

### Design and order coding example

TQ 32	- A	- 2,0 - 3
-------	-----	--------------

#### Coding Flow indicator

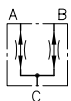
**Design** (A – equal division ratio)

- Basic type, size**
- Pipe connection (no coding)
  - Manifold mounting (P)
- Type TQ, size 2 to 5

### Function

#### TQ

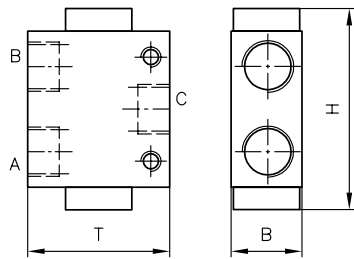
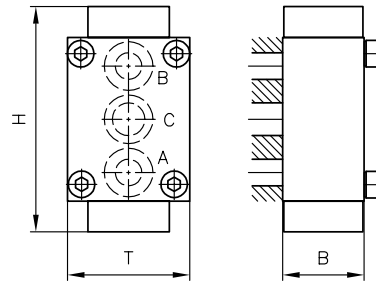
Pipe connection



#### TQ.P

Manifold mounting valve



**General parameters and dimensions**
**TQ...**  
 Pipe mounting

**TQ .P**  
 Manifold mounting


	$Q_{max}$ [lpm]	$p_{max}$ [bar]	Ports (BSPP) <sup>1)</sup>			Dimensions [mm]			m [kg]
			A	B	C	H	B	T	
<b>TQ 2..</b>	7.5 ... 70	350	G 1/4, G 3/8	G 1/4, G 3/8	G 3/8	79	30	50	0.6
<b>TQ 3..</b>	7.5 ... 70	350	G 3/8, G 1/2	G 3/8, G 1/2	G 1/2	85	30	60	0.6 ... 0.7
<b>TQ 3P</b>	7.5 ... 70	350	-	-	-	79	30	50	0.7
<b>TQ 4</b>	80 ... 120	350	G 1/2	G 1/2	G 3/4	110	40	60	1.5
<b>TQ 4P</b>	80 ... 120	350	-	-	-	110	40	60	1.6
<b>TQ 5</b>	140 ... 200	350	G 3/4	G 3/4	G 1	134	50	80	3.0
<b>TQ 5P</b>	140 ... 200	350	-	-	-	134	50	80	3.1

1) For pipe mounting versions only

**Associated technical data sheets:**

- [Flow divider type TQ: D 7381](#)

# Flow valves

## 2.4 Priority valve type PV

Priority valves are a type of metering valve. They ensure that particularly critical consumers are always adequately supplied with hydraulic oil.

The priority valve type PV divides the pump volumetric flow into two circuits. The one circuit has priority of supply, for example the steering on the vehicle. The other circuit receives the remaining volumetric flow.

The valve is suitable for mounting directly on the hydraulic pump.

### Features and benefits:

- Oscillation damping
- Compact mounted valve
- No additional pipework

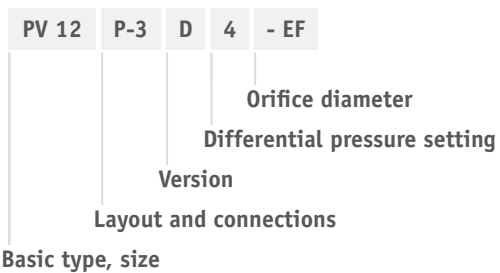
### Intended applications:

- Machines for forestry and agricultural purposes
- Industrial trucks
- Construction machines
- Municipal trucks

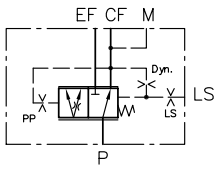
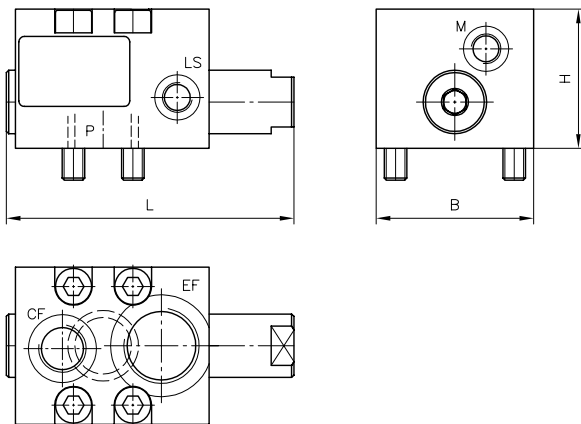


<b>Nomenclature:</b>	Priority valve
<b>Version:</b>	Single valve for pump installation
<b><math>p_{max}</math>:</b>	250 bar
<b><math>Q_{max}</math>:</b>	120 l/min

### Design and order coding example





**Function**

**General parameters and dimensions**
**Single valve**


	Ports				Dimensions [mm]		
	P	EF	CF	M, LS	L	B	H
<b>PV 12</b>	G 1	G 1	G 1/2	G 1/4	127	69,5	61,5

**Associated technical data sheets:**

- [Variable displacement axial piston pump type V30E: D 7960 E](#)
- [Variable displacement axial piston pump type V40M: D 7961](#)
- [Variable displacement axial piston pump type V60N: D 7960 N](#)
- [Fixed displacement axial piston pump type K60N: D 7960 K](#)
- [Proportional directional spool valve, type PSL and PSV size 2: D 7700-2](#)
- [Proportional directional spool valve, type PSL, PSM and PSV size 3: D 7700-3](#)

# Flow valves

## 2.4 Restrictors and restrictor check valve type EB, BE, BC

Restrictors are a type of flow valve. They are used as a local flow resistance that suddenly reduces the line cross-section. The reduction in the cross-section is very short. As a result the flow rate is only dependent on the pressure difference and not on the viscosity.

The restrictor check valve type BE and BC combines the function of a metering valve with a check valve. The valve is available as a perforated restrictor or as a slotted restrictor. It limits the volumetric flow during the switching of directional valves. E.g. it limits the volumetric flow or prevents excessively quick accumulator emptying.

The orifice insert type EB is primarily used in valves for manifold mounting. As such an additional intermediate plate is not necessary.

### Features and benefits:

- Max. 700 bar
- Simple design and installation

### Intended applications:

- General hydraulics
- Winch controls
- Hydraulic pilot systems



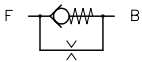
<b>Nomenclature:</b>	Orifice Restrictor check valve
<b>Design:</b>	Orifice insert Screw-in valve Version with housing for in-line installation
<b>p<sub>max</sub>:</b>	700 bar
<b>Q<sub>max</sub>:</b>	120 l/min

### Design and order coding example

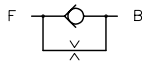
<b>BC1</b>	<b>- 0,8</b>	<b>G</b>
<b>Basic type, size</b>	<b>Orifice</b>	<b>Design with housing</b>
Type BC, size 1 to 3 Type BE, size 1 to 4 Type EB, size 0 to 4, Orifice insert	Hole or slot type orifice, diameter in mm	For pipe connection, type BC, BE (E; F, G)
<b>Additional versions</b>		
▪ Type BC and BE with metric thread		

### Function

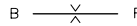
**BC**  
Screw-in valve

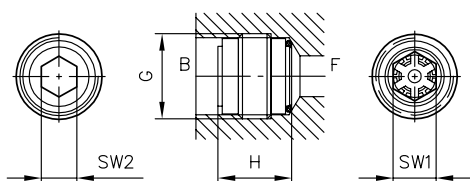
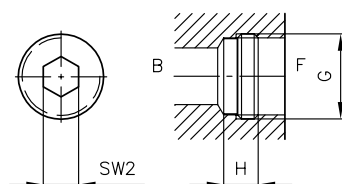
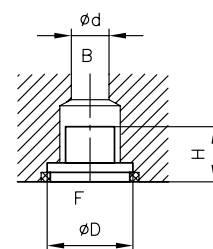


**BE**



**EB**  
Orifice insert



**General parameters and dimensions**
**BC..**  
 Screw-in valve

**BE ..**

**EB..**  
 Orifice insert


	$Q_{max}$ [l/min]	$p_{max}$ [bar]	Thread	Dimensions				m [g]
				H [mm]	G / D	SW = a/f 1/Æd	SW = a/f 2	
<b>BC 1</b>	20	700	G 1/4 A	13	G 1/4 A	SW 8	SW 4	6
<b>BC 2</b>	35	700	G 3/8 A	15	G 3/8 A	SW 9	SW 5	10
<b>BC 3</b>	60	500	G 1/2 A	18	G 1/2 A	SW 12	SW 8	24
<b>BE 0</b>	12	500	G 1/8 A	5	G 1/8 A	SW 4	-	2
<b>BE 1</b>	25	500	G 1/4 A	6	G 1/4 A	SW 5	-	4
<b>BE 2</b>	40	500	G 3/8 A	7	G 3/8 A	SW 8	-	6
<b>BE 3</b>	70	450	G 1/2 A	7.5	G 1/2 A	SW 10	-	10
<b>BE 4</b>	120	400	G 3/4 A	9	G 3/4 A	SW 12	-	18
<b>EB 0</b>	6	500	-	1.8	9	5.6	-	2
<b>EB 1</b>	10	700	-	1.8	11	7.5	-	4
<b>EB 2</b>	40	700	-	9	18	12.8	-	6
<b>EB 3</b>	100	500	-	11.5	22	16	-	10
<b>EB 4</b>	120	500	-	10	28	25	-	18

**Associated technical data sheets:**

- [Restrictor check valve type BC - Screw-in valve: D 6969 B](#)
- [Restrictor check valve type BE - Screw-in valve: D 7555 B](#)
- [Orifice type EB: D 6465](#)

**Similar products:**

- Insert check valves type RK, RB, RC, RE, ER: [Page 240](#)

- Restrictor check valves type RD, ED, RDF: [Page 230](#)

# Flow valves

## 2.4 Throttle valve type Q, QR, QV and FG

Throttle valves are a type of flow valve. They affect the flow rate for single and double-acting consumers.

The throttle valve type Q and the restrictor check valve type QR and QV are, as slotted throttles, insensitive to micro contamination.

The valve type Q, QR, QV and FG can be integrated into control blocks or into the pipework as a banjo screw version.

**Features and benefits:**

- Different installation options
- Simple design

**Intended applications:**

- General hydraulic systems



<b>Nomenclature:</b>	Throttle Restrictor check valves
<b>Design:</b>	Cartridge Individual valve for pipe mounting <ul style="list-style-type: none"> <li>▪ Corner housing</li> <li>▪ Banjo bolt</li> <li>▪ Swivel fitting</li> </ul>
<b>Adjustment:</b>	Tool adjustable
<b>p<sub>max</sub>:</b>	300 .... 400 bar
<b>Q<sub>max</sub>:</b>	0 ... 80 lpm

**Design and order coding example**

QR 20		
FG 1	- H 6	K

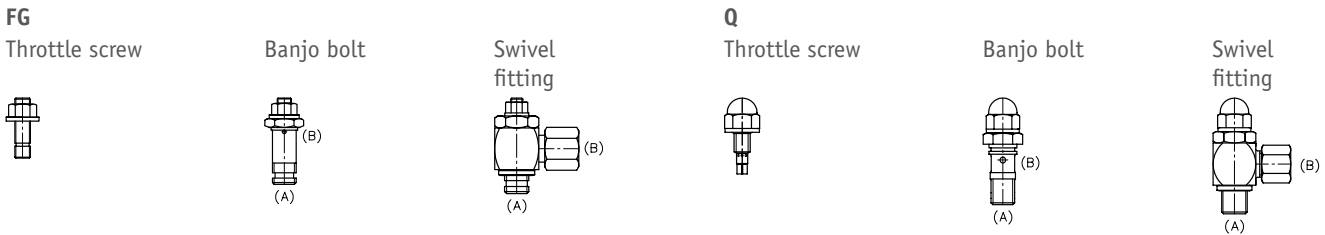
**Version with housing**

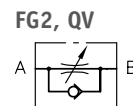
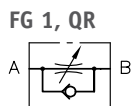
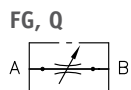
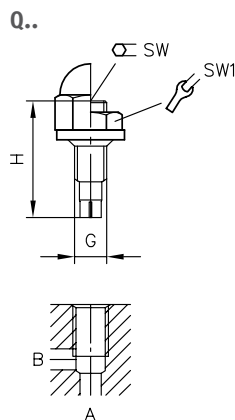
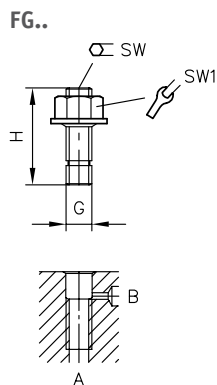
- Without labelling as a screw-in valve
- Available as a banjo bolt and/or with swivel fitting

**Basic type, size, function**

- Throttles type Q, type QR, type QV and precision throttles type FG, subdivided into 5 sizes
- Throttle direction and free flow direction function
- Slot-type throttles, available with or without built-in check valve

**Diagram of devices:**



**Function**

**General parameters and dimensions**


	$Q_{max}$ [lpm] <sup>1)</sup>	$p_{max}$ [bar]	Dimensions				m [g]
			H [mm]	G	SW = a/f	SW =a/f 1	
<b>FG, FG1, FG2</b>	0,15	300	30	M 8	SW 4	SW 13	15
<b>Q20, QR20, QV20</b>	12	400	32	M 8 x 1	SW 4	SW 13	15
<b>Q30, QR30, QV30</b>	25	400	36	M 10 x 1	SW 5	SW 17	25
<b>Q40, QR40, QV40</b>	50	400	41	M 12 x 1.5	SW 6	SW 19	40
<b>Q50, QR50, QV50</b>	90	400	46	M 14 x 1.5	SW 8	SW 22	55
<b>Q 60, QR60, QV60</b>	120	315	58	M 16 x 1.5	SW 10	SW 24	100

1) The values apply to a fully opened valve (observe red marking) and a back pressure of approx. 50 bar (in a throttled direction)

**Associated technical data sheets:**

- [Throttle valve and throttle check valve type Q, QR and QV: D 7730](#)
- [Throttle valve and throttle check valve type FG: D 7275](#)

- Restrictor check valves and orifice inserts  
Typ EB, BE, BC: [Page 226](#)

**Similar products:**

- Throttle valves type CQ, CQR, CQV: [Page 232](#)
- Throttle and restrictor check valves  
Typ ED, RD, RDF: [Page 230](#)

# Flow valves

## 2.4 Throttle valve type ED, restrictor check valve type RD and RDF

Throttle valves are a type of flow valve. They affect the flow rate for single and double-acting consumers.

The valve type ED, RD and RDF can be integrated directly in the line.

**Features and benefits:**

- Sensitively adjustable
- Wear-resistant

**Intended applications:**

- General hydraulic systems



<b>Nomenclature:</b>	Throttle Restrictor check valves
<b>Design:</b>	Individual valve for pipe mounting Screw-in valve
<b>Adjustment:</b>	Manually adjustable (handle, adjusting knob) Fixed
<b>p<sub>max</sub>:</b>	500 bar
<b>Q<sub>max</sub>:</b>	12...130 lpm

### Design and order coding example

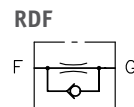
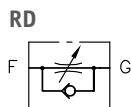
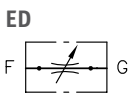
RD 11		- K
RDF 21	/1,0	

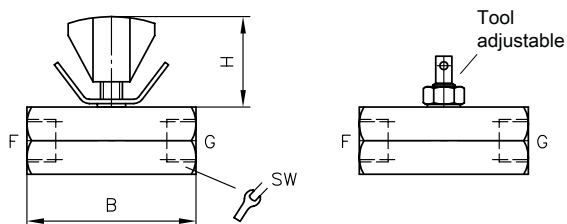
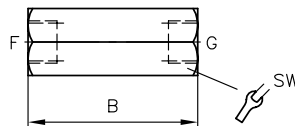
- Adjustability**
- Type ED and RD only
  - Without labelling = manually (wing bolt/lock nut)
  - K = tool adjustable (setting spindle/lock nut)

- Fixed throttles**
- Diameter in mm, type RDF**
- 0.4 - 0.6 (in increments of 0.1)
  - 0.8 - 2.0 (in increments of 0.2)
  - 2.5 - 5.5 (in increments of 0.5)

- Basic type, size**
- Type ED, type RD, type RDF, size 1 to 5
  - Slot-type throttles, available with or without built-in check valve

### Function



**General parameters and dimensions**
**ED.. and RD..**

**RDF..**


1)	$Q_{max}$ [lpm] <sup>2)</sup>	$p_{max}$ [bar]	Ports (BSPP)	Dimensions [mm]			m [g]
				H	B	SW = a/f	
ED 11..	12	500	G 1/4	23.5	52	SW 24	180
RD 11..				23.5			
RDF 11/..				-			
ED 21..	30	500	G 3/8	24	52	SW 27	215
RD 21..				24			
RDF 21/..				-			
ED 31..	60	500	G 1/2	32.5	62	SW 32	340
RD 31..				32.5			
RDF 31/..				-			
ED 41..	80	500	G 3/4	41	72	SW 41	655
RD 41..				41			
RDF 41/..				-			
ED 51..	130	500	G 1	46.5	82	SW 46	835
RD 51..				46.5			
RDF 51/..				-			

- 1) The throttle diameter with type RDF can be only altered by replacing the orifice. Depending on size, diameters between 0.6 and 4 mm are available.  
 2) These figures correspond to completely opened throttle and represent a back pressure of approx. 50 bar (throttled direction of flow)

**Associated technical data sheets:**

- Throttle and restrictor check valves  
 Typ ED, RD, RDF: [D 7540](#), [D 2570](#)

**Similar products:**

- Throttle valves type Q, QR, QV, FG: [Page 228](#)
- Throttle valves type CQ, CQR, CQV: [Page 232](#)
- Restrictor check valves type EB, BE, BC: [Page 226](#)

# Flow valves

## 2.4 Throttle valve and restrictor check valve type CQ, CQR and CQV

Throttle valves are a type of flow valve. They affect the flow rate for single and double-acting consumers.

The throttle valve type CQ and the restrictor check valve type CQR and CQV are, as slotted throttles, insensitive to micro contamination. The restrictor check valve combines the function of a flow valve with a check valve. It regulates in one flow direction and permits free flow in the other direction. The double spindle sealing enables leakage-free adjustment, even under pressure.

The valve type CQ, CQR and CQV can be screwed-in and can be integrated into control blocks. The necessary mounting holes are straightforward to make.

### Features and benefits:

- Leak-free adjustment under pressure
- Operating pressure up to 700 bar

### Intended applications:

- Speed regulation in hydraulic lifting devices



<b>Nomenclature:</b>	Throttle Restrictor check valves
<b>Design:</b>	Screw-in valve
<b>Adjustment:</b>	Tool adjustable Manually
<b>p<sub>max</sub>:</b>	700 bar
<b>Q<sub>max</sub>:</b>	50 lpm

### Design and order coding example

CQV 2 - D - 1/4

#### Single connection blocks

- For pipe connection (1/4, 3/8)
- Manifold mounting (in combination with type CQ and CQV only)

#### Adjustability in operation

- Without labelling = Fixed
- D = Turn knob (with lock nut)
- D3 = Turn knob, diameter 35 mm (without lock nut)

#### Basic type, size

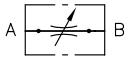
Type CQ, type CQR, type CQV, size 2  
Slot-type throttles, available with or without built-in check valve

- Version with precision control range (size 22)
- Version with pressure compensator (flow control function)

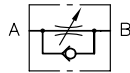


**Function**

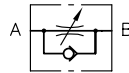
**CQ 2, CQ 22**



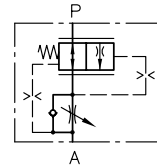
**CQR 2, CQR 22**



**CQV 2, CQV 22**

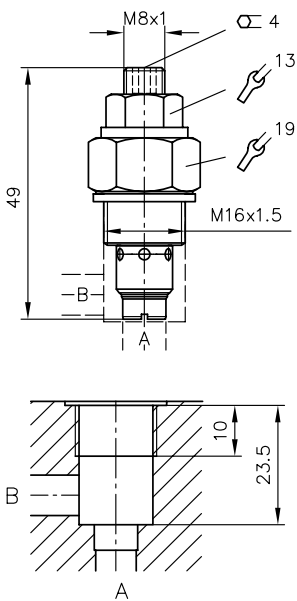


**CQ 2 - P - DW**

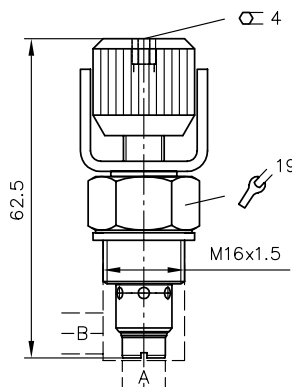


**General parameters and dimensions**

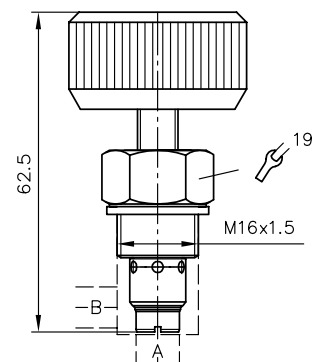
**CQ 2., CQR 2., CQV 2.**



**D**



**D3**



	$Q_{max}$ [lpm]	$p_{max}$ [bar]
CQ 2 / CQ 22	50 / 20	700
CQR 2 / CQR 22		
CQV 2 / CQV 22		

**Associated technical data sheets:**

- [Throttle valve and throttle check valve type CQ, CQR and CQV:](#)  
[D 7713](#)

**Similar products:**

- Throttle and restrictor check valves  
Typ ED, RD, RDF: [Page 230](#)
- Throttle valves type Q, QR, QV, FG: [Page 228](#)

# Flow valves

## 2.4 Throttle valve and shut-off valve type AV, AVT and CAV

Throttle and shut-off valves are a type of metering valve. With the aid of these valves a pressure drop can be established between the inlet and outlet side. In this way the velocity of cylinders in accumulator circuits and the flow rate in control circuits can be regulated or a consumer line completely shut-off (e.g. to protect a pressure gauge).

The throttle and shut-off valve type AV and AVT produces a throttle effect by means of an annular gap. The valve type CAV, as a slotted throttle, is insensitive to micro contamination.

The valve type AV is available as a screw-in valve or valve for pipe connection. The type AVT is mounted in a T-housing and commercially available pipe screw connections permit direct pipe connection. The valve type CAV can be screwed-in and can be integrated into manifolds. The necessary mounting holes are straightforward to make.

**Features and benefits:**

- Various configurations
- Sensitive adjustment and complete shut off possible

**Intended applications:**

- General hydraulic systems



<b>Nomenclature:</b>	Throttle and shut-off valve with/without by-pass check valve
<b>Design:</b>	Individual valve for pipe mounting Screw-in valve
<b>Adjustment:</b>	Manually adjustable (handle, adjusting knob) Fixed
<b>p<sub>max</sub>:</b>	400 ... 630 bar
<b>Q<sub>max</sub>:</b>	12 ... 100 lpm

### Design and order coding example

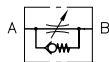
AV 3AVT 10	- K	- 1/4
CAV 1V		
<b>Basic type, size</b>	<b>Means of adjustment</b>	<b>Thread size</b>
Type AV, size 2, 3 Type AVT, size 6... 12 Type CAV, size 1, 2	Fixed Manually (adjustable)	Version with connection block for pipe connection (type CAV)

### Function

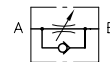
AV, AV.E, AVT, CAV

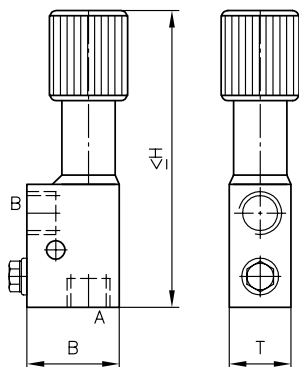
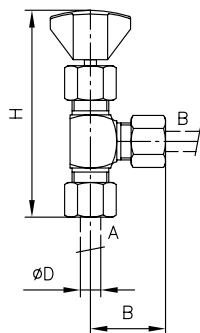
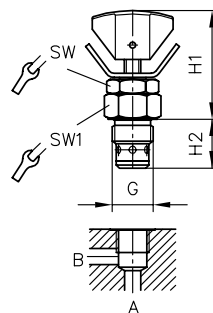
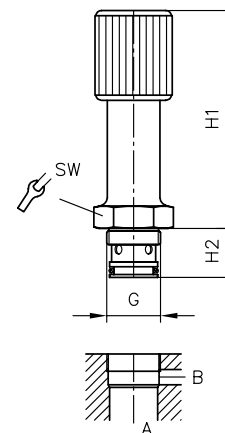


CAV..R



CAV..V, AV..R, AV..RE



**General parameters and dimensions**
**AV..**  
 Valve for pipe connection

**AVT..**

**CAV..**  
 Screw-in valve

**AV..E**


	$Q_{max}$ [lpm] <sup>1)</sup>	$p_{max}$ [bar]	Port size	Dimensions [mm]							m [kg]
				G	H	H1	H2	B	T	SW = a/f	
<b>AV 2</b>	40	500	G 1/2 (BSPP)	145	-	-	45	30	-	-	0.6
<b>AV 3</b>	100	400	G 3/4 (BSPP)	198	-	-	60	40	-	-	1.7
<b>AV 2E</b>	40	500	M 28 x 1.5	-	115	25	-	-	SW 36	-	0.6
<b>AV 3E</b>	100	400	M 40 x 1.5	-	143	38	-	-	SW 46	-	1.0
<b>AVT 6</b>	12	630	6 mm	91	-	-	31	-	-	-	0.14
<b>AVT 8</b>	25	630	8 mm	94	-	-	32	-	-	-	0.18
<b>AV 10</b>	30	630	10 mm	94	-	-	34	-	-	-	0.23
<b>AVT 12</b>	50	630	12 mm	114	-	-	38	-	-	-	0.32
<b>CAV 1</b>	30	500	M 16 x 1.5	-	42	19	-	-	SW 17	SW 22	0.05
<b>CAV 2</b>	50	500	M 20 x 1.5	-	51	21	-	-	SW 22	SW 24	0.07

1) The values apply to a back pressure of approx. 10 bar (in a throttled direction)

**Associated technical data sheets:**

- [Shut-off valve type AVT and AVM: D 7690](#)
- [Throttle valve and shut-off valve type AV: D 4583](#)
- [Throttle valve and shut-off valve CAV: D 7711](#)

**Similar products:**

- Throttle and restrictor check valves  
Typ ED, RD, RDF: [Page 230](#)
- Throttle valves type Q, QR, QV, FG: [Page 228](#)

## 2.5 Check valves

Check valve type RK, RB, RC, RE and ER	240
Check valve type CRK and CRB	242
Check valve type B	244
Releasable check valve type CRH and RHC	246
Releasable check valve type HRP	248
Releasable check valve type RH and DRH	250
Check valve and pre-fill valve type F	252
Line rupture protection valve type LB	254
Shuttle valve type WV and WVC	256



*Check valve type RK, RB, RC, RE and ER*



*Check valve and pre-fill valve type F*

## Check valves

Type	Design	$p_{\max}$ (bar)	$Q_{\max}$ (lpm)
RK, RB, RC, RE, ER	<b>Check valve</b> <ul style="list-style-type: none"> <li>▪ Insert valve</li> <li>▪ Plug-in valve</li> <li>▪ Combination with housing for in-line installation</li> </ul>	RK - 0: 700	RK - 0: 8
		RK - 1: 700	RK - 1: 20
		RK - 2: 700	RK - 2: 50
		RK - 3: 500	RK - 3: 80
		RK - 4: 500	RK - 4: 120
		RK - 6: 420	RK - 6: 400
		RB - 0: 700	RB - 0: 8
		RB - 1: 700	RB - 1: 20
		RB - 2: 700	RB - 2: 50
		RB - 3: 500	RB - 3: 80
		RB - 4: 500	RB - 4: 120
		RC - 1: 700	RC - 1: 20
		RC - 2: 700	RC - 2: 35
		RC - 3: 500	RC - 3: 60
		RE - 0: 500	RE - 0: 12
		RE - 1: 500	RE - 1: 25
		RE - 2: 500	RE - 2: 40
		RE - 3: 450	RE - 3: 70
		RE - 4: 400	RE - 4: 120
		ER - 01: 500	ER - 01: 6
		ER - 11: 500	ER - 11: 12
		ER - 12: 500	ER - 12: 15
		ER - 13: 500	ER - 13: 15
		ER - 21: 500	ER - 21: 30
		ER - 31: 500	ER - 31: 65
		ER - 41: 400	ER - 41: 120
		CRK, CRB	<b>Check valve</b> <ul style="list-style-type: none"> <li>▪ Screw-in valve</li> </ul>
CRK - 2: 500	CRK - 2: 50		
CRK - 3: 500	CRK - 3: 80		
CRB - 1: 500	CRB - 1: 20		
CRB - 2: 500	CRB - 2: 30		
B	<b>Check valve</b> <ul style="list-style-type: none"> <li>▪ Single valve for in-line installation</li> </ul>	B - 1: 500	B - 1: 15
		B - 2: 500	B - 2: 20
		B - 3: 500	B - 3: 30
		B - 4: 500	B - 4: 45
		B - 5: 500	B - 5: 75
		B - 6: 500	B - 6: 120
		B - 7: 500	B - 7: 160

## Releasable check valves

Type	Design	Actuation	p <sub>max</sub> (bar)	Q <sub>max</sub> (lpm)
CRH, RHC	<b>Releasable check valve</b> <ul style="list-style-type: none"> <li>▪ Screw-in valve</li> </ul>	- Hydraulic	CRH - 1: 500 CRH - 2: 500 CRH - 3: 500  RHC - 1: 700 RHC - 2: 700 RHC - 3: 700 RHC - 4: 500 RHC - 5: 500 RHC - 6: 600	CRH - 1: 20 CRH - 2: 30 CRH - 3: 55  RHC - 1: 8 RHC - 2: 15 RHC - 3: 55 RHC - 4: 100 RHC - 5: 150 RHC - 6: 200
HRP	<b>Releasable check valve</b> <ul style="list-style-type: none"> <li>▪ Manifold mounting valve</li> </ul>	- hydraulic - electro-hydraulic	HRP - 1: 700 HRP - 2: 700 HRP - 3: 500 HRP - 4: 500 HRP - 5: 500 HRP - 7: 500	HRP - 1: 20 HRP - 2: 35 HRP - 3: 50 HRP - 4: 80 HRP - 5: 140 HRP - 7: 400
RH, DRH	<b>Releasable check valve</b> <ul style="list-style-type: none"> <li>▪ Single valve for in-line installation</li> <li>▪ Manifold mounting valve</li> </ul>	- Hydraulic	RH - 1: 700 RH - 2: 700 RH - 3: 500 RH - 4: 500 RH - 5: 500  DRH - 1: 500 DRH - 2: 500 DRH - 3: 400 DRH - 4: 400 DRH - 5: 400	RH - 1: 15 RH - 2: 35 RH - 3: 55 RH - 4: 100 RH - 5: 160  DRH - 1: 16 DRH - 2: 30 DRH - 3: 60 DRH - 4: 90 DRH - 5: 140

### Pre-fill valves

Type	Design	Actuation	p <sub>max</sub> (bar)	Q <sub>max</sub> (lpm)
F	<b>Releasable check valve (pre-fill valve)</b> <ul style="list-style-type: none"> <li>Valve in wafer design</li> </ul>	- Hydraulic	F - 25: 400 F - 32: 400 F - 40: 400 F - 50: 400 F - 63: 400 F - 80: 400 F - 100: 400 F - 125: 400 F - 160: 400 F - 200: 400	F - 25: 100 F - 32: 160 F - 40: 250 F - 50: 400 F - 63: 630 F - 80: 1000 F - 100: 1600 F - 125: 2500 F - 160: 4000 F - 200: 7000

### Line rupture safety valve, shuttle valves

Type	Design	Adjustability	p <sub>max</sub> (bar)	Q <sub>max</sub> (lpm)
LB	<b>Line rupture safety valve</b> <ul style="list-style-type: none"> <li>Screw-in valve</li> <li>Combination with housing for in-line installation</li> </ul>	- fixed	LB - 1: 500 LB - 2: 500 LB - 3: 500 LB - 4: 500 LB - 5: 300	LB - 1: 25 LB - 2: 50 LB - 3: 80 LB - 4: 160 LB - 5: 250
WV, WVC	<b>Shuttle valve</b> <ul style="list-style-type: none"> <li>Single valve for in-line installation</li> <li>Screw-in valve</li> </ul>		WV - 6 S: 700 WV - 8 S: 700 WV - 10 S: 500 WV - 12 S: 500 WV - 16 S: 500 WV - 18 L: 315  WVC - 1: 315 WVC - 11: 500	WV - 6 S: 6 WV - 8 S: 15 WV - 10 S: 25 WV - 12 S: 40 WV - 16 S: 100 WV - 18 L: 160  WVC - 1: 6 WVC - 11: 6

# Check valves

## 2.5 Check valve type RK, RB, RC, RE and ER

Check valves are a type of non-return valve. They block the oil flow in one direction and open in the opposite direction. In the closed state they have zero leakage. The check valve type RK, RB, RC and RE can be screwed-in, type ER can be plugged-in. The spring-loaded ball check valve type RK, RB and ER is very robust and insensitive to soiling. The spring-loaded plate valve type RC can be screwed-in in any direction and is particularly suitable for fast switching sequences. Type RE is a plate valve without a spring. Type ER can be integrated directly in valves for manifold mounting. As such an additional intermediate plate is not necessary for the check valve function. Type RE is suitable for isolating pressurising loads or as a foot valve for a pump suction line.

### Features and benefits:

- Operating pressures up to 700 bar
- Easily machined mounting holes
- Sturdy

### Intended applications:

- General hydraulic systems
- Hydraulic pre-loading



<b>Nomenclature:</b>	Check valve
<b>Design:</b>	Screw-in valve Valve insert With housing for in-line installation
<b>p<sub>max</sub>:</b>	700 bar
<b>Q<sub>max</sub>:</b>	400 l/min

### Design and order coding example

RC 2 - E

**Design with housing** For pipe connection (E, F, G), type RK, RB and RC

**Basic type, size** Check valve installation  
type RK, RB, size 0 ... 6  
Type RC, size 1 ... 3  
Type RE, size 0 ... 4  
Type RE, ER (check valve insert), size 0 to 4

### Additional versions:

- Type RK with increased open-up pressure
- Type ER, stainless (size 01 ... 31)
- Type RK, RB, RC and RE with metric thread
- Type RV, RB with KWF thread

### Function

**RK**  
Ball seated valves



**RB**



**ER**



**RC**

Shim type valves



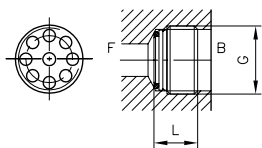
**RE**



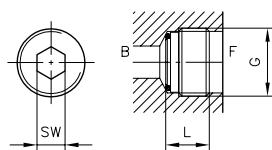


## General parameters and dimensions

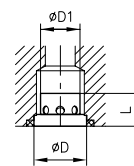
RK..



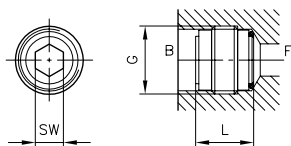
RB..



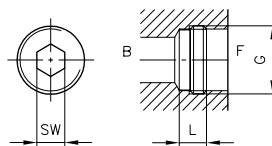
ER..



RC..



RE..



	Q <sub>max</sub> [lpm]	p <sub>max</sub> [bar]	Ports (BSPP)	Dimensions [mm]		m [g]
				L	SW	
RK 0/RB 0	10	700	G 1/8 A	7.2/7.9	SW 5	5
RK 1/RB 1	20	700	G 1/4 A	9/10.3	SW 7	5
RK 2/RB 2	50	700	G 3/8 A	11.2/11.7	SW 6	15
RK 3/RB 3	80	500	G 1/2 A	13.5/13.2	SW 8	15/20
RK 4/RB 4	120	500	G 3/4 A	17.5/17.5	SW 12	35/40
RK 6	400	420	G 1 1/4	55	-	135
RC 1	20	700	G 1/4 A	13	SW 4	6
RC 2	35	700	G 3/8 A	15	SW 5	13
RC 3	60	500	G 1/2 A	18	SW 8	24
RE 0	12	500	G 1/8 A	5	SW 4	2
RE 1	25	500	G 1/4 A	6	SW 5	4
RE 2	40	500	G 3/8 A	7	SW 8	6
RE 3	70	450	G 1/2 A	7.5	SW 10	10
RE 4	120	400	G 3/4 A	9	SW 12	18
				L	D/D1	m[g]
ER 0	6	500	G 1/8 A	5.6	6.1/4.6	0.5
ER 1	12	500	G 1/4 A	5.6	8.6/6.5	1
ER 2	30	500	G 3/8 A	8	14/10.5	5
ER 3	65	500	G 1/2 A	10	17/13	9
ER 4	120	400	G 3/4 A	17.5	28/21	40

### Associated technical data sheets:

- Check valve type ER and EK - Plug-in valve: [D 7325](#)
- Check valve type RE: [D 7555 R](#)
- Check valve type RC: [D 6969 R](#)
- Check valve type RK and RB: [D 7445](#)

- Restrictor check valves type EB, BE, BC: [Page 226](#)

### Similar products:

- Check valves type CRK, CRB: [Page 242](#)
- Check valves type B: [Page 244](#)

# Check valves

## 2.5 Check valve type CRK and CRB

Check valves are a type of non-return valve. They block the oil flow in one direction and open in the opposite direction. In the closed state they have zero leakage.

The check valve type CRK and CRB can be screwed-in and can be integrated into control blocks. The necessary mounting holes are straightforward to make.

### Features and benefits:

- Screw-in valves

### Intended applications:

- General hydraulic systems



<b>Nomenclature:</b>	Check valve
<b>Design:</b>	Screw-in valve
<b>p<sub>max</sub>:</b>	500 bar
<b>Q<sub>max</sub>:</b>	30 ... 80 lpm

### Design and order coding example

CRK 2 - 1/4

#### Individual connection block for pipe connection

#### Basic type

Check valves type CRK and CRB, size 1 to 3

- With/without tapped plug
- With/without tapped blockage/plug combination

**Function**

CRK

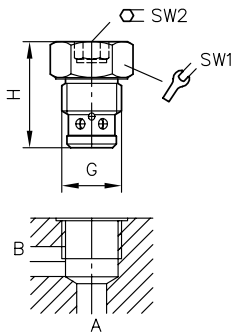


CRB



**General parameters and dimensions**

CRK, CRB



	Q <sub>max</sub> [lpm]	p <sub>max</sub> [bar]	Ports (BSPP)	Dimensions			m [g]
				G	H [mm]	SW 1	
CRK 1 / CRB 1	30	500	M 16 x 1.5	31	SW 22	SW 8	70
CRK 2 / CRB 2	50		M 20 x 1.5	35	SW 24	SW 10	110
CRK 3	80		M 24 x 1.5	38	SW 30	SW 12	125

**Associated technical data sheets:**

- [Check valve type CRK, CRB and CRH: D 7712](#)

**Similar products:**

- Check valves type RK, RB, RC, RE, ER: [Page 240](#)

# Check valves

## 2.5 Check valve type B

Check valves are a type of non-return valve. They block the oil flow in one direction and open in the opposite direction. In the closed state they have zero leakage.

The check valve type B is available in different housing forms and is suitable for direct in-line installation.

The check valve type B is suitable for usage as a foot valve for a pump suction line due to the low opening pressure.

### Features and benefits:

- Flow up to 160 l/min
- Pipe installation

### Intended applications:

- General hydraulic systems



<b>Nomenclature:</b>	Check valve
<b>Design:</b>	Individual valve for in-line installation
<b>p<sub>max</sub>:</b>	500 bar
<b>Q<sub>max</sub>:</b>	15 ... 160 lpm

### Design and order coding example

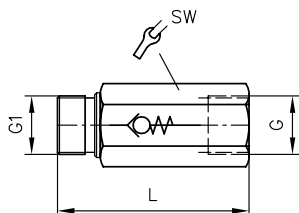
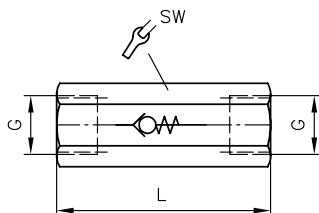
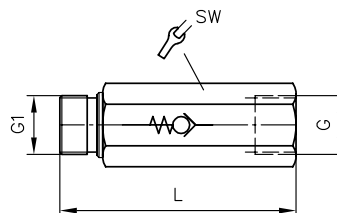
#### B 1 - 2

**Basic type, with housing, size** Check valve type B, version with housing 1 to 3, size 1 to 7

#### Additional versions:

- Open-up pressure 3 bar

**Function**
**B**

**General parameters and dimensions**
**B 1**

**B 2**

**B 3**


Basic type	Size	Q <sub>max</sub> [lpm]	p <sub>max</sub> [bar]	Ports (BSPP)		Dimensions		m [kg]
				G	G1	L [mm]	SW = a/f	
B 1 B 2 B 3	-1	15	500	G 1/4	G 1/4 A	50 ... 60	SW 19	0.11
	-2	20		G 3/8	G 3/8 A	58 ... 67	SW 24	0.16
	-3	30		G 1/2	G 1/2 A	60 ... 66	SW 27	0.19
	-4	45		G 3/4	G 3/4 A	70 ... 78	SW 36	0.36
	-5	75		G 1	G 1 A	94 ... 114	SW 41	0.65
	-6	120		G 1 1/4	G 1 1/4 A	110 ... 130	SW 55	1.3
	-7	160		G 1 1/2	G 1 1/2 A	115 ... 136	SW 60	1.5

**Associated technical data sheets:**

- [Check valve type B: D 1191](#)

**Similar products:**

- Check valves type RK, RB, RC, RE, ER: [Page 240](#)

# Check valves

## 2.5 Releasable check valve type CRH and RHC

Check valves with hydraulic release are a type of check valve. They block one or both hydraulic consumer lines or are used as a hydraulically actuated drain or circulation valve. Check valve type CRH and RHC has zero leakage when closed.

It can be screwed-in and can be integrated into control blocks. The necessary mounting holes are straightforward to make.

Check valve type CRH and RHC is available with hydraulic release. Hydraulic release suppresses relief surges that can occur at high pressure and with a large consumer volume.

### Features and benefits:

- Screw-in cartridge
- Pressures up to 700 bar
- Flows up to 200 l/min
- Sturdy

### Intended applications:

- Industrial hydraulics
- Construction machines



<b>Nomenclature:</b>	Check valve with hydraulic release
<b>Design:</b>	Valve insert Screw-in valve
<b>Actuation:</b>	Hydraulic
<b>p<sub>max</sub>:</b>	500 ... 700 bar
<b>Q<sub>max</sub>:</b>	8 ... 200 lpm

### Design and order coding example

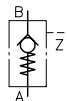
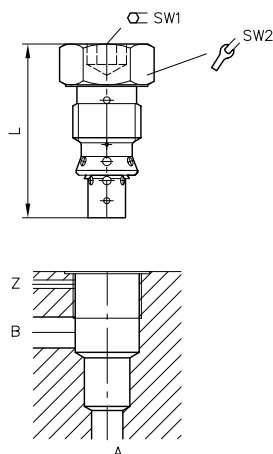
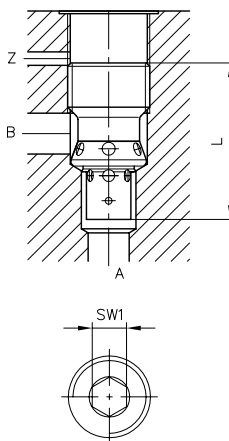
CRH 3 V

**Function** Without pre-release (-)  
With pre-release (V)

**Basic type, size** Releasable check valve  
type CRH, size 1 to 3 and  
type RHC, size 1 to 6

### Additional versions:

- With increased release ratio (approx. 4.2 : 1)
- With sealed tapped journal and control piston
- With hydraulic relieve of the control piston (type RHCE)

**Function**
**CRH, RHC**

**General parameters and dimensions**
**CRH**

**RHC**


	$Q_{\max}$ [lpm]	$p_{\max}$ [bar]	Release ratio $p_a / p_z$	Ports (BSPP)	Dimensions			m [g]
					L [mm]	SW = a/f 1	SW = a/f 2	
<b>CRH 1</b>	30	500	2.6	M 16 x 1.5	47	SW 8	SW 22	60
<b>CRH 2</b>	50	500	2.6	M 20 x 1.5	53	SW 10	SW 24	90
<b>CRH 3</b>	80	500	2.5	M 24 x 1.5	61	SW 12	SW 30	150
<b>RHC 1</b>	15	700	2.6	M 16 x 1.5	32	SW 6	-	20
<b>RHC 2</b>	25	700	2.6	M 20 x 1.5	37.5	SW 8	-	40
<b>RHC 3</b>	55	700	2.5	M 24 x 1.5	47	SW 10	-	70
<b>RHC 4</b>	100	500	2.5	M 30 x 1.5	56	SW 12	-	140
<b>RHC 5</b>	150	500	2.8	M 36 x 1.5	67.5	SW 14	-	250
<b>RHC 6</b>	200	500	2.5	M 42 x 1.5	97	SW 19	-	500

**Associated technical data sheets:**
**Releasable check valves**

- Check valve type CRK, CRB and CRH: D 7712
- Releasable check valve type RHC and RHCE: D 7165

**Similar products:**

- Type HRP: [Page 248](#)
- Type RH: [Page 250](#)

# Check valves

## 2.5 Releasable check valve type HRP

Check valves with hydraulic release are a type of check valve. They block one or both hydraulic consumer lines or are used as a hydraulically actuated drain or circulation valve. In the closed state the check valve type HRP has zero leakage. A leakage line relieves the rear of the control piston. Due to this separate relief the control behaviour of the valve is independent of the pressure in the return.

A solenoid valve can be optionally flange-mounted to arbitrarily control the check valve with the load pressure on the consumer side. The check valve type HRP is available with a hydraulic release. Hydraulic release suppresses relief surges that can occur at high pressure and with a large consumer volume.

**Features and benefits:**

- Manifold mounting valve for pressures up to 700 bar
- Flows up to 400 lpm
- Electrically controlled
- With hydraulic release for smooth switching

**Intended applications:**

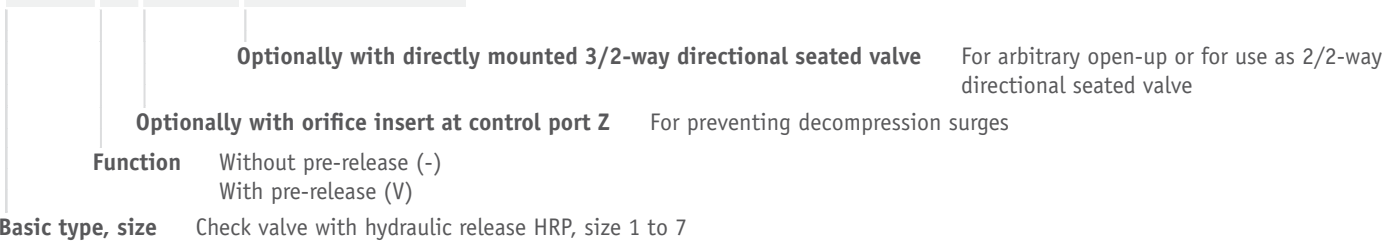
- Industrial and mobile hydraulics



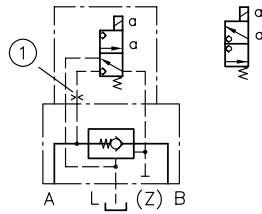
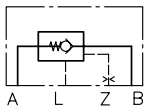
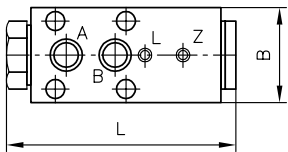
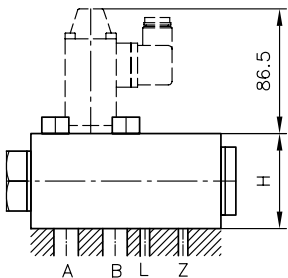
<b>Nomenclature:</b>	Check valve with hydraulic release
<b>Design:</b>	Manifold mounting valve
<b>Actuation:</b>	Hydraulic Electro-hydraulic
<b>p<sub>max</sub>:</b>	700 ... 500 bar
<b>Q<sub>max</sub>:</b>	20 ... 400 lpm

### Design and order coding example

HRP 4 V - B 0,4 - WH 1H B 0,4-G24





**Function**
**HRP**

**General parameters and dimensions**
**HRP**

 Directly mounted  
 3/2-way solenoid valve


	$Q_{\max}$ [lpm]	$p_{\max}$ [bar]	Release ratio	Dimensions [mm]			m [kg]
			$p_A / p_Z$	H	B	L	
HRP 1	20	700	2.9	20	25	74.5	0.25
HRP 2	35	700	3.9	25	30	78	0.4
HRP 3	50	500	4.3	35	35	83	0.7
HRP 4	80	500	3.8	35	50	103.5	1.2
HRP 5	140	500	4.0	40	60	120.5	1.9
HRP 7 V	400	500	3.0	63	100	190	8.0

**Associated technical data sheets:**

- Releasable check valve type HRP: [D 5116](#)

**Similar products:**

- Releasable check valves type RH: [Page 250](#)
- Releasable check valve type RHV: [D 3056](#)
- Releasable check valves type CRH, RHC: [Page 246](#)
- Releasable twin check valves type DRH: [Page 250](#)

# Check valves

## 2.5 Releasable check valve type RH and DRH

Check valves with hydraulic release are a type of check valve. They block one or both hydraulic consumer lines or are used as a hydraulically actuated drain or circulation valve. In the closed state the check valve type RH and DRH has zero leakage. The type DRH is a twin check valve for double-acting consumers.

The check valve type RH and DRH is available with a hydraulic release. Hydraulic release suppresses relief surges that can occur at high pressure and with a large consumer volume.

### Features and benefits:

- Pressures up to 700 bar
- with hydraulic release for smooth switching

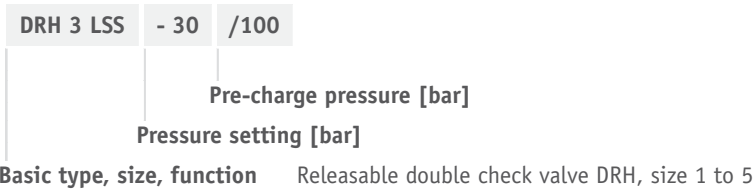
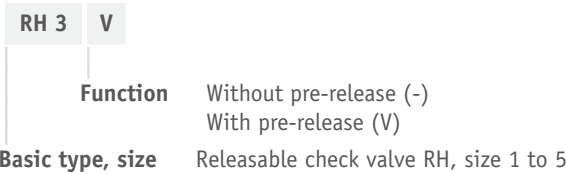
### Intended applications:

- Blocking of leak-free hydraulic cylinders
- Return flow relief
- Hydraulically actuated drain or circulation valve



<b>Nomenclature:</b>	Check valve with hydraulic release or twin check valve
<b>Design:</b>	Individual valve for <ul style="list-style-type: none"> <li>▪ Pipe connection</li> <li>▪ Manifold mounting</li> </ul>
<b>Adjustment:</b>	Hydraulic
<b>p<sub>max</sub>:</b>	400...700 bar
<b>Q<sub>max</sub>:</b>	15...160 lpm

### Design and order coding example



### Additional versions:

- With pre-release (one or both sides)
- With shock valves (for hydraulic motors)
- With safety valve preventing slow pressure rises
- With leakage port preventing unintended open-up when pressure migrated from the control side
- Manifold mounting version (type DRH3P)

## Function

RH

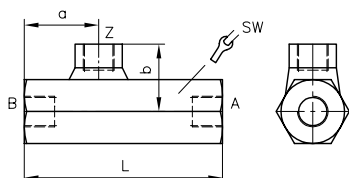


DRH

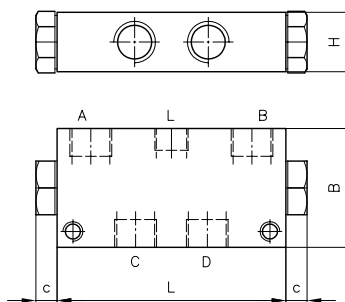


## General parameters and dimensions

RH..



DRH..



	$Q_{max}$ [lpm]	$p_{max}$ [bar]	Release ratio $p_{A(B)}/p_z$	Tapped ports (BSPP)		Dimensions [mm]				m [kg]
				A, B, C, D	Z	L	a	b	SW = a/f	
<b>RH 1</b>	15	700	2.7	G 1/4	G 1/4	84	31.5	27	SW 24	0.4
<b>RH 2</b>	35	700	3	G 3/8		90	32	28.5	SW 27	0.4
<b>RH 3</b>	55	500	2.4	G 1/2		100	36.5	31	SW 32	0.6
<b>RH 4</b>	100	500	2.4	G 3/4		126	45	35.5	SW 41	1.3
<b>RH 5</b>	160	500	3	G 1		143	52	38	SW 46	1.8
						<b>L</b>	<b>B</b>	<b>H</b>	<b>c</b>	
<b>DRH 1</b>	16	500	2.5	G 1/4	-	70	45	20	8	0.5
<b>DRH 2</b>	30	500		G 3/8		89	60	30	10	1.2
<b>DRH 3</b>	60	500		G 1/2		115	60	30	13	1.6
<b>DRH 4</b>	90	400		G 3/4		150	70	40	15.5	2.9
<b>DRH 5</b>	140	400		G 1		195	80	50	17	5.5

### Associated technical data sheets:

- [Releasable check valve type RH: D 6105](#)
- [Releasable twin check valve type DRH: D 6110](#)

### Similar products:

- [Releasable check valve type RHV: D 3056](#)
- Type CRH and RHC: [Page 242](#)
- Type HRP: [Page 248](#)

# Check valves

## 2.5 Check valve and pre-fill valve type F

Check valves and pre-fill valves are a type of non-return valve. Check valves block the oil flow in one direction and open in the other direction. Pre-fill valves are check valves with hydraulic release. They are used, e.g. in top ram presses for suction and emptying the press cylinder on rapid closing and opening.

The check valve and pre-fill valve type F is a spring-loaded disk valve and has zero leakage in the closed state. The valve is attached directly to the cylinder and clamped between the base of the cylinder and the welding-neck flange. Alternatively the valve is installed in the line between the front faces of the welding-neck flanges.

The valve type F is available with hydraulic release. Hydraulic release suppresses relief surges that can occur at high pressure and with a large consumer volume.

### Features and benefits:

- Wafer design
- Extremely large flows, up to 7000 l/min

### Intended applications:

- Press control systems
- Injection moulding machines



<b>Nomenclature:</b>	Check valve Check valve with hydraulic release (pre-fill valve)
<b>Design:</b>	Intermediate section between pipe flanges
<b>Actuation:</b>	Hydraulic
<b>p<sub>max</sub>:</b>	400 bar
<b>Q<sub>max</sub>:</b>	100 ... 7000 lpm

### Design and order coding example

F25

Basic type, size Check valve type F, size 25 to 200

F80B-36 V

Additional versions: Without pre-release (-)  
With pre-release (V), size 25 to 80

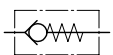
Basic type, size Pre-fill valves type F, size 25 to 200

### Additional functions

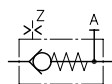
- With holes in the mounting flange (B)

### Function

Check valve

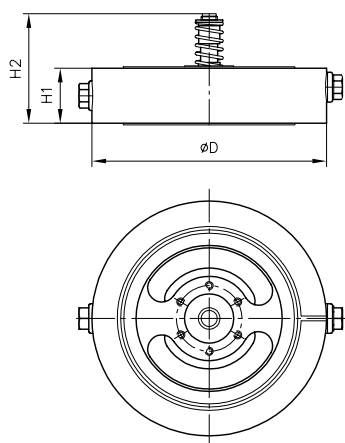


Pre-fill valve

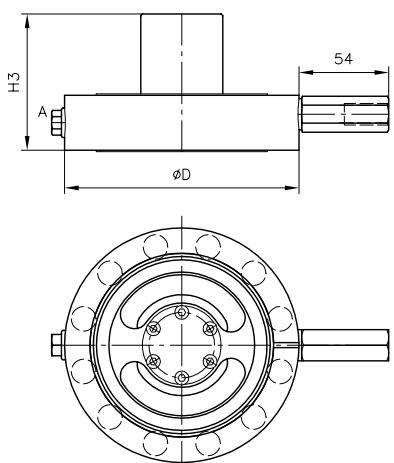


**General parameters and dimensions**

Check valve



Pre-fill valve



Basic type and size		$Q_{max}$ [lpm]	$p_{max}$ [bar]	Release ratio	Dimensions [mm]				m [kg]	
Check valve	Pre-fill valve				$p_A / p_Z$	D	H1	H2	H3	Check valve
F 25	F 25-12	100	400	4.3	83	26	36	43	1	1.1
F 32	F 32-16	160		3.6	93	27	45	55	1	1.2
F 40	F 40-20	250		3.9	108	28	48.5	60	1.4	1.7
F 50	F 50-25	400		4.2	128	29	59	72	2	2.4
F 63	F 63(B)-30	630		4.2	143	33.5	69	83	2.8	3.4
F 64	F 64-30	760		4,2	143	33,5	69	83	2,8	3,4
F 80	F 80(B)-36	1000		4.5	169	38.5	83	97.5	4.4	5.2
F 81	F 81-36	1200		4,5	169	38,5	83	97,5	4,4	5,2
F 100	F 100(B)-45	1600		4.3	212	44	97	118	9.9	11.7
F 101	F 101-45	1920		4,3	212	44	97	118	9,9	11,7
F 125	F 125(B)-60	2500		4.3	248	51	127	155	15.8	19.6
F 160	F 160-76	4000		4.3	310	70	182	233	43	50
F 200	F 200-100	7000	320	4.0	420	150	250	300	114	120

**Associated technical data sheets:**

- [Check valve and pre-fill valve type F: D 6960](#)

# Check valves

## 2.5 Line rupture protection valve type LB

Line rupture protection valves, also called pipe rupture protection valves are a type of check valve. The valves are normally mounted directly on the cylinder. They prevent uncontrolled cylinder movement in the event of a pipe rupture or hose break.

The line rupture protection valve type LB offers a high level of safety in the event of pressure peaks. It features reproducibly accurate, secure closing at the pre-set trigger volumetric flow. Higher volumetric flows causes a plate raised from the valve seat by a spring to be pressed onto the housing seat. The valve closes. A variant with orifice bore in the valve plate permits a low volumetric flow in the check direction. Type LB is available as a screw-in valve and in a housing design for line installation.

The line rupture protection valve type LB is used in industrial vehicles, lifting platforms and lifting equipment.

### Features and benefits:

- Pressures up to 700 bar

### Intended applications:

- Industrial trucks
- Lifting devices



<b>Nomenclature:</b>	Line rupture safety valve
<b>Design:</b>	Valve insert with housing for in-line installation
<b>Adjustment:</b>	Fixed
<b>p<sub>max</sub>:</b>	500 bar
<b>Q<sub>max</sub>:</b>	160 l/min

### Design and order coding example

LB 2 G 1,0 - 25

**Response flow [lpm]** Trigger volumetric flow  $Q_A$  in l/min

**With/without orifice** Orifice diameter 0.5 / 0.8 / 1.0 / 1.2 / 1.5 / 2 (dep. on type and size)

### Design

- Screw-in valve (C)
- Design with housing (F, G)
- Fitting

### Basic type, size:

Line rupture safety valve type LB, size 2 to 4

- Version with imperial thread
- Version with metric thread
- Design with UNF thread

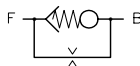
### Function

#### LB

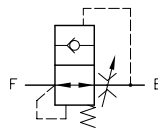
Simplified Series



With orifice

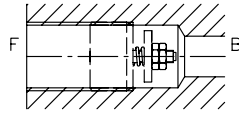
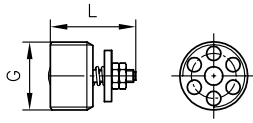
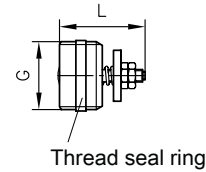


Detailed

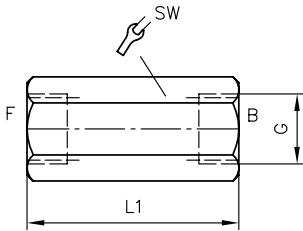
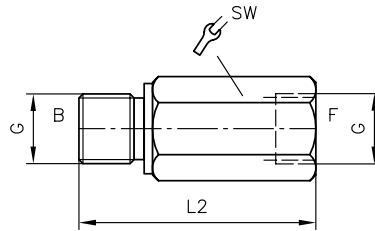
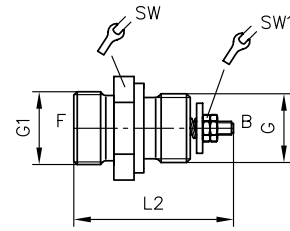


**General parameters and dimensions**
**LB ..C**

Screw-in valve


**LB 11(21)C**

**LB ..G**

Valve with housing


**LB ..F**

**LB 3 E**
**LB 4 E**


	$Q_{max}$ [lpm]	$p_{max}$ [bar]	Ports (BSPP)		Dimensions [mm]					m [g] <sup>2)</sup>
			G	G1	L	L1	L2	SW = a/f	SW = a/f 1	
<b>LB 1 (C, G, F)</b>	4 ... 25	500	G 1/4 (A)	-	17.5	48	50	a/f 19	-	6 / 70
<b>LB 11 C<sup>1)</sup></b>	4 ... 25	700	G 1/4 (A)	-	17.5	-	-	-	-	6 / 70
<b>LB 2 (C, G, F)</b>	6.3 ... 50	500	G 3/8 (A)	-	21	52	58	a/f 22	-	12 / 100
<b>LB 21 C<sup>1)</sup></b>	6.3 ... 45	700	G 3/8 (A)	-	25	-	-	-	-	12 / 100
<b>LB 3 (C, G, F)</b>	16 ... 80	500	G 1/2 (A)	-	25	60	65	a/f 27	-	21 / 170
<b>LB 4 (C, G, F)</b>	25 ... 160	500	G 3/4 (A)	-	30.5	72	78	a/f 36	-	45 / 375
<b>LB 3 E</b> <b>LB 4 E</b>	4 ... 160	500	G 1/4 A - G 3/4 A	M18x1.5 - M36x2	-	-	46.8 - 64.4	SW 27 - SW 41	SW 7	150/210
<b>LB 5</b>	80 ... 200	300	G 1	-	38	-	-	-	-	102

1) Mounting thread, additionally sealed

2) Dimensions for insert valve and/or housing version

**Associated technical data sheets:**

- [Line rupture protection valve type LB: D 6990](#)
- Line rupture safety valves type LB.E  
as a screw joint: Sk 6990 E

# Check valves

## 2.5 Shuttle valve type WV and WVC

Shuttle valves are a type of check valve. They have two inlets and one outlet. As soon as a pressure signal is present on at least one of the two inlets, an outlet signal is generated. The inlet with the higher pressure is automatically connected to the outlet. The other inlet with lower pressure is blocked by a ball (OR operator).

The shuttle valve type WV is integrated in a T-fitting for pipe connection. The type WVC is a screw-in valve. The shuttle valves can withstand pressures up to 700 bar and have low flow resistances.

They can be used for transmitting control pressures or control and operating volumetric flows.

### Features and benefits:

- Pressures up to 700 bar
- Insert and housing versions

### Intended applications:

- In load-sensing systems
- Often in mobile hydraulics
- Construction and construction materials machinery
- Cranes and lifting equipment
- Road vehicle



<b>Nomenclature:</b>	Shuttle valve
<b>Design:</b>	Individual valve for pipe mounting Valve insert Screw-in valve
<b>p<sub>max</sub>:</b>	700 bar
<b>Q<sub>max</sub>:</b>	6 ... 150 lpm

### Design and order coding example

WV 10 - S

#### Design

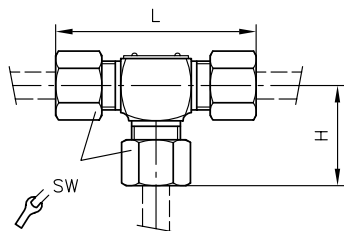
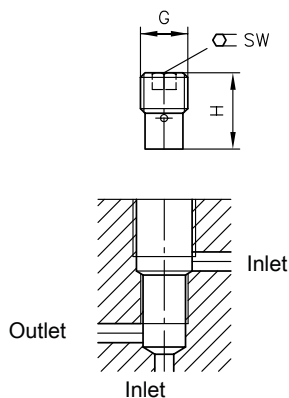
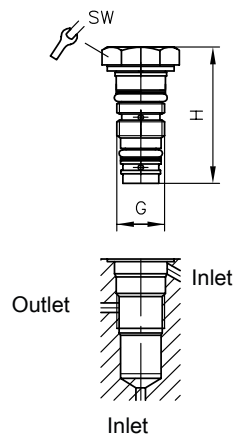
- High pressure version (S)
- Low pressure version (L)

#### Basic type, size

Type WV for pipe connection, size 6 to 18  
Type WVC and WVH as cartridge valve, size 1



**Function**
**WV, WVC, WVH**

**General parameters and dimensions**
**WV**

**WVC**

**WVH**


	$Q_{max}$ [lpm]	$p_{max}$ [bar]	External pipe $\text{\AA}$ [mm]	Mounting thread	Dimensions [mm]			m [g]
					L	H	SW = a/f	
				<b>G</b>				
<b>WV 6 - S</b>	6	700	6	--	62	31	SW 17	120
<b>WV 8 - S</b>	15		8		64	32	SW 19	170
<b>WV 10 - S</b>	25		10		68	34	SW 22	225
<b>WV 12 - S</b>	40		12		76	38	SW 24	290
<b>WV 14 - S</b>	60		14		80	40	SW 27	320
<b>WV 16 - S</b>	100		16		86	43	SW 30	390
<b>WV 18 - L</b>	150	315	18		80	40	SW 32	340
<b>WVC 1</b>	6		--	M 10 x 1	--	16	SW 5	7
<b>WVH 1</b>	3		700	--	M 10 x 1	--	28.5	SW 14

**Associated technical data sheets:**

- [Shuttle valve type WV and WVC: D 7016](#)

**Similar products:**

- Shuttle valves type WVH: **Sk 7962**

# Hydraulic cylinders and hydrostatic motors

Hydraulic clamps type HSE and HSA	260
Axial piston motor type M60N	262



*Hydraulic clamps  
type HSE and HSA*



*Hydrostatic motor  
Type M60N*

### Hydraulic cylinders

Type	Nomenclature/Design	$p_{\max}$ (bar)	$H_{\text{Stroke}}$ (mm)
HSE, HSA	<b>Hydraulic clamps</b> <ul style="list-style-type: none"> <li>▪ Screw-in version</li> <li>▪ Manifold mounting</li> </ul>	HSE - 12: 500	HSE - 12: 8
		HSE - 16: 500	HSE - 16: 12
		HSE - 20: 500	HSE - 20: 20
		HSE - 24: 500	HSE - 24: 20
		HSA - 32: 500	HSA - 32: 20
		HSA - 40: 500	HSA - 40: 25

### Hydrostatic motors

Type	Nomenclature/Design	$p_{\max}$ (bar)	$V_{\max}$ (cm <sup>3</sup> /rev.)
M60N	<b>Fixed displacement axial piston motor</b>	Operation/Peak:	
		012: 350/400	012: 12.6
		017: 350/400	017: 17
		025: 350/400	025: 25.4
		034: 350/400	034: 34.2
		047: 350/400	047: 47.1
		064: 350/400	064: 63.5
		084: 350/400	084: 83.6
		108: 350/400	108: 108

# hydraulic cylinders

## 3 Hydraulic clamps type HSE and HSA

Hydraulic clamping cylinder generate a pressure-controlled clamping force at the piston.

Without pressure the clamping pistons return to their initial position.

The clamping cylinder type HSE is a screw-in cylinder. The type HSA is a screw-on cylinder.

Very high forces can be transmitted in a very small space in fixtures.

The clamping cylinder type HSE and HSA is used in machine tools, machining centres and chucks for clamping, fasten, lock or fix workpieces, tools or machine structures.

### Features and benefits:

- Compact design
- Operating pressure up to 500 bar

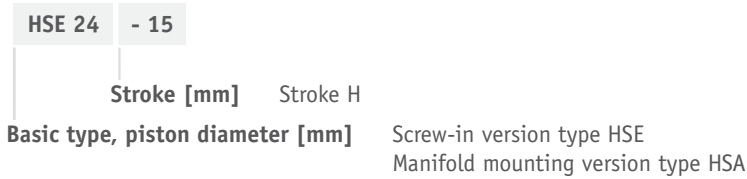
### Intended applications:

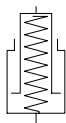
- Clamping systems
- Securing systems
- Machine tools



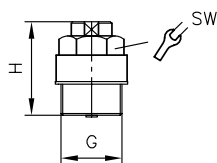
<b>Nomenclature:</b>	Hydraulic clamps
<b>Design:</b>	Screw-in version Manifold mounting
<b>p<sub>max</sub>:</b>	500 bar
<b>F<sub>max</sub>:</b>	60000 N

### Design and order coding example

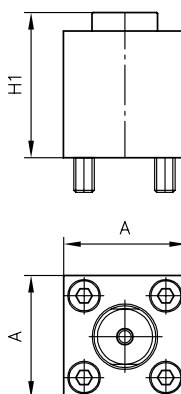


**Function**
**HSE, HSA**

**General parameters and dimensions**
**HSE ..**

Hydraulic screw-in clamps


**HSA ..**

Manifold mounting hydraulic clamps



	$Q_{max}$ [lpm]	Stroke [mm]	$F_{max}$ [N]	Ports	Dimensions [mm]				m [kg]
					H	H1	SW = a/f	A	
			with 500 bar						
<b>HSE 12</b>	500	2 ... 8	5500	M 20 x 1.5	20.5 ... 32.5	-	SW 24	-	0.05 ... 0.08
<b>HSE 16</b>		3 ... 12	10000	M 24 x 1.5	26.5 ... 41.5	-	SW 24	-	0.08 ... 0.12
<b>HSE 20</b>		4 ... 20	15000	M 30 x 1.5	28.5 ... 56	-	SW 30	-	0.14 ... 0.3
<b>HSE 24</b>		5 ... 20	23000	M 36 x 1.5	34 ... 65	-	SW 36	-	0.25 ... 0.5
<b>HSA 32</b>		20	40000	-	-	71	-	60	1.6
<b>HSA 40</b>		25	60000	-	-	85	-	70	2.5

**Associated technical data sheets:**

- Hydraulic clamps type HSE and HSA: D 4711

# hydraulic cylinders

## 3 Axial piston motor type M60N

Axial piston motors are constant motors. They have a constant displacement and therefore generate a fixed rotation speed dependent on the flow rate.

The axial piston motor type M60N is designed for open and closed circuits and operates based on the bent axis principle.

The motor is particularly suitable for usage in mobile applications.

### Features and benefits:

- Optimized power-to-weight ratio
- Rotation speed
- Different shaft and flange versions

### Intended applications:

- Machines for forestry and agricultural purposes
- Fan drives
- Construction machines
- Municipal trucks

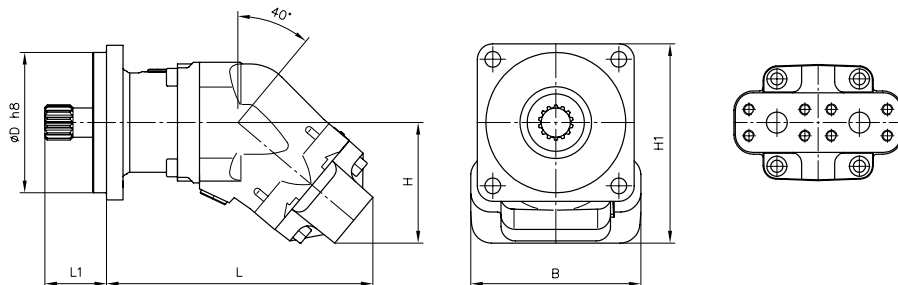


<b>Nomenclature:</b>	Axial piston fixed motor
<b>Design:</b>	Individual motor
<b>p<sub>max</sub>:</b>	400 bar
<b>V<sub>g max</sub>:</b>	12 ... 108 cm <sup>3</sup> /rev

### Design and order coding example

M60N	- 064	B	S	F	N	- S1	00	-G
							Ports	
							Speed sensor	With/without speed sensor
							Version with housing	<ul style="list-style-type: none"> <li>▪ Axial version</li> <li>▪ Radial version</li> </ul>
							Seals	NBR (N), FKM (V), HNBR (H)
							Flange version	<ul style="list-style-type: none"> <li>▪ Flange ISO 7653 - 1985</li> <li>▪ Flange SAE J744</li> <li>▪ Flange ISO 3019 - 2</li> </ul>
							Shaft version	<ul style="list-style-type: none"> <li>▪ ISO 14 parallel key splined shaft</li> <li>▪ SAE J744 parallel key</li> <li>▪ SAE J744 spline shaft and flange</li> <li>▪ DIN 6885 parallel key</li> </ul>
							Rotating direction	Any (B)
							Nominal size	
							Basic type	

**Function**

**General parameters and dimensions**

**Parameters**

	Geom. displacement $V_g$ [cm <sup>3</sup> /rev]	Nom. pressure $p_{nom}$ ( $p_{max}$ ) [bar]	Max. speed $n$ [rpm]	Dimensions [mm]						m [kg]
				L	L1	H	H1	B	ØD	
<b>M60N- 012</b>	12,6	350	7500	206	46	97	147,8	-	101,6	9
<b>M60N- 017</b>	17,0	350	7500	206	46	97	147,8	-	101,6	9
<b>M60N- 025</b>	25,4	350	5900	206	46	97	147,8	-	101,6	9
<b>M60N- 034</b>	34,2	350	5900	206	46	97	147,8	-	101,6	9
<b>M60N- 040</b>	41,2	350	5300	242	56	97	147,8	-	101,6	9
<b>M60N- 047</b>	47,1	350	5300	242	56	109	172,5	155	127	9
<b>M60N- 056</b>	56,7	350	5300	242	56	109	172,5	155	127	9
<b>M60N- 064</b>	63,5	350	5300	242	56	109	172,5	155	127	9
<b>M60N- 084</b>	83,6	350	4400	264	56/74	129	192.5/205.2	-	127/152.4	18/35
<b>M60N- 090</b>	90,7	350	4400	264	56/74	129	192.5/205.2	-	127/152.4	18/35
<b>M60N- 108</b>	108,0	350	4400	264	56/74	129	192.5/205.2	-	127/152.4	18/35
<b>M60N- 130</b>	130,0	350	4200	264	56/74	129	192.5/205.2	-	127/152.4	18/35

**Associated technical data sheets:**

- Variable displacement axial piston pump type V60N: [D 7960 N](#)

**Similar products:**

- Variable displacement axial piston pumps type V40M: [Page 26](#)
- Variable displacement axial piston pumps type V30D: [Page 20](#)
- Variable displacement axial piston pumps type V30E: [Page 16](#)
- Fixed displacement axial piston pump type K60N: [D 7960 K](#)

**Suitable prop. directional spool valves:**

- Type PSL/PSV size 2, 3 and 5: [Page 106](#)
- Type PSLF/PSVF sizes 3, 5 and 7: [Page 112](#)

**Suitable load-holding valves:**

- Type LHK, LHDV, LHT: [Page 204](#)

# Hydraulic accessories

Diaphragm accumulator type AC	266
Piston type accumulator type HPS	268
Pressure switch type DG	270
Pressure filter type PFM	272
Fittings	274



*Pressure switches type DG  
and analogous pressure sensors*



### Pressure accumulators

Type	Nomenclature/Design	$p_{\max}$ (bar)	Nominal volume (dm <sup>3</sup> )	Piston diameter
AC	<b>Pressure accumulators</b> <ul style="list-style-type: none"> <li>▪ Screw-in version</li> </ul>	13: 500	13: 0.01	-
		40: 400	40: 0.04	
		202: 250	202: 0.16	
		603: 330	603: 0.60	
		725: 250	725: 0.08	
		1002: 210	1002: 1.00	
		1035: 350	1035: 1.00	
		1414: 140	1414: 1.40	
		2001: 100	2001: 1.95	
		2002: 250	2002: 1.90	
		2035: 350	2035: 1.95	
		2825: 250	2825: 2.80	
		3225: 210	3225: 0.32	
HPS	<b>Piston-type accumulator</b> <ul style="list-style-type: none"> <li>▪ In-line installation</li> </ul>	350	0.1 ... 40.00	50 ... 180 mm

### Hydraulic accessories

Type	Nomenclature/Design	$p_{\max}$ (bar)
DG	<b>Spring-loaded piston-type pressure switch, electronic pressure switch</b> <ul style="list-style-type: none"> <li>▪ Manifold mounting</li> <li>▪ Screw-in version</li> <li>▪ Version for pipe connection</li> </ul>	1, 5E, 8: 600 3: 700 6: 400
PFM	<b>Pressure filter</b>	250
Fittings	<b>Reducing connector, connection fitting, screen filter, wire mesh filter, pressure gauge</b> <ul style="list-style-type: none"> <li>▪ Screw-in version</li> <li>▪ Version for pipe connection</li> </ul>	350 ... 700

# Hydraulic accessories

## 4 Diaphragm accumulator type AC

Diaphragm accumulators are a type of hydraulic accumulator. A diaphragm separates the compressible gas cushion from the hydraulic fluid.

The diaphragm accumulator type AC is used as a source of pressurized oil. It supports or increases the pump delivery flow or stores pressure energy, e.g. for an accumulator charge circuit.

With the aid of different fittings the hydraulic accumulator type AC can be integrated into a hydraulic system. Different installation orientations and installation positions are possible.

### Features and benefits:

- Compact design
- Option of integration into the HAWE modular system
- Operating pressures up to 350 bar

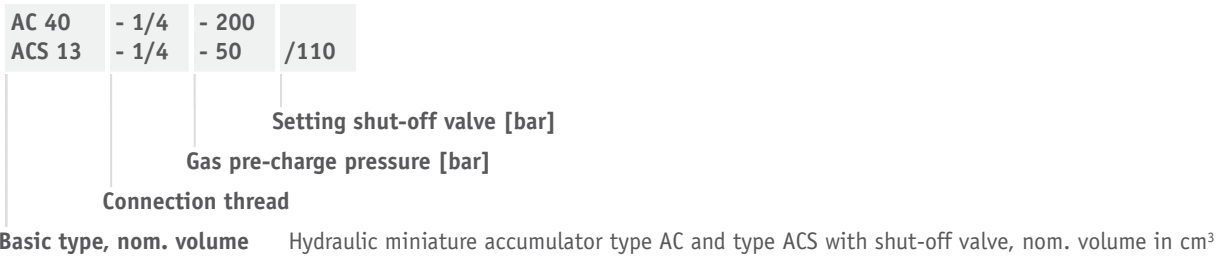
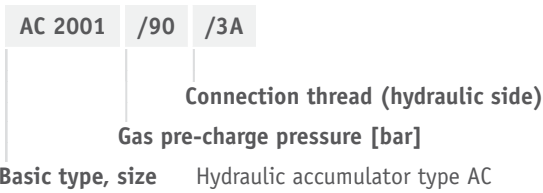
### Intended applications:

- Clamping systems
- Jigs
- Accumulator charging systems

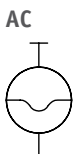


<b>Nomenclature:</b>	Hydro-pneumatic accumulator
<b>Design:</b>	Screw-in version
<b>p<sub>max</sub>:</b>	500 bar
<b>V<sub>max</sub>:</b>	1,95 dm <sup>3</sup>

### Design and order coding example

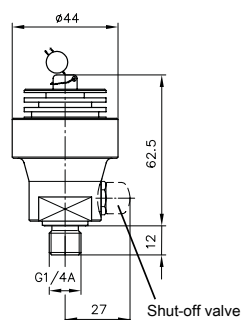


### Function

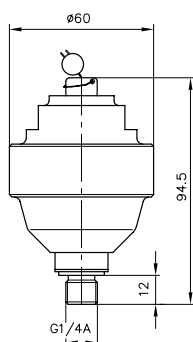
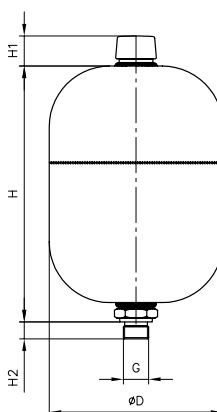
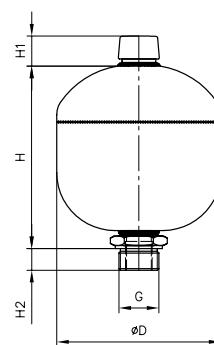


**General parameters and dimensions**

AC(S) 13 - 1/4



AC 40 - 1/4


 AC 0725, AC 202,  
 AC 322, AC 1414

 AC 603, AC 1002,  
 AC 2002, AC 2825


	$V_0$ [dm <sup>3</sup> ]	$p_{max}$ [bar]	Max. gas filling pressure $p_0$ [bar]	Ports (BSPP)	Dimensions [mm]				m [kg]
					H	H1	H2	D	
<b>Hydraulic miniature accumulator</b>									
AC 13-1/4	0.013	500	250	G 1/4 A	see illustration				0.3
ACS 13-1/4	0.013	500	250	G 1/4 A	see illustration				0.3
AC 40-1/4	0.040	400	250	G 1/4 A	see illustration				0.65
<b>Hydraulic accumulator</b>									
AC 0725/1A	0.075	250	130	G 1/4 A	81	26.5	12	64	0.6
AC 202/2A	0.16	250	130	G 3/8 A	102	26.5	-	74	0.8
AC 322/2A	0.32	210	140	G 3/8 A	101.5	25	12	92.5	1.4
AC 603/3	0.6	330	200	G 1/2	149	23	-	115	3.3
AC 1002/22	1.0	210	140	M 22 x 1,5	151	25	18	136	3.5
AC 1414/2A	1.4	140	120	G 3/8 A	162	25	18	147	4.2
AC 2002/4	1.95	250	140	G 3/4	229	25	-	155	7.5
AC 2825/3	2.8	250	130	G 1/2	246	26.5	18	167	8.2

**Associated technical data sheets:**

- [Miniature hydraulic accumulators, type AC: D 7571](#)
- [Diaphragm accumulator type AC: D 7969](#)

**Hydraulic accessories:**

- Fittings type X84: [Page 274](#)

**Similar products:**

- Piston type accumulator type HPS: [Page 268](#)

# Hydraulic accessories

## 4

### Piston type accumulator type HPS

Piston type accumulators are a type of hydraulic accumulator. A freely moving piston separates the compressible gas cushion from the hydraulic fluid.

The piston type accumulator type HPS supports or increases the pump delivery flow or stores pressure energy. It is used in clamping hydraulics to compensate for volume changes in the event of temperature fluctuations, to cover any leakage losses or to dampen oscillations.

The piston type accumulator type HPS can be installed in different situations with the aid of suitable fastening clips.

#### Features and benefits:

- Compact design
- Option of integration into the HAWE modular system

#### Intended applications:

- Accumulator charging systems
- Construction machines
- Wind power plants
- Machine tools

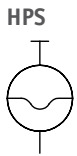


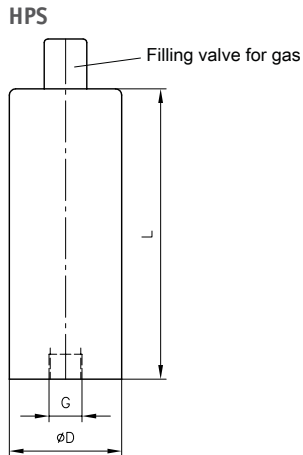
<b>Nomenclature:</b>	Piston accumulator
<b>Operation pressure:</b>	350 bar
<b>Nominal volume:</b>	0.1 - 40 dm <sup>3</sup>
<b>Internal piston diameter:</b>	50 - 180 mm

#### Design and order coding example

HPS 10	- 350	- 160	- 0050	
				Nom. volume $V_0$ [dm <sup>3</sup> ]
				Int. diameter [mm]
				max. operating pressure [bar] 350 bar
Basic type	Piston type hydraulic accumulator type HPS			

#### Function



**General parameters and dimensions**


	Nom. volume $V_0$ [dm <sup>3</sup> ]	$p_{\max}$ [bar]	Ports (BSPP)	Dimensions [mm]	
			<b>G</b>	<b>D</b>	<b>L</b>
HPS 10 - 350 - 050	0.1 ... 1.0	350	G 3/4	60	130 ... 588
HPS 10 - 350 - 080	0,4 ... 4,0		G 3/4	95	166 ... 883
HPS 10 - 350 - 100	2.0 ... 10.0		G 1	115	381 ... 1400
HPS 10 - 350 - 140	4.0 ... 25.0		G 1 1/2	160	418 ... 1783
HPS 10 - 350 - 160	6.0 ... 30.0		G 1 1/2	180	490 ... 1684
HPS 10 - 350 - 180	8.0 ... 40.0		G 1 1/2	205	496 ... 1754

- The data listed represent only a selection of the various differing versions

**Associated technical data sheets:**

- [Piston type accumulators, type HPS: D 7969 HPS](#)

**Similar products:**

- Diaphragm accumulator type AC: [Page 266](#)

# Hydraulic accessories

## 4 Pressure switch type DG

Pressure switches open and close an electrical contact at a previously defined pressure. As soon as the pressure is reached, a further work step is started or stopped by an electrical signal.

The pressure switch type DG is available as a mechanical or electronic switch. The pressure can be adjusted up to 700 bar. The adjustment is made via a pushbutton, a setting knob, a setting screw or a setting ring.

The pressure switch is also available with two switching points for different pressures.

### Features and benefits:

- Compact design
- Option of integration into the HAWE modular system
- Operating pressures up to 1000 bar

### Intended applications:

- General hydraulic systems
- Machine tools



<b>Nomenclature:</b>	Spring loaded piston type pressure switch Electronic pressure switch Pressure transducer
<b>Design:</b>	Screw-in version Manifold mounting Designed for pipe fittings
<b>p<sub>max</sub>:</b>	700 bar

### Design and order coding example

DG 1	RF	
DG 35	V	-YS 8

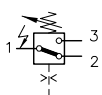
- Hydraulic connection**
- With various tapped journals or to be mounted at fittings (type DG 3..)
  - Combination with various fittings

- Means of adjustment, mounting**
- Manually adjustable (R) or Turn-knob (V, H = with lock) (type DG 3..)
  - Design with bezel for installation in control panels (F)

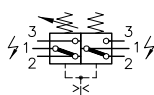
**Basic type** Pressure switch type DG  
 Type DG 1, 3, 8 (spring loaded piston type switch)  
 Type DG 5, DG 6 (Electronic pressure switch with two switch points)  
 Operating voltage 12 V DC, 24 V DC, 110 V AC, 230 V AC  
 Analogous pressure transducer type DT  
 Type DT 11  
 Type DT 2

### Function

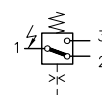
DG 1 R

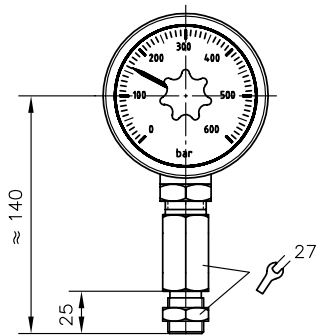
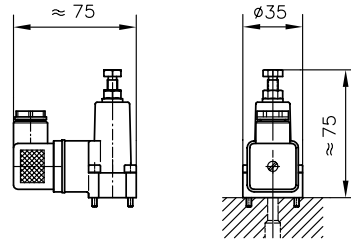
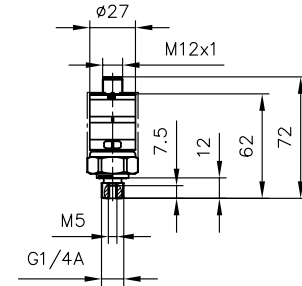
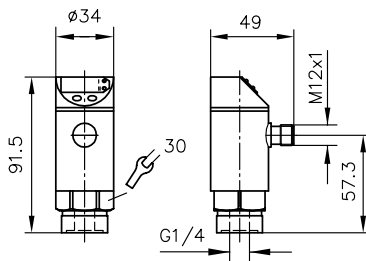
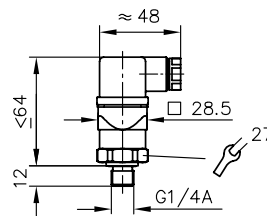
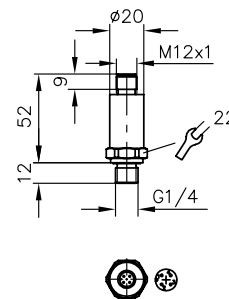


DG 8



DG 3...



**General parameters and dimensions**
**DG 1 R**

**DG 3 ..**

**DG 6.**

**DG 5 E**

**DT 11**

**DT 2**


	Brief description	Adjustable pressure $p_{max}$ [bar] <sup>1)</sup>	Ports (BSPP)	m [kg]
DG 1 R	Adjustment via turn-knob at the dial	20 ... 600	G 1/2 or G 1/4 A	1,3
DG 3..	Compact design for manifold mounting Adjustment via set screw	4 ... 700	G 1/4 or G 1/4 A <sup>2)</sup>	0,3
DG 5 E	Electronic pressure switch with two switch points	0 ... 600	G 1/4 A	0,25
DG 6..		0 ... 400	G 1/4 A or M 5	0,08
DT 11	Analogous pressure sensor	0 ... 1000	G 1/4	0,08
DT 2		0 ... 600	G 1/4	0,7

1) The max. operating pressure of 700 bar is not influenced by the max. possible set pressure

2) For versions with adapter only

**Associated technical data sheets:**

- [Pressure switch type DG: D 5440](#)
- [Electronic pressure switch type DG 5: D 5440 E/1](#)
- [Electronic pressure switch type DG 6: D 5440 F](#)

**Hydraulic accessories:**

- Fittings type X, X 84: [Page 274](#)

**Similar products:**

- [Electronic pressure transducer type DT 11: D 5440 T/2](#)
- [Electronic pressure transducer type DT 2: D 5440 T/1](#)

# Hydraulic accessories

## 4 Pressure filter type PFM

Pressure filters protect downstream hydraulic components against soiling. They are installed in the high-pressure line typically after the pump.

The pressure filter type PFM contains a filter element through which the fluid flows from the inside to the outside. It can be replaced without drips or soiling using standard tools. The ratio of size to performance is optimal, for this reason the filter has low pressure losses even after absorbing a large amount of soiling.

The pressure filter type PFM is used in machine tools, industrial trucks, lifting platforms and in general in oil hydraulics.

- Energy-efficient thanks to low back pressure
- Long change intervals due to high dirt-holding nominal volume
- Filter element replacement is simple and clean

### Intended applications:

- Machine tools
- Industrial trucks
- Lifting platforms
- General oil hydraulics



<b>Nomenclature:</b>	Pressure filter
<b>Version:</b>	In-line installation Can be flanged
<b>p<sub>max</sub>:</b>	250 bar
<b>Q<sub>max</sub>:</b>	90 l/min

### Design and order coding example

PFM4	-4	8	10	-R4	T	-VO	/-
<b>Basic type</b>							
<b>Port</b>	4 = in-line installation UNF3 = in-line installation 7/8-14 UNF F = flange design						
<b>Volumetric flow</b>		5 = less than 40 l/min 8 = less than 90 l/min					
<b>Filter fineness</b>		10 μm					
<b>By-pass valve</b>				R4 = 4 bar X = without			
<b>Installation position</b>					T = vertical D = suspended		
<b>Visual clogging display</b>						VE = electrically 12/24V VO = visually VX = retrofittable - = without	
<b>Seal</b>						without = series KB = cold-resistant	

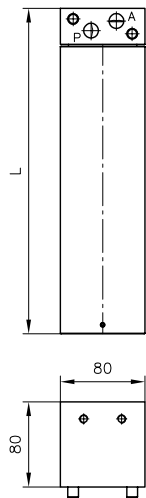
### Function



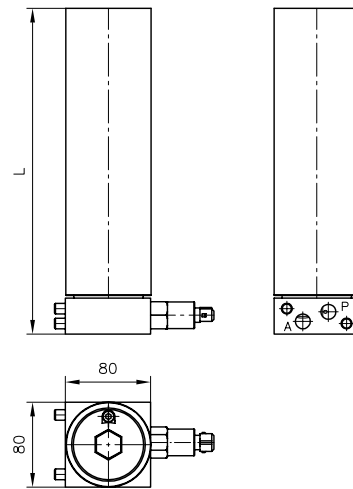


**General parameters and dimensions**

Flange design with corner dimensions



In-line installation with corner dimensions



Type	Dimensions [mm]
	L
PFM4-45	234
PFM4-F5	236
PFM4-48	305
PFM4-F8	301

**Associated technical data sheets:**

- [Pressure filter type PFM: D 8040](#)

# Hydraulic accessories

## 4 Fittings

A selection of hydraulic accessories is available for use in hydraulic systems. Measuring instruments, for example pressure gauges, are used for pressure monitoring and command devices, for example pressure switches, for pressure-controlled switching. Hydraulic accumulators are also available. Various fittings are available, which are used to connect these hydraulic devices to the pressure lines of HAWE hydraulic power packs and valves in various assembly situations. The devices can be combined using reducing connectors. Additional accessory parts such as screen and wire mesh filters safeguard the hydraulic devices against larger, stray impurities which may occasionally occur.

### Features and benefits:

- Compact design
- Option of integration into the HAWE modular system
- Operating pressures up to 700 bar

### Intended applications:

- General hydraulic systems



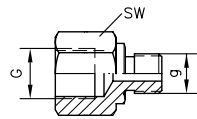
<b>Nomenclature:</b>	Reducing connector Connection fitting Screen filter Wire mesh filter Pressure gauge
<b>Design:</b>	Screw-in version for pipe connection
<b>p<sub>max</sub>:</b>	350... 700 bar

### Designs

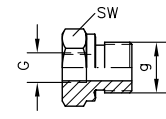
#### Reducing connectors (various dimensions)

##### G - g

- Internal thread - external thread
- BSPP thread - metric thread
- BSPP thread - BSPP thread
- Metric thread - metric thread



SW 19 - 55  
Example: G 1/2A - M 16 x 1.5



Example: G 1/2 - G 1A

##### G - g

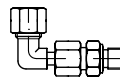
- Metric thread - BSPP thread

#### Fittings

- Connection fitting with tapped journal G 1/4
- Connection fitting with fastening nut and internal port G 1/4
- Connecting pieces for attaching the cutting ring for external pipe diameter 6 to 20 mm
- Straight screw-in fitting
- Swivel fitting
- L-fitting



Example:  
Straight fitting  
type X... G



Example:  
Elbow fitting  
type X... V



Example:  
Swivel fitting  
type X... S

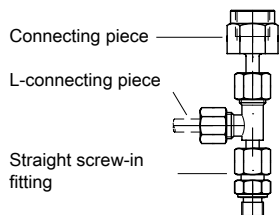
Symbol:



Fitting combinations

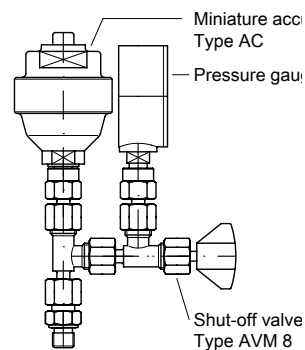
**Consisting of:**

- Connecting pieces
- Straight screw-in fitting
- Swivel fitting
- L-connecting pieces
- Elbow fitting
- AVM 8 shut-off valve
- Locking element



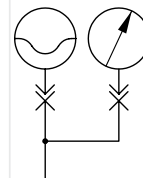
Example: X 84T

Symbol:



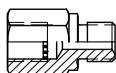
Example: X 84U - AC 40/100-9/400

Symbol:



Screen and wire mesh filters

- BSPP thread
- Metric thread
- Screw-in strainer type HFC (hole  $\text{AE}$  0.63 mm)
- Screw-in wire mesh filter disc type HFC.. F (filter fineness approx. 100  $\mu\text{m}$ )
- Also available with housing



Example:  
**HFE 3/8**  
Strainer with housing (hole  $\text{AE}$  approx. 0.5 mm), with connection thread G 3/8(A)



Example:  
**HFC 1/4 F**  
Screw-in wire mesh filter disc for port G 1/4, filter fineness approx. 100  $\mu\text{m}$

Symbol:



**Associated technical data sheets:**

- [Reducing connector type G: D 845](#)
- [Fitting type X: D 7065](#)
- [Fitting type X 84: D 7077](#)
- [High-pressure screen filter type HFC, HF and HFE: D 7235](#)
- Shut-off valves type AVM 8: [Page 234](#)

# Electronics

Electronic additional components	278
Programmable logic valve control type PLVC	280
Valve controls type CAN-IO, EV2S-CAN	282



*Programmable logic valve controls  
type PLVC*



*Electronic amplifiers*

### General electronic accessory components

Type	Nomenclature/Design	Features
<b>Electronic accessory components</b> Type MSD etc., EV	<ul style="list-style-type: none"> <li>▪ Female connectors with no special feature (standard)               <ul style="list-style-type: none"> <li>- With rectifier circuit, -</li> <li>With clamp diode,</li> <li>- With LED with economy circuit</li> </ul> </li> <li>▪ Amplifier units for proportional solenoids</li> <li>▪ Supply voltage units</li> </ul> <p><b>Version</b></p> <ul style="list-style-type: none"> <li>▪ Female connectors</li> <li>▪ Modules with screw terminals</li> <li>▪ Cards with terminal block</li> </ul>	<p><b>Features and benefits:</b></p> <ul style="list-style-type: none"> <li>▪ Compact design</li> <li>▪ Functions tailored to HAWE-products</li> </ul>

### Electronic controls

Type	Nomenclature/Design	Features
PLVC, CAN-IO	<p><b>Programmable logic valve control</b></p> <ul style="list-style-type: none"> <li>▪ Modular system with               <ul style="list-style-type: none"> <li>- Basic modules</li> <li>- Extension modules</li> <li>- CAN bus nodes</li> <li>- Display</li> <li>- Software</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>▪ Modular systems with extension and enhancement modules (Basic and expansion module)</li> <li>▪ Flexible programming</li> <li>▪ Different interfaces (RS 232, CAN bus, Profibus)</li> <li>▪ All output parameters can be customised</li> <li>▪ Software function modules (PLC programs)</li> </ul>

## 5 Electronic additional components

Proportional amplifiers actuate proportional solenoid valves by converting an input signal into a corresponding control current.

The proportional amplifier type EV is available as a module for top-hat rail mounting or, alternatively, as a card for a card holder. Highly precise functions are possible thanks to the feedback measurement at the valve outputs.

The control parameters ( $I_{\min}$ ,  $I_{\max}$ , dither, ramp times) are configured using pushbuttons or a potentiometer.

### Features and benefits:

- Compact design
- Easy commissioning
- Functions tailored to HAWE-products

### Intended applications:

- For the actuation of proportional valves
- Switch cabinet installation in an industrial setting



<b>Nomenclature:</b>	<ul style="list-style-type: none"> <li>▪ Female connectors with no special feature (standard)</li> <li>▪ With rectifier circuit</li> <li>▪ With clamp diode</li> <li>▪ With LED with economy circuit</li> <li>▪ Amplifier units for proportional solenoids</li> <li>▪ Power supply units</li> </ul>
<b>Design:</b>	<ul style="list-style-type: none"> <li>▪ Female connectors</li> <li>▪ Modules with screw terminals</li> <li>▪ Cards with terminal block</li> </ul>

### General parameters and dimensions

#### Male connector for solenoid valves (single and twin solenoid)

Brief description	Application
No special feature (standard)	For all applications with no special requirements
Version with LED	Visual switching function and EMC protection (note prolonged cut-off times)
Version with clamp diode	For optimum EMC protection (note prolonged cut-off times)
Version with economy circuit	Increased functional security and prolonged lifetime of the solenoids by reducing the voltage (pulse width modulation) after a defined period. Recommended for use in areas with high ambient temperatures and/or for application where the solenoids are permanently energised (e.g. safety circuits)
Version with rectifier circuit	Enables use of DC solenoids when a supply voltage of 110V AC, 230V AC is available

Male connectors with no special feature (DC voltage supply) or the version with rectifier circuit for supply voltage of 110V AC, 230V AC are included as standard in the scope of delivery of the solenoid valve.

## Proportional amplifier

Features:		Adjustable parameters:
<ul style="list-style-type: none"> <li>Constant current control (regardless of the supply voltage and changes in resistance of the solenoid due to heating effects)</li> <li>Improved EMC properties</li> <li>Use in a broad temperature range</li> </ul>		<ul style="list-style-type: none"> <li><math>I_{\max}</math> and <math>I_{\min}</math> setting</li> <li>Setting for ramp time up to 10 sec</li> <li>Reference voltage for potentiometric setpoint generator available</li> <li>Option to set dither amplitude and frequency</li> </ul>
Type	Brief description	Application
EV 1 M EV 1 D	Module version (board only or built-in housing)	Suitable for installation in switch cabinets, secured with screw terminals
EV 22 K	Card version	Card suitable for control of two proportional solenoids. Use in card holder for one, or in a module rack for max. 3 amplifier cards

## Power supply for solenoid valves

Type	Brief description	Application
MNG	Power supply for input voltage 230V AC and output voltage 24V DC, max. power rating 5A	Power supply for solenoid-actuated hydraulic valves or electrical amplifiers for proportional solenoids

## Associated technical data sheets:

### Male connectors:

- [Line connector type MSD and others: D 7163](#)
- [Economy circuit plug type MSE 28026 with adjustable economy voltage: D 7832](#)

### Electronic amplifiers:

- [Proportional amplifier type EV1M3: D 7831/2](#)
- [Electronic amplifier type EV1D: D 7831 D](#)
- [Proportional amplifier type EV22K2: D 7817/1](#)

### Power supply:

- [Power supply unit type MNG: D 7835](#)

### Additional electrical components:

- Proportional amplifier: [Page 278](#)
- Programmable logic valve control type PLVC: [Page 280](#)
- CAN node type CAN-IO: [Page 282](#)
- Other electronic accessories [See "Electronics"](#)

### Suitable products:

#### Lifting modules:

- Type HMT, etc.: [Page 156](#)

#### Prop. pressure valves:

- Type PM, PMZ: [Page 190](#)
- Type PMV, PDV: [Page 178](#)
- Type PDM: [Page 192](#)

- Prop. directional seated valves type EMP: [Page 140](#)
- Prop. directional spool valves type PSL, PSV: [Page 106](#)
- Prop. flow control valves type SE, SEH: [Page 218](#)

#### Electronic pressure sensors:

- Type DT 11 and DT 2: [Page 270](#)

## 5 Programmable logic valve control type PLVC

Valve controls control and regulate complex mobile or stationary hydraulic systems. The programmable valve control type PLVC is a freely programmable PLC with integrated proportional amplifiers. Highly precise functions are possible thanks to the feedback measurement at the valve outputs. The number of digital and analogue inputs and outputs can be configured variably.

The valve control is of modular design and can be expanded to suit the application. It can be very straightforwardly integrated into existing systems due to the existing interfaces.

- Modular systems with extension and enhancement modules (Basic and expansion module)
- Flexible programming
- Different interfaces (RS 232, CAN bus, Profibus)
- All output parameters can be customised
- Software function modules (PLC programs)

### Intended applications:

- Construction machines
- Crane systems
- Complex lifting devices
- Machines for forestry purposes
- Machine tools and press construction



**Nomenclature:** Programmable logic valve control

**Design:** Modular concept with

- Basic modules
- Expansion modules
- CAN bus nodes
- Display
- Software

### General parameters and dimensions

	PLVC 41	PLVC 21	PLVC 8
Number of inputs <sup>1)</sup>			
Digital	27 (3 / 24)	13 (5 / 8)	17 (10 / 7)
Analogue	28 (4 / 24)	12 (4 / 8)	23 (11 / 12)
Frequency	3 (3 / -)	3 (3 / -)	3 (3 / -)
Emergency stop	x	x	x
Number of outputs <sup>1)</sup>			
Digital	16 (- / 16)	16 (8 / 8)	13 (- / 13)
Analogue (PWM)	16 (4 / 16)	4 (4 / -)	16 (16 / -)
Analogue (0 ... 10V)	1 (1/-)	--	--
Relay	8 (3 / 8)	4 (- / 4)	--
Auxiliary voltage	1 (5V DC)	--	--
Interfaces			
RS 232	x	x	x
CAN bus	x	x (- / x)	x (x / x)
Profibus	--	x	--
Power supply (10 ... 30V DC)	5A (10A)	5A	5A

1) Always max. number of inputs and outputs, figures in brackets apply to basic modules and expansion modules

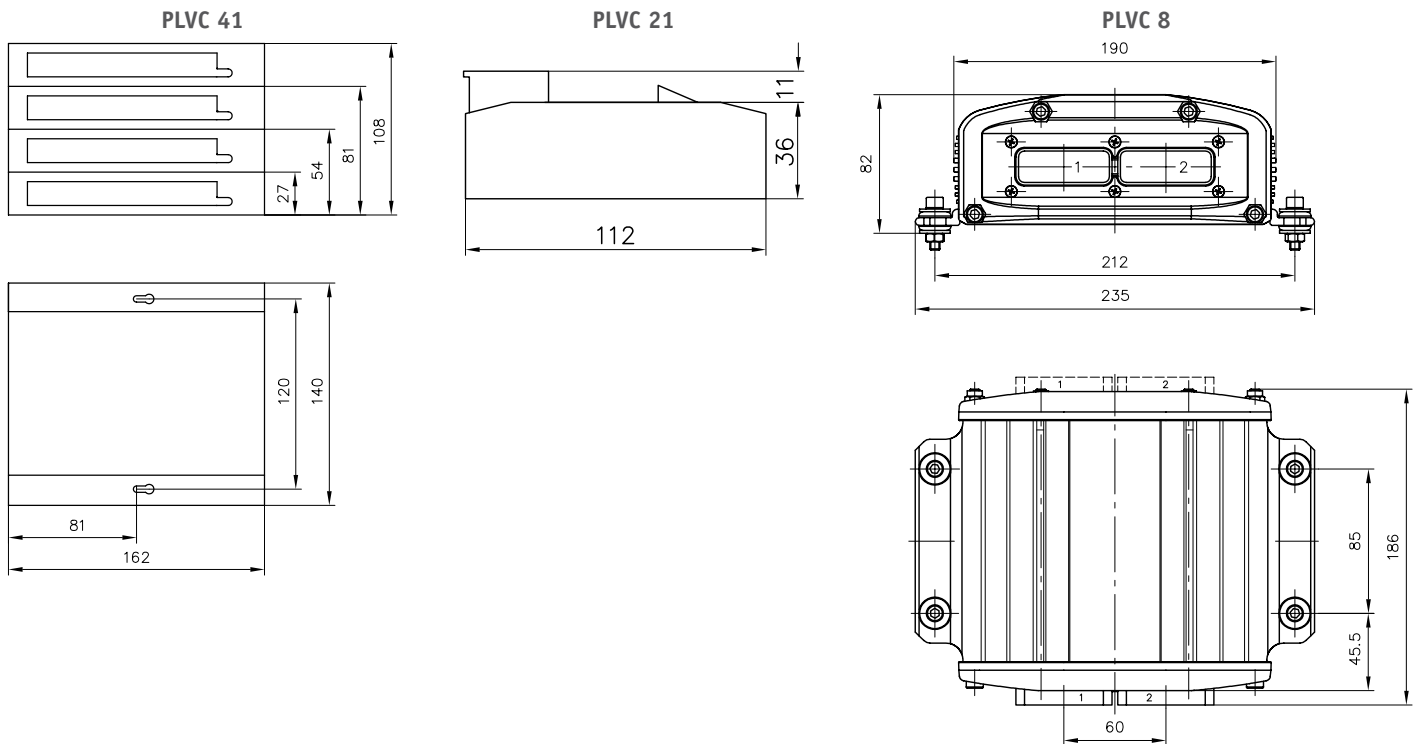


### Software function packs (examples):

- Position measurement
- CAN bus communication
- Position and volumetric flow control
- Fault detection
- Controller for closed control circuits
- Ganging
- Electronic volumetric flow distribution
- Stability
- Limit load control
- Pressure control

Advantage: PLC programming using structured texts (ST) (see above) – The customer can customise the control at any time.

### Dimensions



#### Programmable logic valve control:

- Programmable logic valve control with Profibus type PLVC 21: [D 7845-21](#)
- Programmable logic valve control type PLVC 41: [D 7845-41](#)
- Programmable logic valve control type PLVC 8: [D 7845 M](#)
- CAN node type CAN-IO: [D 7845-IO 14](#)

#### Proportional valves:

- Including type HMT lifting modules: [Page 156](#)
- Proportional directional spool valves type PSL, PSV: [Page 106](#)

#### Proportional valves:

- Proportional flow control valves type SE, SEH: [Page 218](#)
- Proportional pressure-reducing valve type PM, PMZ: [Page 190](#)
- Proportional pressure-limiting valve type PMV, PDV: [Page 178](#)
- Proportional pressure-reducing valve type PDM: [Page 192](#)

## 5 Valve controls type CAN-IO, EV2S-CAN

Valve controls control and regulate complex mobile or stationary hydraulic systems. The programmable logic valve control type CAN IO is a freely programmable PLC with integrated proportional amplifiers. The input and output parameters are set using logical operators. All outputs can also be used as inputs. It is possible to connect together several decentral CAN IO valve controls using the CAN bus.

The proportional amplifier type EV2S-CAN is a plug amplifier designed to be fitted directly on a proportional single or twin solenoid. Parameters can be configured either using the pushbuttons and an integrated display or via CAN bus using computer software.

### Features and benefits:

- CAN bus interface
- Functions and settings tailored to HAWE products
- Precise current-controlled outputs

### Intended applications:

- Mobile machinery and the industry sector
- Connection of analogue proportional valves in the CAN bus networks
- Closed control circuits
- Simple expansion of existing systems



### Nomenclature:

- Programmable logic valve control
- Amplifier plug for proportional solenoids

### Design:

- Valve control with central plug
- Plug amplifier with M12 connection
- Plug amplifier with 3 m cable
- Plug amplifier for two single-stroke solenoids

### General parameters and dimensions

	CAN-IO 14	EV2S-CAN
Number of inputs		
Digital	1	--
Analogue	6 (10)	2
Number of outputs		
Digital	4	--
Analogue (PWM)	4	2
RS 232	x	--
CAN bus	x	x
Power supply	10 ... 30 V DC	10 ... 30 V DC
Output current	2 A (max. 10 in total)	2 A



# Appendix

## 6 Hydraulic fluids – notes for selection

The performance of a hydraulic system depends to a large extent on the quality of the hydraulic fluid used.

The hydraulic fluid should essentially be selected according to the operating conditions, such as

- Temperature (see viscosity classes)
- Device type (possible ban on certain hydraulic fluids due to undesired reactions with metals, seals etc.)
- Usage type (e.g. environmentally compatible hydraulic fluids)
- Surroundings (use of existing hydraulic fluids)

<b>Temperature range:</b>	Ambient: -40...+80°C <b>Important:</b> Air-driven pumps type LP +5...+80°C
<b>Start temperature:</b>	Hydraulic fluid: -25...+80°C Please observe viscosity range and any additional restrictions.
<b>Viscosity range:</b>	Down to -40°C permissible Observe start viscosities as long as the steady-state temperature is at least 20K higher for subsequent operation! For biologically degradable or fire inhibiting hydraulic fluids generally not over max. +60...+70°C.
	Min. approx. 4 mm <sup>2</sup> /s, Max. approx. 1500 mm <sup>2</sup> /s Optimal operating range approx. 10...500 mm <sup>2</sup> /s

### Mineral oils

Hydraulic fluid	Characteristics	Unusual features / restrictions
▪ Hydraulic oils HLP (DIN 51524 part 2)	Mineral oil with additives improving corrosion, oxidation and wear protection	Common hydraulic fluid
▪ Hydraulic oils HL (DIN 51524 part 1)	Mineral oil without wear protecting additives	Not suitable for any types of gear pump due to the lack of wear protection additives. <ul style="list-style-type: none"> <li>▪ No pumps and power packs with gear pumps type RZ, Z</li> <li>▪ No compact hydraulic power packs HC, KA, MP, MPN, HK, HKL</li> </ul>
▪ Hydraulic oils HVLP (DIN 51524 part 3)	Mineral oil with same additives as HLP, but with increased viscosity index for use in higher temperature ranges	The viscosity index correctors have a negative effect on the shear strength (viscosity loss approx. 30% when loaded), demulsifying behaviour and air release characteristics, for example. Only use if required due to temperature range. Oil manufacturer must be consulted!
▪ Unalloyed oils H e.g. <ul style="list-style-type: none"> <li>- Lubricating oils (DIN 51517 Part 1)</li> <li>- White oils (e.g. NSF H1)</li> </ul>	Mineral oil without additives	Due to lack of additives only suitable for systems in the standby mode (S2 or S3 mode) (low lubricity). White oils are mostly used in systems with possible contact with foodstuffs.
▪ Hydraulic oils PAO (tested for compliance with DIN 51524 Part 2 and Part 3)	Mineral oil with additives improving corrosion, oxidation and wear protection	See information on hydraulic oils HVLP
▪ Special fluids in the aviation sector (MIL H-5606) in the marine sector (NATO H 540)	Mineral oils are based as a rule on naphthenic oil with wide temperature range	Seals made of fluor rubber FPM might be required, depending on hydraulic fluid. Consult the oil manufacturer!
▪ Other mineral oils <ul style="list-style-type: none"> <li>Engine oils HD</li> <li>ATF automatic transmission fluid (AQ A, suffix A)</li> <li>Diesel</li> <li>Test oil for diesel injection pump test</li> </ul>	Mineral oils which basically were developed for other application purposes	More or less suitable hydraulic fluids. Pay attention to the presence of oxidation and corrosion protection as well as material compatibility (above all in relation to the seals). Attention: increased leakage with directional spool valves. Oil manufacturer must be consulted!

## Environmentally compatible hydraulic fluids ISO 15380

Hydraulic fluid	Characteristics	Unusual features / restrictions
<ul style="list-style-type: none"> <li>▪ Seed oil type HETG</li> </ul>	Fluids based on seed oils e.g. rape or sunflower with additives show only low temperature resistance (< 60...70°C)	Not suitable for compact power packs type HC, KA, MP, MPN, HK, HKL, all valves with wet armature solenoids as well as control systems utilizing many throttles. HETG fluid show a tendency to gum, ageing, and sticking at higher temperatures (> 60...70°C). Their use should be avoided!
<ul style="list-style-type: none"> <li>▪ Polyethyleneglycol HEPG PEG-Polyethylene (may be solved in water) PPG-Polypropylene (can't be solved in water)</li> </ul>	Fluids based on polyethylene glycol (PEG) Properties similar to mineral oil with regard to lifetime, lubricity and pressure resistance	No restrictions with regard to the operation behavior, but it <ul style="list-style-type: none"> <li>▪ Is harmful to standard enamel (does not apply to two-pot enamel)</li> <li>▪ Will clog cellulose filters (use only glass fiber or metallic filters)!</li> <li>▪ Shows bad lubrication characteristic with material pairings steel / light alloy or brass</li> <li>▪ No pumps and power packs with gear pumps type RZ and Z</li> <li>▪ Do not use compact hydraulic power packs type HC, KA, MP, MPN, HK, HKL</li> <li>▪ No connection blocks with return line filter type A.F., AF, BF, EF, FF</li> </ul>
<ul style="list-style-type: none"> <li>▪ Synthetical ester HEES (carbon acid ester, diester, polyester)</li> </ul>	Similar qualities i.e. lifetime, lubricating characteristics and pressure resistance, like mineral oil	No restrictions with regard to the operation behavior. Contact with PVC should be avoided.

## Flame-resistant hydraulic fluids ISO 12922

Hydraulic fluid	Characteristics	Unusual features / restrictions
<ul style="list-style-type: none"> <li>HFA (pressurized water, emulsions)</li> </ul>	Oil in water emulsion, (water content > 80%) max. temp. range approx. 60°C	<p>There is the danger of corrosion and cavitation due to the high water content, only use devices specially constructed for this purpose (radial piston pumps type R, directional seated valves type G) Max. pump pressure 50...60% (danger of cavitation) minimum content of mineral oil &gt; 4%</p> <ul style="list-style-type: none"> <li>Do not use compact hydraulic power packs HC, KA, MP, MPN, HK, HKL – risk of short circuit</li> <li>No paper filters – risk of blockage No connection blocks with return line filter type A.F., AF, BF, EF, FF</li> </ul>
<ul style="list-style-type: none"> <li>HFC</li> </ul>	Diluted (poly) glycol solution (water content > 35%) max. temp. range up to approx. 60°C	<p>No restrictions with regard to the operation behavior, but it</p> <ul style="list-style-type: none"> <li>Incompatible with zinc</li> <li>No paper filters – risk of blockage No connection blocks with return line filter type A.F., AF, BF, EF, FF</li> <li>Will clog cellulose filters (use only glass fiber or metallic filters)!</li> <li>Shows bad lubrication characteristic with material pairings steel/light alloy or brass</li> <li>No compact hydraulic power packs HC, KA, MP, MPN, HK, HKL</li> </ul>
<ul style="list-style-type: none"> <li>HFD HFDR phosphoric ester HFDU polyolester</li> </ul>	Fluids without water content, properties similar to mineral oil	<p>Normal operation possible Restrictions:</p> <ul style="list-style-type: none"> <li>Requires seals out of FPM (FKM) (see also section "Seals")</li> <li>Oil manufacturer must be consulted!</li> </ul>

## Special fluids

Hydraulic fluid	Characteristics	Unusual features / restrictions
<ul style="list-style-type: none"> <li>AT-Brake fluid</li> </ul>	Brake fluid based on glycol (DOT 4)	<p>No restrictions with regard to the operation behaviour, but devices must be equipped with EPDM or SBR seals (see "Seals" section) No compact hydraulic power packs type HC, KA, MP, MPN, HK, HKL</p>

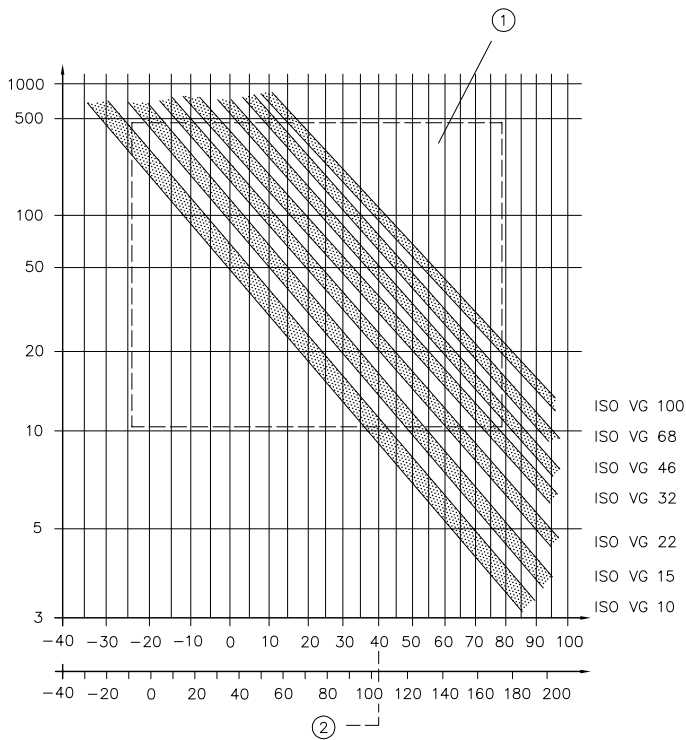
### Viscosity grade selection

Of the 18 viscosity classes (ISO VG) listed in the standard "ISO viscosity classification for liquid lubricants" (ISO 3448), the areas ISO VG10 to ISO VG68 are relevant for hydraulic systems. The number after "ISO VG" corresponds to the nominal viscosity at a reference temperature of 40°C. The temperature behaviour displayed in the diagram corresponds to that of mineral hydraulic oils. The characteristic curve increase of HVLP and the environmentally compatible hydraulic fluids is flatter, indicating that the temperature effect is lower.

Due to manufacturer-related differences, the following benchmark figures are to be clarified and compared with the permissible viscosity ranges:

- Viscosity at 40°C
- Viscosity at the lowest (estimated or demanded) temperature
- Viscosity at the highest (estimated or demanded) temperature (to ensure sufficient service life of the seals not above 80°C!)

### Temperature / viscosity curve



- 1 Optimum range
- 2 Reference temperature  
ISO 3448

### Guide lines for selection

- VG10, VG15  
Systems intended for short time operation or use in the open or for clamping devices.  
Systems intended for continuous operation (for use in the open, operation in winter only)
- VG22, VG32  
General application (for use in the open, operation in summer only)
- VG46, VG68  
Systems in tropical conditions at ambient temperatures up to 40°C or closed rooms

## Hydraulic fluid filtration

Fine contamination (e.g. debris and dust) or contamination in the macro range (e.g. wear debris, rubber particles from hoses and seals) may significantly impair the function of a hydraulic system.

Maintain the following hydraulic fluid purities (assuming a thorough flushing has taken place prior to the date of commissioning):

Recommended purity of the hydraulic fluid	Recommended filter fineness	Devices	Note
<b>ISO 4406 : 1999</b>			
21/18/15...19/17/13	$\beta_{16...25} \geq 75$	Radial piston and gear pumps, valves, cylinders (use in general mechanical engineering)	The purity degree of the hydraulic fluid is especially important for the repeatability accuracy with proportional valves.
20/17/14...18/15/12	$\beta_{6...16} \geq 75$	Prop. pressure and flow control valves	It should be noted that new hydraulic fluid "from the barrel" does not necessarily fulfil the highest cleanliness requirements.
19/17/14	$\beta_{6...16} \geq 75$	Variable displacement axial piston pumps	

Lower limits must be applied for pressure above 250 bar

## Service life of the hydraulic fluid

The aging of hydraulic fluids is caused by shearing processes, cracking induced by high temperatures (gumming), mixing with (condensed) water or reaction with other materials (e.g. metal) in the system (sludging). A major factor for the service life of the fluid is beside the anti-shear additives of the fluid the lay-out of the system e.g. tank size, operation temperature, number and design of throttling sections.

Besides the properties of the hydraulic fluid itself (e.g. due to additives for high shear stability), the design of the hydraulic control system (e.g. tank size, steady-state temperature, number and type of throttling points) has a major influence on this.

The following points are to be noted:

- Service temperature in the tank < 80°C  
(mineral oils, hydraulic fluids with low water content) Avoid higher temperatures – Service life reduction – (+10K corresponds to half service life)
- Rotational conditions of hydraulic fluid  $\frac{Q_{pump}[lpm]}{V_{circuit}[l]}$  (guideline)
  - approx. 0.2...0.4/min for conventional compact hydraulic power packs
  - approx. ...1/min in mobile hydraulics
  - approx. ...4/min for hydraulic power packs in standby or no load operation
- Control of the hydraulic fluid on a regular base (fluid level, contamination, coloring index, neutralization value etc.)
- Change of the hydraulic fluid on a regular base (depending on fluid type and application conditions)  
Guideline:
  - approx. 4000 ... 8000 h (mineral oil)
  - approx. 2000 h (other hydraulic fluids)
  - or at least annually
 Take into account notes of the fluid manufacturer!

## Changing the hydraulic fluid

Do not mix different types of hydraulic fluids! This may lead to undesirable chemical reactions causing sludge, resinification etc.

The relevant manufacturers should be consulted when switching between different hydraulic fluids. In all cases, the whole hydraulic system should be thoroughly flushed.



### Interaction with seals

Any question about the compatibility with seal material should be settled with the fluid manufacturer always before using a certain hydraulic fluid (except mineral oil and synthetic esters). A rough overview is given in the table at the start of this section. HAWE utilizes seals made of the following materials as standard:

- NBR (acrylonitrile rubber, e.g. Bunan, Perbunan) or HNBR (hydrated NBR).

Some devices are available on request with seals made of:

- FPM (also FKM, fluor rubber) e.g. for fluids type HFD
  - The coding ...-PYD should be added to the coding for HAWE devices, e.g. WN1H-G24-PYD
- EPDM (ethylene propylene rubber) or SBR (styrene-butadiene rubber)
  - The coding ...-AT should be added to the coding for HAWE devices, e.g. WN1H-G24-AT (for brake fluid)

### Storing hydraulic fluids and hydraulic components

Storage conditions for hydraulic components depend primarily on the following factors:

- seals utilised, moistening with oil during the factory functional test

The storability of rubber materials is generally influenced by the following factors:

- Warmth, light, humidity, oxygen, ozone

As far as possible, components should be de-energised and without deformation when stored. A storage temperature range of 15 to 20°C is optimum. Relative humidity approx. 65% (+-10%). Exposure to direct sunlight or a light source with strong UV rays should be avoided. Ozone-producing equipment (electric motors, high-voltage equipment) among other things must not be present in the storage room. If seals are packaged in plastic bags, these should not contain any plasticisers and, if necessary, should be impermeable to UV light.

Details on storage of elastomers are also available in the following standards: DIN 7716/BS4F68:2012, MIL-HDBK-695, SAE ARP 5316, SAE AS 1933, DIN 9088.

Hydraulic fluids can be stored for an unlimited period in sealed containers supplied by the manufacturer, as no chemical reactions take place. The presence of atmospheric oxygen, dust and moisture can lead to more or less rapid oxidation and resinification, depending on the type of oil and its additives.

A dark room with virtually constant temperature and humidity is recommended for storage of hydraulic components. The parts should be kept in a plastic bag to protect them from dust and continuous air exchange.

A functional test (manual override, dry switching) should be carried out at least once a year to ensure operation.

Safety-related components: A six-monthly functional test on site and a regular factory inspection including seal replacement every 2 years.

When the hydraulic components are stored as described above, the risk of corrosion is low. Most external parts of HAWE components are coated with a protective layer (galvanised, nitrided) and moistened with oil.

Hydraulic systems planning must be carried out taking a variety of factors into consideration, whereby the hydraulic elements are selected according to the desired functional processes.

The most important condition for this is the definition or specification of relevant consumer variables, such as the loads (load forces, load torques or turning torques), motion functions (travel, speeds, rotational speeds, timing) etc.

Only then is it possible to determine hydraulic consumers (hydraulic motors, hydraulic cylinders), drive units (pumps with drives), control and regulating devices (valve types with actuations) as well as connecting elements (lines, branch points).

Other factors that have an influence on the choice of hydraulic systems and components include noise emission values and thermal budget considerations.

The following formulae and tables are non-binding and are intended to make producing the rough design for a hydraulic system easier.

Equipment	Formulas and description		Symbol
General information	Basic equations (static, without any loss)		
	$Q = \frac{V}{t}$ $V = A \cdot s$ $F = p \cdot A$ $p = \frac{F}{A}$ $Q = A \cdot v$ $M = \frac{V \cdot p}{2 \pi}$ $v = \frac{s}{t}$	force volume A: Q: v: V: torque s: M:	Force Pressure Area volumetric flow Speed Volume Time Travel (stroke) Torque
Equipment	Formulas and description		Symbol
<b>Hydraulic cylinders</b>			
<ul style="list-style-type: none"> <li>Single acting</li> </ul>	$A [mm^2] = \frac{\pi}{4} d^2 [mm]$ $v \left[ \frac{m}{s} \right] = \frac{s [mm]}{1000t [s]}$ $F_s [N] = 0,1 p_B [\text{bar}] \cdot A [mm^2]$ $p_B [\text{bar}] = \frac{-10 F_s [N]}{A_1 [mm^2]}$ $Q_{in} [l/min] = 0,06 \cdot A [mm^2] \cdot v \left[ \frac{m}{s} \right]$	d: piston diameter [mm] A: piston area [mm <sup>2</sup> ] F <sub>s</sub> : force [N] p <sub>B</sub> : operating pressure [bar] v: Piston speed $\left[ \frac{m}{s} \right]$ Q <sub>in</sub> : inflow [lpm] s: stroke [mm] t: time [S]	
<ul style="list-style-type: none"> <li>Double acting</li> </ul>	<b>Extending</b> Basic equations (balance of forces): $A_1 = \frac{\pi}{4} d_1^2 \approx 0,78 d_1^2$ $A_3 = \frac{\pi}{4} (d_1^2 - d_2^2)$ $p_1 \cdot A_1 = p_3 \cdot A_3 - F$ $p_1 = \frac{1}{A_1} (p_3 \cdot A_3 - F)$ $Q_{in} = A_1 \cdot v$ $Q_{out} = A_3 \cdot v$	Simplified: $p_1 [\text{bar}] = \frac{p_3 [\text{bar}] \cdot A_3 [mm^2] - 10 F [N]}{A_1 [mm^2]}$ $F [N] = \frac{-p_1 [\text{bar}] \cdot A_1 [mm^2] + p_3 [\text{bar}] \cdot A_3 [mm^2]}{10}$ p <sub>3</sub> is the result of flow resistance from pipes and valves for Q <sub>out</sub> Attention: note possible pressure intensification!	
	<b>Retracting</b> Basic equations (balance of forces): $p_1 \cdot A_1 = p_3 \cdot A_3 + F$ $p_3 = \frac{1}{A_3} (p_1 \cdot A_1 - F)$ $Q_{in} = A_3 \cdot v$ $Q_{out} = A_1 \cdot v$	Simplified: $p_3 [\text{bar}] = \frac{p_1 [\text{bar}] \cdot A_1 [mm^2] - 10 F [N]}{A_3 [mm^2]}$ $F [N] = \frac{p_1 [\text{bar}] \cdot A_1 [mm^2] - p_3 [\text{bar}] \cdot A_3 [mm^2]}{10}$ p <sub>1</sub> result of flow resistance from pipes and valves for Q <sub>out</sub>	
	A <sub>1</sub> : piston area [mm <sup>2</sup> ] A <sub>3</sub> : rod side area [mm <sup>2</sup> ] d <sub>1</sub> : piston AE [mm] d <sub>2</sub> : rod AE [mm] F: force [N]	Q <sub>in</sub> : inflow [lpm] Q <sub>out</sub> : outflow [lpm] p <sub>1</sub> : pressure, piston side [bar] p <sub>3</sub> : pressure, rod side [bar] s: stroke, travel [mm]	

Equipment	Formulas and description		Symbol
Hydraulic pumps / hydraulic motors	Basic equations:	$\Delta p = p_1 - p_o^{1)}$	 Hydraulic pump
	Geometric volume per revolution (piston pumps):	$V = A \cdot h$ $V [cm^3] \approx \frac{A [mm^2] \cdot h [mm]}{1000}$	
	volumetric flow:	$Q = V \cdot n$ $Q [lpm] \approx \frac{V [cm^3] \cdot n [min^{-1}]}{1000}$	 Hydraulic motor
	Middle torque:	$M = \frac{V \cdot \Delta p}{2 \pi}$ $M [Nm] \approx \frac{V [cm^3] \cdot \Delta p [bar]}{62}$	
	Power:	$P_{hydr} = \Delta p \cdot Q$ $P_{hyd} [kW] \approx \frac{\Delta p [bar] \cdot Q [lpm]}{612}$	
	Power rating (motor)	$P_{mech} = \frac{\Delta p \cdot Q}{\eta_T} = \frac{M \cdot 2 \pi n}{\eta_T}^{2)}$ $P_{Drive} [kW] \approx \frac{\Delta p [bar] \cdot Q [l/min]}{500}$	
	Power output (pump)	$P_{max} = \Delta p \cdot Q \cdot \eta_T = M \cdot 2 \pi n \cdot \eta_T^{2)}$ $P_{Output} [kW] \approx \frac{\Delta p [bar] \cdot Q [lpm]}{740}$ $\approx \frac{M [Nm] \cdot n [min^{-1}]}{12000}$	
V: displacement [cm <sup>3</sup> ] A: effective piston area [mm <sup>2</sup> ] h: double stroke [mm] n: rev. rating [rpm] M: middle torque [Nm] p: pressure [bar] Δp: effective pressure [bar] Q: volumetric flow [lpm] P <sub>hydr</sub> : hydraulic performance [kW] P <sub>mech</sub> : mechanical performance [kW] η <sub>T</sub> : total efficiency (including volumetric and mechanical losses)		Simplified:  Guideline: A power rating of 1 kW for the drive is necessary to achieve a delivery volumetric flow of Q = 1 lpm with operating pressure p = 500 bar!	

<sup>1)</sup> p<sub>o</sub> is calculated from line and valve resistance

<sup>2)</sup> incl. degree of efficiency η<sub>T</sub> ≈ 0.82

Equipment	Formulas and description	Symbol
<b>Valves</b> Directional valves Pressure valves Metering valves Check valves	Losses of pressure by streaming fluid The pressure loss in hydraulic systems consists of: <ul style="list-style-type: none"> <li>Flow resistance of valves</li> <li>Flow resistance of pipes</li> <li>Flow resistance due to geometric shape (elbows etc.)</li> </ul> Pressure losses Δp in the valves that are caused by the volumetric flow of fluid can be found in the Δp-Q characteristics of the relevant documentation. For the purposes of an initial rough design, a performance loss of approx. 20... 30% in the overall control system can generally be expected.	Examples: Directional valve  Pressure limiting valve  Flow control valve  Releasable check valve 



Equipment	Formulas and description	Symbol
<b>Volumetric losses</b> (due to pressure increase)	Basic equation: $\Delta V = \beta_p \cdot V_o \cdot \Delta p$ with $\Delta p = p_2 - p_1$	$F = \Delta p \cdot A$ 
	$p_1$ : pressure, start [bar] $p_2$ : pressure, end [bar] $V_o$ : initial volume [l] $\Delta V$ : change in volume [l] $\beta_p$ : compressibility	
<b>Volumetric losses</b> (due to temperature rise)	Basic equation: $\Delta V = \beta_T \cdot V_o \cdot \Delta \vartheta$ with $\Delta \vartheta = \vartheta_2 - \vartheta_1$	
	$\vartheta_1$ : temperature, start [°C] $\vartheta_2$ : temperature, end [°C] $\Delta \vartheta$ : temperature, difference [K] $V_o$ : initial volume [l] $\Delta V$ : volume alternation [l] $\beta_T$ : expansion coefficient	
<b>Pressure increase caused by temperature rise</b> (without volumetric compensation)		$\Delta V = 0,7 \cdot 10^{-4} \cdot \Delta p = 0,7 \cdot 10^{-3} \cdot \Delta \vartheta$ i.e. $\Delta \vartheta \approx 1 \text{K} \Leftrightarrow \Delta p \approx 10 \text{ bar}$
	<b>Note:</b> A temperature rise of trapped oil volume will cause a pressure increase! (i.e. a pressure limiting valve will be required sometimes) <b>Guideline:</b> The pressure will rise by approx. 10 bar for 1 K of temperature increase.	

Equipment	Formulas and description	Symbol
<b>Hydraulic accumulators</b> Pressure alternations, isotherm (slow) adiabatic (quick)	Hydraulic accumulators are intended for the supply of pressurized fluid during sudden demands (quick, adiabatic pressure alternations), compensation of leakage losses or to dampen oscillations (slow, isotherm pressure alternations).	
	Basic equations:	$p_1 = 1,1 \cdot p_o$
	isotherm (slow)	$\Delta V = V_1 \cdot \left(1 - \frac{p_1}{p_2}\right)$
	adiabatic (quick)	$\Delta V = V_1 \cdot \left(1 - \left(\frac{p_1}{p_2}\right)^{0,71}\right)$
	$p_o$ : filling pressure for the gas [bar] $p_1$ : lower operating pressure [bar] $p_2$ : upper operating pressure [bar] $V_1$ : initial volume [l] $\Delta V$ : volume alternation [l]	

Equipment	Formulas and description		
<b>Cavitation</b>	Approx. 9 % (volumetric) air are solved in oil at atmospheric pressure. There is the danger of bubble cavitation during atmospheric pressure below 0,2 bar. These situations can occur, accompanied by sudden noise, during suction process of pumps and cylinders as well as at extreme throttle sections. The hydraulic components where this occurs will show increased wear.		
<b>Equipment</b>	<b>Formulas and description</b>		
<b>Thermal level</b> Dissipation power and oil temperature	<p>The hydraulic power losses in a hydraulic system result in a temperature rise of the fluid and the equipment which is partly radiated to the surroundings via the surface of the system. They roughly amount 20 - 30% of the induced performance. The induced and the radiated heat will balance at some point after the warm-up of the system.</p> <p style="text-align: center;">Basic equations: <math>P_v = 0,3 \cdot P_{hydr} \quad \vartheta_{\dot{o}lmax} \approx \vartheta_{Umg} + C \cdot \frac{P_v}{A}</math></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 70%;">           Surface with unhindered circulation <math>c \approx 75</math>            Surface with bad circulation <math>c \approx 120</math>            with fan (<math>v \approx 2 \text{ m/s}</math>) <math>c \approx 40</math>            Oil/water radiator <math>c \approx 5</math> </td> <td style="width: 30%; text-align: center;">           Simplified:  <math display="block">\vartheta_{\dot{o}lmax} \approx \vartheta_{Umg} + C \cdot \frac{0,3 \cdot P_{hydr}[kW]}{A[m^2]}</math> </td> </tr> </table> <p> <math>P_v</math>: performance loss, transformed in heat [kW]  <math>P_{hydr}</math>: hydraulic performance [kW]  <math>\vartheta_{\dot{o}lmax}</math>: max. fluid temperature [°C]  <math>\vartheta_{amb}</math>: ambient temperature [°C]            A: surface of the system (tank, pipes etc.) [m<sup>2</sup>]         </p>	Surface with unhindered circulation $c \approx 75$ Surface with bad circulation $c \approx 120$ with fan ( $v \approx 2 \text{ m/s}$ ) $c \approx 40$ Oil/water radiator $c \approx 5$	Simplified: $\vartheta_{\dot{o}lmax} \approx \vartheta_{Umg} + C \cdot \frac{0,3 \cdot P_{hydr}[kW]}{A[m^2]}$
Surface with unhindered circulation $c \approx 75$ Surface with bad circulation $c \approx 120$ with fan ( $v \approx 2 \text{ m/s}$ ) $c \approx 40$ Oil/water radiator $c \approx 5$	Simplified: $\vartheta_{\dot{o}lmax} \approx \vartheta_{Umg} + C \cdot \frac{0,3 \cdot P_{hydr}[kW]}{A[m^2]}$		

### Conversion table

Nomenclature	Codings	Unit	≈	Factor X	Unit
Pressure	p	$1 \frac{N}{mm^2}$	≈	10	bar
		1 MPa	≈	10	bar
		$1 \frac{kgf}{cm^2}$	≈	1	bar
		1 psi	≈	0.07	bar
Force	F	$1 \frac{kg \cdot m}{s^2}$	=	1	N
		1 lbf	≈	4.45	N
Length, travel, stroke	l, s, h	1 in	≈	25.4	mm
		1 ft	≈	304.8	mm
Torque	M	$1 \frac{kg \cdot m^2}{s^2}$	=	1	Nm
Performance	P	1 PS, 1 hp	≈	0.74	kW
Area	A	1 ft <sup>2</sup>	≈	92903	mm <sup>2</sup>
		1 in <sup>2</sup>	≈	645.16	mm <sup>2</sup>
Volume	V	1 ft <sup>3</sup>	≈	28.92	l
		1 in <sup>3</sup>	≈	$1.64 \cdot 10^{-2}$	l
		1 UK gal	≈	4.55	l
		1 US gal	≈	3.79	l
Temperature	T, $\vartheta$	5 (°F-32)/9	≈	1	°C
Weight	m	1 lb	≈	0.45	kg
Cinematic viscosity	v	1 cST	=	1	$\frac{mm^2}{s}$

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