Product overview





## Preface

Now more than 50 years have passed since the founding of "Heilmeier & Weinlein Fabrik für Oelhydraulik GmbH & Co. KG" which is better known today as "HAWE Hydraulik". Innovative ideas, high product quality and a lot of enthusiasm has contributed to HAWE's steady growth. We now have more than 1000 employees, a worldwide sales network with sales offices in Germany, eight HAWE subsidiaries and more than 30 representatives international.

The product range has been widened continuously over the years, covering standard valves e.g. pressure valves etc. as well as many products tailored for special purposes such as pre-fill valves, lifting/lowering valves etc. There are three distinguishing features that make HAWE products unique in the fluid power industry: All HAWE products are developed based on the HAWE modular design concept, i.e. components and manifold circuits can be combined simply with other HAWE products to form additional control functions at minimal cost. Secondly, all pressurized parts are made of steel. And finally, all products are produced by German craftsmen to ISO 9000:2000 quality standards.

This Product Overview is intended to give you a summary of the general capabilities of the variety of pumps, valves, and



other equipment manufactured by HAWE.

This publication is supplemented with additional product specific pamphlets, all containing detailed technical specifications as well as "how to order" information. The technical information contained in these pamphlets is substantial and include guarantee and warrantee details. These pamphlets may be ordered from your local HAWE sales representative or directly from HAWE in Munich (contact: Mrs. Kettenstock).

All of our HAWE sales representatives as well as our Technical Information Department in Munich, Germany will be also pleased to assist you with your specific circuit design as well as help you select the most functional and cost effective HAWE product for your application. It is our understanding to be Your partner for all hydraulic related problems and to give You all from planning assistance till after sales service.



#### Note:

All information from HAWE, our staff or our representatives provide product or system options for further investigation by users having technical expertise. Before you select or use any product or system it is important that you analyse all aspects (incl. safety regulations) of your application and review the information concerning the product or system in the current product catalogue.



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# **Turn-key solutions from our modular system**

Complete hydraulic control systems can be created at minimal cost by combining our hydraulic power packs, connection blocks and valve banks.

These valve banks may be also fed via pipes when connection blocks type C 15 / C 16 are used as start block of the valve bank. A detailed description of the HAWE products, including their performance parameters, may be found at the appropriate pages in this catalogue or the corresponding pamphlets additionally listed.

Nomenclature:	Compact hydraulic power pack with directly mounted valve bank
Design:	Complete hydraulic control system
p <sub>max</sub> :	700 bar



#### **Order examples** FP 12 - H 0,56 -C 5 B31/450 - EM11 V - 13 - G 24 HC 34/0,9 -MP 24 - H 1,39 - Z 12,3/B 25 - NE 21 - 320/25 -VB 21 GM - RH - 3 - G 24 AS 1 F 2/300 -HK 448 ST/1 - H 5,0 -BVZP 1 F23 - G 52/22 - H14 N15/0 - 1 - 1 - G 24 BWN 1F - HJ5 - 1 - 1 - G 24 C 16 -AP 34 - 43/24 -Compact hydraulic power packs Connection blocks Directly mounted valve banks **Further information** Compact hydraulic power pack type FP D 7310 Connection block type A... D 6905 A type HC, HCW, HCG D 7900, D 7900 G D 6905 TÜV D 6905 B type MP, MPW D 7200, D 7200 H type B.. type HK, HKF, HKL D 7600 ff type C.. D 6905 C • Dual stage valves type NE D 7161 • Hydraulic power pack with radial piston pump D 6010, D 6010 H • Dual stage connection block type NA D 6905 A type R, RG • Directional spool valves type SWC, SKC D 7450, D 7230 • Hydraulic power pack with gear pump type Z D 6820 • Switch unit type CR D 7150 • Hydraulic power pack with dual stage pump D 6910, D 6910 H Valve banks type VB D 7302 type RZ type BWH(N) D 7470 B/1 D 7280, D 7280 H type BVZP D 7785 B

• Hydraulic power pack with pneumatically operated pump type LP

• also see section "Devices for special applications"

(Hydraulics for clamping, Press controls, Devices for up to 700 bar)

type SWR, SWS

type BA, BV

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D 7450, D 7451, D 7951

D 7788

#### **Possible combinations**



load operation ( $P_{max} = 700$  bar,

Q<sub>max</sub> = 15 lpm) available in 5 sizes,

also as dual stage pump, various

tank sizes

for miniature hydraulic systems with 5 ...10% ED ( $P_{max} = 700$  bar,  $Q_{max} = 2.1$  lpm)

systems with 10...30% ED

(P<sub>max</sub> = 700 bar,

Q<sub>max</sub> = 12.9 lpm),

available in 3 sizes

( $P_{max} = 700$  bar,  $Q_{max} = 16$  lpm),

and triple circuit pump

available in 3 sizes, also as double



# Miniature hydraulic power packs type FP

This ready for connection hydraulic power pack is used to supply pressurized fluid for low volume actuators such as clamping functions, small lifting platforms with short operation cycles and prolonged idling periods.

The power pack consists of a cover plate, where motor and pump are mounted and fixed to the tank. The electrical source is connected with an electrical lead provided.

Complete hydraulic control systems can be created by directly mounting various connection blocks and valve banks to the hydraulic power pack.



#### Basic types and general parameters

Nomenclature:	Radial piston pump with integrated electric motor (version for 3-phase mains)
Design:	Oil immersed compact hydraulic power pack for short period operation
p <sub>max</sub> :	700 bar
Q <sub>max</sub> :	approx. 2.1 lpm (V <sub>g</sub> = 0.75 cm³/rev)
V <sub>usable</sub> :	1.31

Basic type					Delivery fl	ow coding					Symbol
FP 12	H 0,18	H 0,28	H 0,43	H 0,56	H 0,73	H 0,27	H 0,42	H 0,64	H 0,85	H 1,1	
Q <sub>max</sub> (lpm) <sup>1</sup> )	0.34	0.54	0.77	1.0	1.37	0.52	0.81	1.15	1.6	2.1	
p <sub>max</sub> (bar)	700	700	620	430	220	700	600	400	300	200	$\left \begin{array}{c} M\\ M\\ 3\infty\end{array}\right $
Additional p	arameter										
	Rev. rating	n <sub>N</sub>	P <sub>N</sub>	V <sub>usable</sub>	Nom. vol	tage					
_	(rpm)	(k	W) <sup>2</sup> )	(I)							
FP 12	2810		0.37	1.3	3 ~ 400V	Ƴ 50 Hz ³)					
					3 ~ 230V .	△ 50 Hz <sup>3</sup> )					
					3 ~ 500V	Ƴ 50 Hz		<sup>1</sup> ) Q <sub>ma</sub> <sup>2</sup> ) The	<sub>ax</sub> applies for actual powe	r mains 50 Hz er input is der	z, Q ~1.2 x Q <sub>max</sub> for mains 60 Hz pendent on the respective opera-

P

(winding protection is standard)

#### **Additional versions**

- Cover plate version for installation in customer furnished tanks
- Design without winding protection (type FPX..)
- Design with nom. rev. rating  $n_N = 1320$  rpm (type FP 14)
- Design with AC-motor (1 ~ 230 V, 50 Hz), approx. 30-50% reduced performance (type FPW..)

tion pressure and can be up to 2.0 x  $P_N$ <sup>3</sup>) also suitable for mains 3  $\sim$  460 or 265 V  $\curlyvee \triangle$  60 Hz

 Completion with connection block and valve banks (see also "Additional information")

limiting valve (420 bar) and check valve in port P (coding 3) and

directly mounted valve bank type BWH 1

#### Order example

#### FP 12 H0,42 / K1,3 - A3/420 - BWH1F H N3 - 1 - 1 - G24

Hydraulic power pack type FP 12, pump delivery flow approx. 0.81 lpm (tank  $\rm V_{usable}$  approx. 1.3 l), with connection block type A, pressure

#### Dimensions



#### **Additional information**

Miniature hydraulic power packs type FP	D 7310
Connection blocks type A	D 6905 A
Connection blocks type B	D 6905 B
Connection blocks type C	D 6905 C

- Directly mountable valve banks type VB D 7302 type BWN(H) D 7470 B/1
- see also "Turn-key solutions from our modular system"

• see also section "Devices for special applications" (Hydraulics for clamping, Devices for up to 700 bar)

For section and page of the additionally listed devices, see type index



# **Compact hydraulic power packs type HC and HCW**

These ready for connection hydraulic power packs are intended for intermittent operation (S 3) and used to supply pressurized fluid to consumers with low fluid demand, such as for jigs or machine tools or general machine building.

The power pack consists of a housing (tank) with integrated motor and pump. The housing of size 2, 3 and 4 features also a filling gauge, enabling visual control of the fluid level even during operation. The electrical connection takes place via an integrated terminal box. Complete hydraulic control systems can be created by directly mounting various combinations of connection blocks and valve banks to the

hydraulic power pack.

Nomenclature:	Radial piston pump with integrated electric motor (3- and 1-phase version)			
Design:	Oil immersed hydraulic power pack for intermittent service (S 3-service)			
p <sub>max</sub> :	700 bar			
Q <sub>max</sub> :	approx. 12.9 lpm (Vg = 4.6 cm³/rev)			
V <sub>usable max</sub> :	81			



#### Basic types and general parameters

Basic type and size		Ра	rameter:	Delivery 1	flow Q <sub>pu</sub> max. pre	(lpm), app ssure p <sub>m</sub>	proximate <sub>ax</sub> (bar) <sup>1</sup> )	e referenc	e value a	nd	Symbol
HC 14	Q <sub>pu</sub>	0,2	0,31	0,45	0,61	0,83	1,05				•
	p <sub>max</sub>	700	650	450	315	240	160	-			$\overline{\Box} \cdot \underline{\Box} \cdot \underline{\Box}$
HC 12	Q <sub>pu</sub>	0,4	0,65	0,94	1,28	1,7	2,15				
	p <sub>max</sub>	600	380	260	200	150	120				
HC 24	Q <sub>pu</sub>	0,27	0,42	0,64	0,81	1,1	1,35	1,39	1,77	2,27	
	p <sub>max</sub>	700	700	700	515	400	300	300	235	185	
HC 22	Q <sub>pu</sub>	0,52	0,82	1,17	1,58	2,06	2,61	2,68	3,41	4,41	
	p <sub>max</sub>	700	700	550	400	300	240	240	180	140	
HC 34	Q <sub>pu</sub>	0,9	1,25	1,5	2,5	3,6	4,3	5,1	5,6	6,5	
	p <sub>max</sub>	700	700	600	400	300	250	210	180	150	
HC 32	Q <sub>pu</sub>	1,75	2,45	3,0	4,9	7,1	8,5	10,2	11,1	12,9	
	p <sub>max</sub>	700	550	400	250	160	120	100	80	65	<ol> <li>Q<sub>pu</sub> applies for mains 50 Hz, Q ~<sup>-1</sup> mains 60 Hz</li> </ol>
HC 44(48)	Q <sub>pu</sub>	0,9	1,25	1,5	2,5	3,6	4,3	5,1	5,6	6,5	<sup>2</sup> ) The actual power input is depend
	p <sub>max</sub>	700	700	700	500	400	300	250	220	200	respective operation pressure and 1.5 x P <sub>N</sub> .
HC 42(46)	Q <sub>pu</sub>	1,75	2,45	3,0	4,9	7,1	8,5	10,2	11,1	12,9	3) Also suitable for mains 3 ~ 460 or
	p <sub>max</sub>	700	700	700	450	310	260	230	200	180	00 HZ

#### **Additional parameter**

Basic type	Rev. rating	P <sub>N</sub>	Vusable
and size	n <sub>N</sub> (rpm)	(kW) <sup>2</sup> )	(I)
HC 14	1380	0.18	0.5
HC 12	2860	0.25	0.5
HC 24	1390	0.55	1.5
HC 22	2880	0.55	1.5
1.1-8			

Basic type	Rev. rating	P <sub>N</sub>	V <sub>usable</sub>
and size	n <sub>N</sub> (rpm)	(kW) <sup>2</sup> )	(I)
HC 34	1410	1.1	3.5
HC 32	2850	1.5	3.5
HC 44(48)	1405	2.2(3)	8
HC 42(46)	2870	2.2(3)	8

.2 x Q<sub>pu</sub> for

- ent on the can be up to
- 265 V \́∆

Nom. voltage	

3 ~ 400 V 🍸 50 Hz <sup>3</sup> )
3 ~ 230 V $ riangle$ 50 Hz <sup>3</sup> )
3 ~ 500 V 🍸 50 Hz

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#### **Additional versions**

- Hydraulic power pack with AC-motor (e.g. 1 ~ 230 V (50 Hz), 30 ... 50% reduced performance depending on size (type HCW..)
- Design for level installation (reduced height) (type HC..L)
- Hydraulic power pack with DC-motor type HCG
- Version with gear pump

- Design with fluid level gauge
- Former design (split housing and connection leads) also available as size 4 but equal  $Q_{pu max}$  as size 3
- Completion with connection block and valve banks (see also "Additional information")
- Version as dual stage pump

#### **Order example**

### HC 24/0,64 - A1/400 - BWH1F - R1 H - 1 - 1 - G24 (3 ~ 400 V 50 Hz)

Hydraulic power pack type HC, size 24, pump delivery flow approx. 0.64 lpm, with connection block type A and pressure limiting valve (400 bar) and directly mounted valve bank type BWH1

#### Dimensions

Dimensional drawing and symbol acc. to the order example.



Terminal box



#### Valve bank type BWH1 69 Connection block type A1/400 83,5<sup>2</sup>) т $\Box$ BWH1F-RH-1-1-G24 Н В Т m (kg) <sup>3</sup>) 197 120 120 6.3 243 148 148 10.1 М 300 184 184 17.2 3~ 380 230 230 23 P 400 bar R <sup>2</sup>) Dimension for order example above 3) without oil filling All dimensions in mm, subject to change without notice ! HC24/0,64 A1/400



**Additional information** 

Compact hydraulic	s type HC	D 7900	
		type HCG	D 7900G
Connection blocks	type A		D 6905 A
	type B		D 6905 B
	type C		D 6905 C
Directly mountable	valve banks	type VB	D 7302
		type BWH(N)	D 7470 B/1
		type BVZP	D 7785 B
		type SWR, SWS	D 7450, D 7451, D 7951
		type BA, BV	D 7788

Size

HC 1.

HC 2.

HC 3.

HC 4.

- see also "Turn-key solutions from our modular system"
- see also section "Devices for special applications" (Hydraulics for clamping, Devices for up to 700 bar)

For section and page of the additionally listed devices, see type index



# Hydraulic power packs type MP and MPW

The ready for connection hydraulic power packs are intended intermittent or load/no load operation and are used to supply fluid to hydraulic consumers.

This type is suitable for dual stage drives for presses or dual c tems, particularly by the possible combination of high and low stage (radial piston and gear pump) or two low pressure stage The tank is available in different sizes enabling convenient cus Complete hydraulic control systems can be created by directly various combinations of connection blocks and valve banks to hydraulic power pack.



#### Basic types and general parameters (selection)

for pressurized ircuit sys-	Nomenclature:	Radial piston and/or gear pump with integrated motor single or dual circuit pump
es. estomization. y mounting o the	Design:	Oil immersed hydraulic power pack for intermittent or load/no load operation (S 3-/S 6-service)
	p <sub>max</sub> :	Radial piston pump 700 bar (high pressure) Gear pump 180 bar (low pressure)
	Q <sub>max</sub> :	15 lpm (high pressure) ( $V_g = 10.7 \text{ cm}^3/\text{rev}$ ) 87 lpm (low pressure) ( $V_g = 60 \text{ cm}^3/\text{rev}$ )
	V <sub>tank max</sub> :	approx. 74 lpm

#### Basic type Parameter: Delivery flow Q<sub>pu</sub> (Ipm) approximate reference value and max. pressure p<sub>max</sub> (bar) <sup>1</sup>) Radial piston pump and size Gear pump **MP 14** Coding H 0,27 H 0,42 H 0,64 H 0,81 H 1,1 Z 0,5 Z 1,8 Z 3,5 Z 6,9 Q<sub>max</sub> 0.64 0.27 0.42 0.82 1.07 0.5 1.85 3.5 6.9 700 570 370 280 220 150 75 40 15 p<sub>max</sub> MP 12 Coding H 0,27 H 0,42 H 0,64 H 0,81 H 1,1 Z 1,0 Z 1,8 Z 2,7 Z 3,5 0.53 Q<sub>max</sub> 0.82 1.18 1.61 2.1 2.0 3.7 5.4 6.9 700 650 420 320 250 150 110 75 60 **p**<sub>max</sub> **MP 24** Coding H 0,46 H 0,70 H 1,08 H 1,39 H 1,77 Z 2,0 Z 3,5 Z 5,2 Z 12,3 Q<sub>max</sub> 0.46 0.7 1.0 1.37 1.73 2.0 3.5 5.2 12.3 p<sub>max</sub> 700 650 520 400 310 150 120 80 35 MP 22 Coding H 0,46 H 0,70 H 1,08 H 1,39 H 1,77 Z 2,0 Z 5,2 Z 9 Z 21 Q<sub>max</sub> 0.88 1.37 1.94 2.69 3.51 10.2 17.1 41.3 4 700 650 430 320 260 150 75 45 18 p<sub>max</sub> **MP 34** Coding H 1,25 H 1,5 H 2,5 H 3,6 H 6,5 Z 3,5 Z 6,9 Z 12,3 Z 28 1.2 1.63 2.54 3.66 6.3 3.5 6.9 12.3 28 Q<sub>max</sub> 700 530 340 240 135 150 100 65 30 p<sub>max</sub> **MP 44** Coding H 2,6 H 4,2 H 6,0 H 7,0 H 10,9 Z 3,5 Z 16 Z 24 Z 75 **Q**<sub>max</sub> 2.7 4.24 6.1 7.2 10.6 3.5 16 24 75 700 540 370 315 190 150 130 90 25 p<sub>max</sub> MP 54 Coding H 3,7 H 5,8 H 8,4 H 9,8 H 15,3 Z 12,3 Z 24 Z 37 Z 87 Q<sub>max</sub> 3.8 5.9 8.5 10.0 14.8 12.3 24 37 87 700 550 420 360 210 150 120 100 40

<sup>1</sup>) The parameter listed here represent only a choice from a variety of possibilities.

p<sub>max</sub>

#### **Symbols**

#### Single stage pump

(radial piston pump, gear pump)

### Dual stage pump

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



#### **Additional versions**

• Temperature switch

- Hydraulic power pack with AC-motor (e.g. 1 ~ 230V ( 50 Hz), 30 ... 50% reduced performance dependent on the size (type MPW)
- Completion with connection blocks and valve banks (see also "Additional information")
- Cover plate version for customer furnished tank

### **Order examples**

### MP 34 - H 1,25

Installation pump type MP 34 with radial piston pump  $Q_{pu}$  = 1.25 lpm; p<sub>max</sub> = 700 bar (motor and pump, retro-completion with tank and valves by the customer)

#### MP 24 - H1,08 Z12,3/B 25 NE21 - 500/30 - VB 21 GM - RH - 3 -G24

Dual stage pump type MP 24 with radial piston and gear pump  $Q_{pu} = 1.08/12.3$  lpm;  $p_{perm max} = 520/30$  bar, tank B 25 ( $V_{usable}$  approx. 24 l), two stage valve type NE 21 (high pressure 500 bar, low pressure 30 bar) with directly mounted valve bank type VB 21

#### Dimensions

### Single stage pump

(see order example, without tank and valves)

### Dual stage pump

(see order example, without tank and valves)









All dimensions in mm, subject to change without notice !

Basic type	H1 <sup>4</sup> )	H2 <sub>max</sub>	D	m <sub>max</sub> (kg) <sup>4</sup> )
MP 14, MP 12	183 / 228	249	124	5.2 / 5.0
MP 24, MP 22	195 / 291	322.5	140	9.1 / 7.7
MP 34	237 / 315	358.5	158	12.3 / 12.9
MP 44	265 / 377	424	178	18.0 / 18.5
MP 54	298 / 410	461	197	27.5 / 26.4

<sup>4</sup>) Figures apply to both radial piston pump and gear pump

#### Compact hydraulic power pack

(see order example, for tank with directly mounted valves)





Symbol



Size	Tank size	н	В	т
MP'1.	В 3	225	216	136
MP 1., MP 2.	B 5	265	258	160
MP 2., MP 3., MP 4.	B 10	332	324	200
MP 3., MP 4., MP 5.	B 25	413	402	250
MP 3., MP 4., MP 5.	B 55	413	560	350

#### Additional information

• Hydraulic power pa	icks type MP, MPW	D 7200, D 7200 H	<ul> <li>Directly mountable valve banks</li> </ul>	
Connection blocks	type A	D 6905 A	type VB	D 7302
	type B	D 6905 B	type BWH(N)	D 7470 B/1
	type C	D 6905 C	type BVZP	D 7785 B
• Directly mountable	valves		type SWR, SWS	D 7450, D 7451, D 7951
Two stage valve typ	be NE	D 7161	type BA, BV	D 7788
		<ul> <li>see also "Turn-key solutions from our mo</li> </ul>	odular system"	

• see also section "Devices for special applications"

(Hydraulics for clamping, Press controls, Devices for up to 700 bar)

For section and page of the additionally listed devices, see type index



Because of the unique integrated fan configuration, the "ready for connection" hydraulic power packs are ideal for continuous operation. Annother version for temperature sensitive applications features an auxiliary blower, thereby gaining improved cooling (approx. 25%). This type is available for single circuit operation (radial piston or gear pump), dual circuit operation (radial piston and/or gear pump) or triple circuit operation (radial piston pump only). Both single and dual circuit pumps are also available as a lying version (type HKL). Complete hydraulic control systems can be created by directly mounting various combinations of connection blocks and valve banks to the



hydraulic power pack. These hydraulic power packs are used for machine tools (lathes and milling machines), jigs or general machine applications, making a commonly used external radiator superfluous.

Nomenclature:	Radial piston pump and/or gear pump with integrated motor (Version for 3-phase mains)
Design:	Oil immersed compact hydraulic power pack for permanent and intermittent operation (S 1 / S 3 service)
p <sub>max</sub> :	700 bar (radial piston pump) 150 bar (gear pump)
Q <sub>max</sub> :	Radial piston pump approx. 13 lpm (high press.) $(V_g = 9.15 \text{ cm}^3/\text{rev})$ Gear pump 16 lpm (low pressure) $(V_g = 11.0 \text{ cm}^3/\text{rev})$
V <sub>usable max</sub> :	approx. 4.6 l

#### **Basic types and general parameters**

Basic type	Parameters: Delivery flow Q <sub>pu</sub> (lpm), approximate reference								
and size		value and max. pressure P <sub>max</sub> (bar) with S 6 operation <sup>1</sup> )							
Standard version			Radial pi	ston pump			Gear pump		
Single circuit pump:	0	H 0.46	407	H 1 09	H 1 77				
NK 24	Q <sub>max</sub>	T 0,40	п <b>U</b> ,7	400	200				
	P <sub>max</sub>	700	550	400	200	707	745	700	
HK 33, HK 338	Q <sub>max</sub>	H 1,25	H 2,5	н 3,0	H 0,5	۲ ۲٫۱	Ζ 4,5	2 0,9	
	p <sub>max</sub>	380	185	130	70	150	100	70	
HK 34, HK 348	Q <sub>max</sub>	H 1,25	H 2,5	H 3,6	H 6,5	Z 2,7	Z 4,5	Z 6,9	
	p <sub>max</sub>	700	400	270	150	150	100	70	
HK(F) 43, HK(F) 438	<b>Q</b> <sub>max</sub>	H 2,08	H 2,6	H 7,0	H 13,1	Z 4,5	Z 11,3	Z 16	
HK(F) 435, HK(F) 439	p <sub>max</sub>	580	450	170	90	170	110	70	
HK(F) 44 (445, 485)	<b>Q</b> <sub>max</sub>	H 2,08	H 2,6	H 7,0	H 13,1	Z 4,5	Z 11,3	Z 16	
HK(F) 448 (449, 489)	p <sub>max</sub>	700	550	215	130	170	130	90	
Dual circuit pump:									
HK(F) 44 (445, 485)	<b>Q</b> <sub>max</sub>	H 0,9	H 1,5	H 3,6	H 6,5	Z 2,7	Z 4,5	Z 16	
HK(F) 448 (449, 489)	p <sub>max</sub>	700	550	350	160	150	150	90	
Triple circuit pump:									
HK(F) 44 (445, 485)	<b>Q</b> <sub>max</sub>	H 0,83	H 1,6	H 2,4	H 4,4				
HK(F) 448 (449, 489)	p <sub>max</sub>	700	450	350	130				
Lying version:									
HKL(W) 34, HKL(W) 348	<b>Q</b> <sub>max</sub>	H 1,65	H 3,35	H 4,80	H 8,70	Z 2,7	Z 4,5	Z 11,3	
HKL(W) 32, HKL(W) 328	p <sub>max</sub>	700	560	390	220	170	170	130	

 The parameter listed here represent only a choice from a variety of possibilities.

#### **Symbols**

Single stage pump (radial piston pump, gear pump)



#### Dual stage pump

(radial piston/radial piston pump,

М

Joint pump pedestal

Т

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

Ρ3

P1

R



(only radial piston pump)



#### **Additional parameter**

Basic type	Rev. rating	P <sub>N</sub>	V <sub>usable max</sub>	Nom. voltage	
and size	n <sub>N</sub> (rpm)	(kW) <sup>2</sup> )	(I)		
HK 24	1400	0.55	0.85	3 ~ 230/400V △丫 50 Hz 3)	
HK 33, HK 338	1410	0.8	1.45/2.9	3 ~ 500V Ƴ 50 Hz	2) The actual power input is de-
HKL(W) 32, HKL(W) 328 4)	2840	1.8	1.7/2.6		pendent on the respective op-
HKL(W) 34, HKL(W) 348 4)	1410	1.8	1.7/2.6		eration pressure and can be up to 1.5 x PN
HK 34, HK 348	1400	1.1	1.45/2.9		<sup>3</sup> ) Also suitable for mains
HK(F) 43, (438, 435, 439)	1425	1.5	2.4/4.6/1.8/5.5		3 ~ 265/460V △ ↑ 60 Hz <sup>4</sup> ) The motors of the single phase
HK(F) 44, (448, 445, 449)	1410	2.2	2.4/4.6/1.8/5.5		version (type HKLW) are avail-
HK(F) 485, (489)	1460	3	1.8/5.5		able for $1 \sim 2300 / 50$ Hz and $1 \sim 115V / 60$ Hz

BWN1F-HH5R-1-1-G24

#### **Additional versions**

- Temperature and fluid level switches
- Additional fan shield
- Increased tank filling volume with type HK 3.8 resp. HK 4.8, HK 4.9

#### **Order examples**

#### HK 34 T/1 - H 3,6 - AS1/260 - BWN1F - H H5 R 1 - G24 - 1 2

Compact hydraulic power pack type HK 34 with temperature switch (coding T), radial piston pump H 3,6, connection block (type A 1/260) with pressure limiting valve (260 bar) and idle circulation valve as well as directly mounted valve bank type BWN 1



 $\nabla$ 

- Version with additional leakage port (type HK 4.L)
- Various oil filler necks

Μ

Ρ2

• Completion with connection block and valve banks (see also "Additional information")

#### HK 44 /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, pressure outlet on separate pump pedestals, two connection blocks (type AS1/..) with pressure limiting valve (400 bar and 110 bar) and idle circulation valve (direct connection of valve banks possible)



#### Dimensions

### HK..

(illustrated version acc. to the example circuit on next page)





HKL..



Basic type	H <sub>max</sub>	В	Т	m (kg)
HK 24	340	196	196	13
HK 33, HK 34	405	212	212	20.5
HK 3.8	495	212	212	22.2
HKL(W) 32, HKL(W) 34	251	368	196	19.2
HKL(W) 3.8	251	486	196	20.5
HK(F) 43, HK(F) 44	460	240	240	29
HK(F) 4.8	580	240	240	34
HK(F) 4.9	630	240	240	36
HK(F) 4.5	513	240	240	30

All dimensions in mm, subject to change without notice!



#### **Additional information**

Compact-hydraulic power packs	s type HK(F) 43 (44)	D 7600-4
	type HK 33 (34)	D 7600-3
	type HK 24	D 7600-2
	type HKL	D 7600-3L
Connection blocks type A		D 6905 A
type B		D 6905 B
type C		D 6905 C
• Directly mountable valve banks	type VB	D 7302
	type BWH(N)	D 7470 B/1
	type BVZP 1	D 7785 B
	type SWR, SWS	D 7450, D 7451, D 7951
	type BA, BV	D 7788

• see also "Turn-key solutions from our modular system'

• see also section "Devices for special applications"

(Hydraulics for clamping, Devices for up to 700 bar)

For section and page of the additionally listed devices, see type index



HK448/1 - HH1,0/2,8 - H4,4 - SS

**Circuit example** 

1



# **Connection blocks type A, B, and C**

The HAWE connection blocks provide the "ready for connection" feature for compact hydraulic power packs type FP, HC, MP, and HK. Compact control systems can be created by directly mounting valve banks onto type A connection blocks (see also "Turn-key solutions from our modular system").

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



#### **Basic types**

Basic types	Brief description	Options	Symbol		
A	Connection block with pressure limiting valve • For direct pipe connection • For direct mounting of valve banks	<ul> <li>Check valve in port P</li> <li>Prop. pressure limiting valve</li> <li>Reflow filter</li> <li>Idle circulation valve (solenoid actuated)</li> <li>Switch-off valve</li> <li>Pressure limiting valve, tool or manually adjustable</li> </ul>	Type A		
В	Connection block for the control of single and double acting cylin- ders with pressure limiting valve suitable for pipe connection	<ul> <li>Check valve in port P</li> <li>Throttle for the regulation of the drop rate</li> <li>Idle circulation valve, open or closed in idle position</li> <li>Pressure switch in port P</li> </ul>			
с	Connection block without additional elements for direct				

#### **1.1**-18

pipe connection

#### **Additional versions**

- Intermediate blocks for dual stage pumps
- Connection block for direct mounting of directional spool valves type SKC and SWC
- Connection blocks for dual stage pumps with intermittent operation
- Adaptor blocks type C 15(16) enabling direct piping for other connection blocks type A or B (type C 15(16) features the hole pattern of the pump pedestal on one side)
- Connection block type B..DW featuring a pressure actuated valve enabling automatic clamping and releasing
- Direct connection of valve banks type VB, BWH(N), BVZP, and SWR(P) on to connection blocks type A (see also "Additional information")
- Connection blocks type A utilizing a pressure limiting valve with unit approval

#### **Order examples**

#### HK 44/1 - H 2,08 -AS 3 F2/400 - G24

Connection block type A with idle circulation valve (coding S, open in idle position), tool adjustable pressure limiting valve (coding 3, 400 bar) and return flow filters (coding F2), solenoid voltage 24V DC

#### FP 12 / H 0,27 - C 5

Connection block type C, tapped ports G 1/4 (coding 5)

#### Dimensions

Type AS .. (see order example)

### HC 34/1,5 - B 31/450 - EM 11V - 13/3 - G24

Connection block type B with tool adjustable pressure limiting valve (coding 3, 450 bar), drain valve type EM 11V, check valve in port P and throttle (coding 13) as well as pressure switch type DG 33 (coding 3), solenoid voltage 24V DC









All dimensions in mm, subject to change without notice!

### Туре С ..

(see order example)



### Additional information

Connection blocks type A		D 6905 A	Switch unit type CR	D 7150	
		D 6905 TÜV	<ul> <li>Directional spool valves type SKC</li> </ul>	D 7230	
type	в	D 6905 B	type SWC	D 7450	
type	e C	D 6905 C	Directly mountable valve banks		
<ul> <li>Compact hydraulic power packs</li> </ul>			type VB	D 7302	
	type FP	D 7310	type BWH(N)	D 7470 B/1	
	type MP, MPW	D 7200, D 7200 H	type BVZP	D 7785 B	
	type HC, HCW	D 7900	type SWR(P), SWS	D 7450, D 7451, D 7951	
	type HK, HKF	D 7600-2, -3, -4	type BA, BV	D 7788	
	type HKL	D 7600-3L	<ul> <li>see also "Turn-key solutions from our m</li> </ul>	nodular system"	
Two stage valve type NE		D 7161			
<ul> <li>Two stage connection block type NA</li> </ul>		D 6905 A	For section and page of the additionally I	isted devices,	
			see type index		

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# Valve bank type BA and BV

The valve banks type BA, BV show the identical connection hole pattern as the connection blocks (type A...) for the compact hydraulic power packs. This enables direct mounting without any adapter plate. The connection hole pattern downstream is suited to add-on all other type of valve banks (directional seated and spool valves) e.g. type BWN, BWH, VB, BVZP, SWS, SWP and SWS).

Valves with industrial standard connection pattern type NSMD2, NSWP2, NSVP16 may be combined with valve sections type BV (2/2-, 3/2, 3/3, 4/3and 4/4-way functions) . The valve blocks may be optionally equipped with additional functions on the pump or consumer side (e.g. throttle,



restrictor check valve, releasable check valve or manually adjustable pressure reducing valve or pressure switch/gauge) to suit changing requirements. The preferential field of application are machine tools with their various requests.

Nomenclature:	Sub-plates / directional seated valve, zero leakage
Version:	Valve section with sub- plate for pipe connection
Actuation:	Solenoid Pressure actuation • Hydraulic • Pneumatic Manual
p <sub>max</sub> :	400 bar
Q <sub>max</sub> :	20 lpm

#### Basic types and general parameters

Basic types	and general pa	arameters			Order coding e	example		
Basic type	Delivery flow	Pressure	Ports	Nomenclature	BA2 A5 - <u>NBV</u>	<u>/P 16</u> S/0 –		Manifold mounting
and size	Q <sub>max</sub> (I/min)	p <sub>max</sub> (bar)	A, B, P, R, M		- NSV	VP 2 W/02/0	)	- valve with sub-plate
	<del>-</del>		+		- BV1	0 H/M/0	/2/1 AB 0,7-1-G24	
BA2	20	400	G 1/4, G 3/8	Sub-plate		TTTT		
BV1	20	400	G 1/4, G 3/8	Valve section				
								- Solenoid voltage
	4			Basic ty	vpe and size			- End plate
					Port size ——			- Ancillary block
				Flow pat	tern symbol ——			- Pressure switch
					Actuation			- Additional element
								e a throttle in P

#### **Connection blocks/adapter plates**

Basic type	Brief description	Symbol
BA2	Direct mounting onto connection blocks type A, AF etc. of the compact hydraulic power packs type HC, HK, MP	without
BA2 A5	Version for pipe connection without pressure limiting valve	
BA2 A8	Like version BA2 A5 but with check valve in R	

#### **Symbols**

max. 12 valve sections can be combined



- Sub-plate with industrial standard hole pattern and throttle/restrictor check valve
- Intermediate plate with industrial standard hole pattern for an 2. speed rate (parallel connection)

04/01

- Sub-plate with integrated pressure reducing function for 3/2 way manifold mounting valves
- Valve sections with throttle/restrictor check valve on the consumer side
- Ancillary block with pressure gauge or pressure switch for side A and/or B

#### Actuations

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M:	Solenoid actuation (p <sub>max</sub> = 400 bar)
GM:	Solenoid actuation ( $p_{max}$ = 250 bar)

- H: Hydraulic actuation
- P: Pneumatic actuation
- Manual actuation A:

Solenoid voltage

• 12V DC, 24V DC, 230V AC 50/60 Hz

• Further voltages on inquiry

• Plug with LEDs for improving the EMC or with economy circuit (see also "Further information")

### End plates



#### **Order example**

BA2 A5 -NBVP 16 S/0-NSWP 2 W/02/0 BV1 0-H/M/0/2/1 AB 0,7-1-G24

Valve bank type BA2 with connection block A5 for pipe connection without pressure limiting valve.

Valve section 1 with 3/2-way directional seated valve (NG6) type NBVP16, flow pattern symbol S, mounted onto standard sub-plate (coding /0). Valve section 2 with directional spool valve type NSWP2 flow pattern symbol W, prepared for retrofitting of a pressure switch type DG3 at port B (coding /02), mounted onto standard sub-plate (coding /0).

Valve section 3 with section BV1, flow pattern symbol H, solenoid actuation (coding /M), without additional element at P (coding /0), valve section prepared for retrofitting of a pressure switch type DG 3 (coding /2) with directly mounted ancillary block , port size G1/4 (coding /1) and orifice  $\varnothing$ 0.7 at port A (coding AB 0.7), end plate (standard, coding 1) and solenoid voltage 24V DC.



0.8

1.0

#### Drain valve

R

#### **Circuit example**

HK 489/1 - H7,0 - U2 - A1/400 - BA2 - NSBVP16Z/0

- NBVP16Z/R/0
  - BV10H/M/0/2/1AQRBQR
  - BV10G/M/0/2/1A3B2
  - BVZP1F G22/22
    - R5M5/20
      - 1-1-G24

Compact hydraulic power pack type HK Size 4; intermediate plate with connection block and pressure limiting valve (pre-set to 400 bar by HAWE).

Valve bank type BA2 with individually controllable functions, 2 of them as industrial standard valves mounted onto sub-plates, 2 sections with ancillary blocks featuring additional functions (pressure switch and restrictor check valves) plus 3 valve functions fed via intermediate plate, throttle function for flow in the subplate

#### Main parameter of the example circuit

 $\begin{array}{ll} Q_{pu} & = 5 \text{ lpm (at 1450 rpm)} \\ p_{max\,pu} & = 450 \text{ bar} \\ p_{system} & = 400 \text{ bar (setting of the pressure limiting valve)} \\ V_{consum} & = \text{approx. 5.0 I} \end{array}$ 



#### Additional information

Compact hydraulic	D 7310	
	type HC	D 7900
	type MP	D 7200, D 7200 H
	type HK, HKL	D 7600 ff
Connection blocks	D 6905 A	
• Valve banks type E	D 7788	
Clamping module t	ype NSMD	D 7787
Directional spool v	alve type NSWP	D 7451 N
• Directional seated	D 7765	
• Valve banks type E	D 7785 B	
• Directional seated	D 7785 A	



<ul> <li>Valve banks type BWN1, BWH</li> </ul>	D 7470 B/1
type VB01, VB11	D 7302
Pressure switches type DG 3, DG 5E	D 5440, D 5440 E
<ul> <li>Pressure reducing valves type CDK</li> </ul>	D 7745
type DK	D 7941
<ul> <li>Slot-type throttle type Q, QR, QV</li> </ul>	D 7730
Plug with LED etc.	D 7163

• see also "Complete solutions in the modular system"

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For section and page of the additionally listed devices, see type index



# **1.2 Standard pumps and power packs**

**1.2**-4

**1.2**-8

- Radial piston pumps type R and RG
- Variable displacement axial piston pumps type V30D and V60N

Pumpen



# **Radial piston pumps type R and RG**

The radial piston pumps consist of radially arranged, valve controlled pumping pistons. Higher delivery flows can be created by stacking of up to 6 sections on a common shaft. The pump is commonly driven by an electric motor, which is connected with the pump by means of a flange and a coupling .

The closed pump housing permits "in tank" installation (hydraulic power pack) as well as the common external pump/ motor installation (pump with motor). The possibility of a radial piston pump with several pressure outlets (several equal or differing delivery flows) is particularly innovative. Type RG utilizes slide bearings and is intended for extreme application



conditions to increase the service life. Complete hydraulic control systems can be created by directly mounting various connection blocks and valve banks to the cover plate of the hydraulic power pack.

Nomenclature:	Radial piston pump		
Design:	Individual pump Pump complete with motor Hydraulic power pack		
p <sub>max</sub> :	700 bar		
Q <sub>max</sub> :	91.2 lpm (V <sub>g</sub> = 64.18 cm³/rev)		
V <sub>max tank</sub> :	approx. 470 l		

### Symbols Individual pump









Pump with several pressure outlets (example for on individual pump)



#### Basic types and general parameters

Design			Number of	Version R or RG with delivery flow $\mathbf{Q}_{pu}$ (lpm) (approximate reference value at 1450 rpm)				
			cylinders		and r	max. pressure p <sub>max</sub>	, (bar) <sup>1</sup> )	
				700 bar	550 bar	450 bar	250 bar	160 bar
		ГĪ	<sup>T</sup> 2 <sup>T</sup>	R 0,18	R 0,28	R 0,43	R 0,92	Γ
7631	$( \odot )$	<b> </b>  ∎	3	R 0,27	R 0,42	R 0,64	R 1,35	
	$\downarrow$		5	R 0,46	R 0,7	R 1,08	R 2,27	
		л	1	R(G) 0,3	R(G) 0,5	R(G) 0,8	R(G) 1,7	R(G) 2,2
6010		₩ <b>E</b>	2	R(G) 0,6	R(G) 1,0	R(G) 1,6	R(G) 3,3	R(G) 4,4
		∎_] <b>r</b>	3	R(G) 0,9	R(G) 1,5	R(G) 2,5	R(G) 5,1	R(G) 6,5
6011			5	R(G) 1,4	R(G) 2,6	R(G) 4,2	R(G) 8,3	R(G) 10,9
	-		7	R(G) 2,1	R(G) 3,7	R(G) 5,8	R(G) 11,8	R(G) 15,3
		- <del></del>						
6012	E C		10	R(G) 2,7	R(G) 5,3	R(G) 8,2	R(G) 16,8	R(G) 21,7
	ł		14	R(G) 4,0	R(G) 7,4	R(G) 11,6	R(G) 23,5	R(G) 30,4
6014	E		20	R(G) 6,1	R(G) 11,0	R(G) 17,4	R(G) 35,0	R(G) 43,4
	0 E		28	R(G) 8,0	R(G) 15,0	R(G) 23,0	R(G) 47,0	R(G) 60,8
6016			42	R(G) 12,7	R(G) 22,0	R(G) 34,5	R(G) 70,0	R(G) 91,2

#### **Additional parameter**

Additional parameter						
Design	Drive power	Tank sizes				
	rating P <sub>N</sub> (kW) <sup>2</sup> )	(optional) V <sub>usable</sub> (I)				
7631	0.250.55	645				
6010	0.253	680				
6011	0.555.5	6160				
6012	2.211	20160				
6014	5.522	80450				
6016	1130	120450				

1) The parameter listed here represent only a choice from a variety of possibilities.

2) Standard motor, design IM B 35 for pumps complete with motor or IM B 5 for hydraulic power packs

#### **Order examples**

#### R 5,8

Individual pump, design 6011,

 $Q_{pu} = 5.8$  lpm at 1450 rpm  $p_{max} = 450$  bar

### R 4,0/M 7,5

Pump complete with motor, design 6012,

 $Q_{pu}$  = 4.0 lpm at 1450 rpm,  $p_{max}$  = 700 bar, motor  $P_{N}$  = 7.5 kW

#### **Additional versions**

- Pumps complete with motor (incl. flange a. coupling) and hydraulic power packs also available without motor
- Cover plate version to be installed on customer furnished tanks
- Design with several pressure connections
- One or two pump cylinders individually routed out (Q<sub>max</sub> 4.4 lpm) e.g. for control oil supply
- Integrated switch-off valve with two pressure connections
- Version with DC-motor (only pump design 6011)

### R 11,0/B 75 A 550 - V 15

Hydraulic power pack consisting of radial piston pump, design 6014,  $Q_{pu}$  = 11.0 lpm at 1450 rpm,  $p_{max}$  = 550 bar, tank B 75 (V<sub>usable</sub> approx. 80 I), directly mounted connection block (coding A..) with pressure limiting valve (550 bar ) and electric motor  $P_N = 15 \text{ kW}$ 

#### Pumps

#### Dimensions

Individual pump







Design	D	L	L1 max	m (kg) <sup>3</sup> )
7631	130	53	109	3.2
6010	174	82.5	113	3.1
6011	185	86	155	5.8
6012	185	146	188	10.5
6014	218	250	188	24.2
6016	238	311	212	39.1

<sup>3</sup>) Mass of the individual pump

#### Motor pump



All dimensions in mm, subject to change without notice !



Size	B6	B13	B20	B30	B40	B50	B75	B100	B160	B250	B400
н	230	230	320	320	320	403	478	536	666	575	825
В	253	368	368	448	448	600	600	650	650	1000	1000
Т	315	260	260	320	440	420	420	500	500	600	600
V <sub>max tank</sub> (I)	9.3	17	25	39	55	85	107	152	193	309	469

#### **Circuit example**

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



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The InLine variable displacement pump type V30D works according to the swash plate principal and is intended for open circuit operation in industrial and mobile hydraulics. There is also an option for a thru-drive shaft for flange mounting additional variable and fixed displacement pumps. The main field of application for type V60N are trucks where they are driven by the ancillary drive shaft.

These pumps are suited for a wide range of applications due to various pump controllers and their low running noise.

Hydraulic circuits where several outlet flows are required can be fed ei-



ther by one individual pump or a multiple pump (type V 30 D). Main benefit of type V 30 D is the sturdy design, the good performance/weight ratio, long

service life due to oversized bearings, and the swash plate angle indicator.

Nomenclature:	Variable displacement axial piston pump
Design:	Individual pump Pump combination
p <sub>max</sub> :	350 bar (continuous) 420 bar (peak)
Q <sub>max</sub> : (V <sub>g max</sub> )	65 365 lpm (1450 rpm) (45 251 cm³/rev)

#### **Symbols**

Individual pump







#### Basic type and main parameter

Basic type	Geom.	Delivery flow	Nom.
	displacement	Q <sub>max</sub>	pressure
	V <sub>g</sub> (cm³/rev)	(lpm) <sup>1</sup> )	p <sub>nom</sub> (bar) <sup>3</sup> )
V30D -045	045	65	350 (420)
-075	075	109	350 (420)
-095	095	139	350 (420)
-115	115	167	250 (300) <sup>2</sup> )
-140	140	206	350 (420)
-160	160	238	250 (300) <sup>2</sup> )
-250	250	365	350 (420)
V60N -090	090	130	350 (400)

1) Approximate reference value at 1450 rpm

2) Higher pressure is possible with reduced geom. displacement

<sup>3</sup>) Figures in brackets =  $p_{max}$  (bar)

#### Additional versions (basic types)

 Double pumps (tandem or twin version)
 Additional pumps may be mounted directly via flanges conforming to SAE-A, B, C, D.

· Variable displacement pumps for closed circuits

Type coding



## Controllers type V30D (V60N)

Description (type)		
Power controller:	L	-Limitation of the driving torque,
		(also V60N)
	Lf1	-Option of limiting the flow
• Load-Sensing-controller:	LS	-Suited for proportional valves
	LSN	I-With pressure limitation, (also V60N)
Pressure controller:	Ν	-Suited for constant pressure systems
	Ρ	-With remote control port
	Pb	-With remote control port for systems
		with a tendency to oscillations
<ul> <li>Flow controller:</li> </ul>		-For maintaining a constant flow
	Qb	-For maintaining a higher pump speed
• V -Electro-hydraulic pro	porti	onal control of the pump delivery via

; prop ۱y electronic control card

• VH -Controller with hydraulic prop. control of the pump delivery

### Dimensions

(see order example)



'ሐ Suction port 5) (SAE .. 3000 psi)

4) Figures in brackets with contoller

 <sup>5</sup>) Location of t
 <sup>6</sup>) BSPP-ports Location of the ports for clockwise rotation

#### **Additional information**

• InLine variable displacement axial piston pump type V30D					
type V30Z	D 7960 Z				
<ul> <li>Variable displacement axial piston pump type V60N</li> </ul>	D 7960 N				
<ul> <li>Prop. directional spool valve type PSL/PSV size 3</li> </ul>					
type PSL/PSV size 5	D 7700-5				
type PSLF/PSVF size 3/5	D 7700-F				

#### **Order examples**

### V 30 D - 160 R D N - 1 - 1 - 01 / LSN - 2 - 250

Pump type V 30 D, nom. size 160, for clockwise rotation and spline shaft (DIN 5480) and NBR seals, standard shaft (no thru-shaft). Pump with swash plate dial indicator, Load-Sensing-controller and pressure limitation, stroke limitation (coding 2), LSN-contoller with operation pressure set for max. 250 bar.

Basic type	L	L1	В	н	H1	m (kg) <sup>4</sup> )
V30D -045	268	68	160	150	82	40 (46)
-075	310	80	178	170	86	60 (66)
-095	341	93	196	196	87	70 (76)
-115	341	93	196	196	87	70 (76)
-140	363	90	212	212	85	85 (91)
-160	363	90	212	212	85	85 (91)
-250	432	115	272	224	97	130 (136)
V60N -090	278	55	120	189	43	26.7

	Ports				
Basic type	D1, D2 6)	St <sup>6</sup> )	Α	В	
V30D-045	G 1/2	G 1/4	1 1/2"	3/4"	
-075	G 3/4	G 1/4	2"	1"	
-095	G 3/4	G 1/4	2"	1 1/4"	
-115	G 3/4	G 1/4	2"	1 1/4"	
-140	G 3/4	G 1/4	2 1/2"	1 1/4"	
-160	G 3/4	G 1/4	2 1/2"	1 1/4"	
-250	M33x2	Rohr Ø8	3"	1 1/2"	

All dimensions in mm, subject to change without notice!







Ports	at	type	V60N-090:
-------	----	------	-----------

Pressure outlet G 1 \_

- Suction port G 1 1/2 S =
- D Leakage port G 1/2 =
- LS = LS-signal port G 1/4

<ul> <li>Over-center valves type LHK</li> </ul>	D 7100
LHDV	D 7770
LHT	D 7918

• see also section "Devices for special applications" (mobile hydraulics)

For section and page of the additionally listed devices, see type index



## 1.3 Dual stage pump

• Dual stage pump type RZ

**1.3**-4
## **Dual stage pumps type RZ**

Dual stage pumps consist of a high pressure section (radial piston pump, HP) and a directly coupled low pressure section (gear pump, LP). The pump is usually driven by an electric motor, which is connected with the pump by means of a flange and a coupling .

Complete hydraulic control systems (e.g. for presses) can be created by directly mounting dual stage valves or valve banks to the cover plate of the hydraulic power pack.



Nomenclature:	Dual stage pump
	(radial piston and
	gear pump)
Design:	Individual pump
	Pump complete with motor
	Hydraulic power pack
p <sub>max</sub> :	700 bar (radial piston pump)
	150 bar (gear pump)
Q <sub>max</sub> :	Radial piston pump
	91.2 lpm (high pressure)
	(V <sub>g</sub> = 64.18 cm <sup>3</sup> /rev)
	Gear pump
	135 lpm (low pressure)
	(V <sub>g</sub> = 89.6 cm <sup>3</sup> /rev)
Q <sub>max tank</sub> :	approx. 470 l

#### **Basic types and general parameters**

High pressure section (like radial piston pump type R) Basic type RZ..

Design	(Delivery flow Q <sub>pu</sub> (Ipm), approximate reference value at					
	1450 rpm) and max. pressure p <sub>max</sub> (bar) <sup>1</sup> )					
	700 bar	250 bar				
7631	RZ 0,18	RZ 0,64	RZ 2,27			
6910	RZ 0,9	RZ 2,5	RZ 5,1			
6911	RZ 1,4	RZ 5,8	RZ 11,8			
6912	RZ 2,7	RZ 8,2	RZ 16,8			
6914	RZ 8,0	RZ 23,0	RZ 47,0			
6916	RZ 12,7	RZ 34,5	RZ 70,0			

#### **Symbols**

Individual pump, only high pressure section, low pressure section is customer furnished



Individual pump, high pressure section and low pressure section



Pump complete



Low pressure section (gear pump type Z)

Baugröße	Q <sub>pu</sub> (Ipm) and				
	max	max. pressure p <sub>max</sub> (bar) <sup>1</sup> )			
	120 bar	80 bar	4060 bar		
	·i				
/1	5.2	8.8	11.3		
/2	12.3	16	37		
/3	24	110	135		

1) The parameter listed here represent only a choice from a variety of possibilities.

Hydraulic power pack



#### **Additional parameter**

Design	Max. permissible	Combination	Tank sizes
	drive power	with gear	(optional)
	P <sub>N</sub> (kW) <sup>2</sup> )	pumps, size	V <sub>usable</sub> (I) <sup>3</sup> )
7631	1.5	1	13 42
6910	3	2	22 80
6911	11	2 and 3	32 400
6912	11	2 and 3	60 400
6914	22	2 and 3	100 400
6916	30	2 and 3	100 400

#### **Order examples**

#### RZ 2,5/2

Individual pump, high pressure section  $Q_{HP} = 2.5$  lpm at 1450 rpm,  $p_{max} = 450$  bar, connection hole pattern for gear pump ( size 2 ) (Gear pump is customer furnished)

#### RZ 0,9/2 - 16/B 75 NE 20 - 650/30 - V 1,5

Passing hydraulic power pack consisting of dual stage pump, high pressure section  $Q_{HP} = 0.9$  lpm at 1450 rpm,  $p_{max} = 650$  bar, low pressure section  $Q_{LP} = 16$  lpm, tank B 75 (V<sub>usable</sub> approx. 80 l), directly mounted two stage valve type NE (high pressure 650 bar, low pressure 30 bar) and electric motor  $P_N = 1.5$  kW

#### Dimensions

#### Individual pump



Design	Н	D	m (kg)
7631	58	130	3,1
6910	85,5	175	3,1
6911	85	185	6,3
6912	125	185	10,5
6914	221	218	23,9
6916	320	238	39,1

Size	H1	m (kg)
/1	70 86	1,2
/2	96 132	3,1
/3	140 178	8,4

All dimensions in mm, subject to change without notice!

D 6910

D 6010

D 6010 H D 7410

D 6910 H

#### **Additional versions**

- Pumps complete with motor and hydraulic power packs also available without motor
- Cover plate version for installation in customer furnished tanks
- Version of the high pressure pump (type RF) with 2-hole SAE-flange for e.g. VICKERS type 20V, 25V
- Type RGZ.. utilizes slide bearing for increased the service life

<sup>2</sup>) Industry standard motor shape IM B 35 for pumps complete with motor or IM B 5 for hydraulic power packs

<sup>3</sup>) Minimum size determined by overall height of the pump

#### RZ 8,0/3 - 110

Individual pump, high pressure section  $Q_{HP} = 8.0$  lpm at 1450 rpm,

p<sub>max</sub> = 700 bar,

Gear pump (size 3), Q<sub>LP</sub> = 110 lpm, p<sub>max</sub> = 80 bar (Attention: Take into account max. permissible power rating!)

#### Hydraulic power pack



#### **Additional information**

Dual stage	pump	type	RZ
------------	------	------	----

- Pumps with motor only and hydraulic power packs type RZ
- Radial piston pump type R and RG
- Hydraulic power packs type R and RG
- Dual stage pump type RF

Two stage valves type NE	D 7161			
<ul> <li>Switching valves type CR</li> </ul>	D 7150			
• see also section "Devices for special applications"				
(Press controls, Devices for up to 700 bar)				

For section and page of the additionally listed devices, see type index



## **1.4 Air driven hydraulic pumps**

• Air driven hydraulic pumps type LP

**1.4**-4

100



## Air driven hydraulic pumps type LP

These hydraulic pumps are reciprocating, valve controlled plunger pumps. They are basically oscillating pneumatic/hydraulic pressure intensifiers which are available in three sizes. These pumps stop automatically when the opposing forces on the pneumatic side of the piston are in equilibrium with the forces on the hydraulic side. Likewise the pumps will start when the forces are unequal. This force equivalent also determines the cycle frequency.

The hydraulic pumps type LP are available in various versions e.g. pump only, hydraulic power pack with tank or as turn-key power pack with the required directional valves directly mounted. These pumps are commonly

> used in hazardous areas where electric motor drive pumps may cause fire or explosion such as in dye works, mining, pyrotechnic industry, petroleum refineries etc. These pumps also perform well in laboratory presses, jigs or lubrication applications.

Nomenclature:	Air driven hydraulic pumps	
Design:	Individual pump Hydraulic power pack	
P <sub>max hyd</sub> r:	1601500 bar	
p <sub>max air</sub> :	10 bar	
Q <sub>max</sub> :	0.912 lpm	

#### Resid types and general parameter

Dasic type	es anu y	eneral parameters				
Basic type		Operating	Pressure	Geom. volume per	Tapped port	Symbol
and size		pressure	ratio	double stroke	(pneumatic)	
		p <sub>max</sub> (bar)		V <sub>Hydr</sub> (cm <sup>3</sup> )	Pipe diameters for high	
					pressure connection	
	8	700	1:200	1.5		
LP80-	10	630	1:63	2.3	G 1/4	
	12	430	1:43	3.4	$\varnothing$ 6mm	
	16	240	1:24	6		<u> </u> L
	8 🗸	1500	1:243	2		
1 1 LP125- 1	10	1500	1:155	3.1		P
	12	700	1:108	4.5		
	16	600	1:60	8	G 3/8	s s
	18	470	1:47	10.2	Ø 8mm, Ø 10mm	L L
	20	380	1:38	12.6		
	25	240	1:24	19.6		
	30	160	1:16	28.3		
	8	1500	1:400	2		
	10	1500	1:255	3.1		
	12	700	1:177	4.5		
LP160-	16	700	1:100	8	G 1/2	
	18	700	1:78	10.2	Ø 8mm, Ø 10mm	
	20	620	1:63	12.6		
	25	390	1:40	19.6		
	30	265	1:24	28.3		

F

Δ

#### **Additional versions**

- Hydraulic pump type LP, ready for connection
- Hydraulic power packs with valve banks type VB, BWH(N) (see also "Additional information")

#### **Additional elements**

- Suction parts for hydraulic pump
- Tank for hydraulic pump

#### **Order examples**

#### LP 125 - 16 E

Hydraulic pump type LP, size 125, plunger  $\varnothing$  16 mm, Single version for customer furnished piping

#### Dimensions

#### LP 80 -8

Hydraulic pump type LP, size 80, plunger  $\varnothing$  8 mm, ready for connection







Basic type	н	H1	В	т	m (kg)
LP 80	119	94	121	85	5
LP 125	159	114	156	135	8.5
LP 160	228	136	156	175	11.5

#### Additional information

•	Hydraulic pump type LP	0
	Hudraulia power packs type I P	г

• Tryuraulic	power	μαυκό	туре с	

Valve banks type VB

D 7280
D 7280 H
D 7302

- Valve banks type BWH(N)
- D 7470 B/1
- see also section "Devices for special applications"
- (Press controls, Devices for explosion hazardous areas, Devices for up to 700 bar)



## 1.5 Hand pumps

Hand pumps type H, HE, HD, and DH

**1.5**-4

66

**1.5**-2

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## Hand pumps type H, HE, HD, and DH

The hand pumps type H are available in single acting and double acting versions. The single acting design pumps in one lever direction only, the reverse motion performs the suction stroke.

The double acting design pumps and intakes simultaneously in both lever directions. In one particular design, the suction side may be charged with up to 150 bar.

The lever mechanism may be protected from harsh environments if desired, and may incorporate a drain valve (connecting  $P \rightarrow S$ ), a pressure limiting valve or a tank. These additional options enable the use of this pump in a wide array of application.

Nomenclature:	Piston pump
Design:	Single acting hand pump Double acting hand pump
p <sub>max</sub> :	80 600 bar
V <sub>max</sub> :	4 78 cm³/stroke



#### Basic types and general parameters

Basic type	Pressure	Geom. volume	Tapped	l ports	Symbol
and size	p <sub>max</sub> (bar)	per stroke	Р	S	
	_	V <sub>H max</sub> cm <sup>3</sup> /stroke		_	
H 16	350	6	T I	T	Design with pressure lir
H 20	220	9.4	G 1/4	G 1/4	valve and drain valve
H 25	150	14.7			P
HE 4	600	4			
HD 13	350	13	G 1/4	G 1/4	2 7
HD 20	220	20			
HD 30	150	30			$\checkmark$ $\checkmark$ $\checkmark$
DH 40	150	51			<b>├</b>
DH 45	140	64	G 3/8	G 3/8	's
DH 50	80	78			

### niting



#### **Additional versions**

- Hand pumps with pressure limiting valve and/or drain valve
- Hand pumps with tank ( $V_{max} = 0.5$  l)

Pumps

#### **Order examples**

#### H 25

Hand pump type H, size 25

#### HE 4

Hand pump type HE, size 4

#### Dimensions

#### Туре Н..





DH 40

Hand pump type DH, size 40



Type HE.. and HD..



Basic type	Р	S	m (kg)
Н	G 1/4	G 1/4	3.1
HE and HD	G 1/4	G 1/4 and G 3/8	4.8
DH	G 3/8	G 3/8	6.2 6.6

All dimensions in mm, subject to change without notice!

#### Additional information

• Hand pumps type H D 7147/1

• see also section "Devices for special applications" (Devices for up to 700 bar)



## **2.1 Directional spool valves**

On/off directional spool valves	
Directional spool valve type SG and SP	<b>2.1-</b> 4
<ul> <li>Directional spool valve type SKP and SKH</li> </ul>	<b>2.1-</b> 8
<ul> <li>Directional spool valve type SW, SWR, SWP, and SWS</li> </ul>	<b>2.1-</b> 12
• Directional spool valve type HSR(L), HSF, and HSL	<b>2.1-</b> 16
Throttling directional spool valves	
Manually actuated directional spool valve type DL	<b>2.1-</b> 20
Proportional directional spool valves	
Prop. directional spool valve type PSL and PSV	<b>2.1-</b> 24
Valve combinations	
Clamping module type NSMD	<b>2.1-</b> 28

2 1



Directional spool valve

Individual valve for

pipe connection or

Manifold mounting

• With autom. spring return

Solenoid

With detent
Mechanical
Roller head
Pin head
Pressure

(only or combined with manual actuation)

HydraulicPneumatic

200 ... 400 bar

12 ... 100 lpm

Manual

Nomenclature:

**Design:** 

Actuation:

p<sub>max</sub>:

Q<sub>max</sub>:

## **Directional spool valves type SG and SP**

The directional spool valves with optional pressure limiting valve type SG and SP are available either for pipe connection (type SG) or manifold mounting (type SP).

They are widely used to control the direction of movement of hydraulic consumers e.g. motors or cylinders.

The sturdy design and a wide range of different actuations enable utilization of these valves in many applications such as mobile hydraulics or on ships.



#### Basic types and general parameters

Basic type and size		Flow	Oper.	pressure p <sub>m</sub>	<sub>ax</sub> (bar) for act	uation versi	on	Tapped
Individual valve for	Manifold		Solenoid	Manual	Mechanical	Pressure	Manual/	ports <sup>1</sup> )
pipe connection	mounting valve	Q <sub>max</sub> (Ipm)		_		_	pressure	(BSPP)
SG 0		12	200	400	400	400	400	G 1/4 / G 3/8
SG 1	SP 1	20	200	400	400	400	400	G 3/8
SG 2		30	315	400	400	400	400	G 3/8
SG 3	SP 3	50	315	400	400	400	400	G 1/2
SG 5		100	200	400	315	400	400	G 1

1) With type SG

#### **Additional versions**

- Integrated pressure limiting valve with type SG
- Directional spool valve with enlarged ports and control grooves for delayed de-pressurization (preventing pressure surges)

#### **Basic symbol** Symbol SG SP G С D Е Ν w R Z 2) U 2) v Individual valve for Indiv. valve for manifold pipe connection mounting a a a 0 0 F L н Υ s X 2) Ē With pressure limiting valve <sup>2</sup>) Only size 2, 3, and 5 Additional versions (symbols) · Selection of positive (blocked in intermediate positions) and negative (slightly) over lapping directional spool valves **Actuations** Manual Solenoid Mechanical Pressure **Double acting** Roller head Pin head Pneumatic Hydraulic Spring Detent Pneumatic / Hydraulic / return manual manual ск MU RE BE NU NM KD KM AK ME NE BD MD RD ND a 0 0 Solenoid voltage Actuation force: Control pressure: 12V DC, 24V DC, 90 ... 280 N Pneumatic 5 ... 10 bar 230V AC 50/60 Hz 12 ... 20 bar depending on size Hydraulic other voltage on request

#### **Order examples**

#### SG 1 G - AK

Indiv. directional spool valve for pipe connection, size 1, flow pattern G, manual actuation AK

#### SP 3 E - MD 3/24

Indiv. directional spool valve, manifold mounting, size 3, flow pattern E, solenoid actuation coding MD3, solenoid voltage 24V DC

#### Dimensions

Type SG.-AK (see order example)

#### Type SP.-M. (see order example)



- <u> </u>

H1<sub>max</sub> 3)

151

342

В

40

49.5

Basic type	н	H1 <sub>max</sub> <sup>3</sup> )	В	т	m <sub>max</sub>	Basic type
	_				(kg) <sup>3</sup> )	
SG 0(1)	59.5	151	39.5	51	0.8 1.0	SP 1
SG 2(3)	max.100.5	342	49.5	73	2.5 5.7	SP 3
SG 5	110	342	50	80	2.9 6.1	

Ξ

I

All dimensions in mm, subject to change without notice!

#### Additional informations

<ul> <li>Directional spool valve type SG, SP</li> </ul>	D 5650/1
Actuations	
Manual	D 6511/1
Solenoid	D 7055
Mechanical	D 5870
Pressure	D 6250

<sup>3</sup>) Depending on actuation

Н

59.5

94.5

<ul> <li>Directional spool valve connected in series</li> </ul>	D 7230
or in parallel type SKP and SKH	
Plugs with LED etc.	D 7163
<ul> <li>Plugs with economy circuit</li> </ul>	D 7813, D 7833

For page and section of the devices additionally listed, see type index

m<sub>max</sub>

(kg) <sup>3</sup>)

0.8 ... 1.0

2.5 ... 5.7

т

51

73

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The directional spool valve banks type SKP or SKH serve to control the direction of movement of hydraulic consumers e.g. motors or cylinders. The individual directional spool valve may be either connected in parallel (type SKP) or in series (type SKH) depending on flow pattern. Mixed combinations are also possible.

The valve bank consists of a starting spool valve block with or without pressure limiting valve, the add-on valves and the end plate.

There are connection blocks available enabling direct mounting onto hydraulic power packs with fluid immersed motor (type R, RZ, Z), hydraulic power packs (type HC, MP, HK) or for pipe connection.



A wide range of actuations (manual, solenoid, hydraulic and pneumatic) enable these directional spool valves to be used in a wide range of applications.

Nomenclature:	Directional spool valve
Design:	Valve bank connected in parallel (SKP) or in series (SKH) combination with hydraulic power packs
Actuation:	Solenoid Manual • With autom. spring return • With detent Pressure (only or combined with manual actuation) • Hydraulic • Pneumatic
p <sub>max</sub> :	200 400 bar
Q <sub>max</sub> :	12 100 lpm

#### Basic types and general parameters

Basic type and size Flow		Flow		ersion	Tapped		
Conne	ected		Manual	Solenoid	Pressure	Manual /	ports
in parallel	in series	Q <sub>max</sub> (lpm)				pressure	(BSPP)
	•						
SKP - 0	SKH - 0	12	400	200	400	400	G 1/4 <sup>1</sup> ) / G 3/8
SKP - 1	SKH - 1	20	400	200	400	400	G 3/8
SKP - 2	SKH - 2	30	400	315	400	400	G 3/8
SKP - 3	SKH - 3	50	400	315	400	400	G 1/2
SKP - 4	SKH - 4	100	400	200	400	400	G 3/4

Permissible reflow pressure 12...100 bar depending on valve type and actuation

<sup>1</sup>) Port P at the under side with SKH = G 3/8 (BSPP)

#### Valve bank coding

#### Starting spool valve / adaptor plates / connection blocks



#### Additional versions of starting spool valves, adaptor plates and connection blocks

- Starting spool valve without pressure limiting valve
- Adaptor plates for direct mounting onto connection blocks of hydraulic power packs type R and Z
- Connection blocks with or without pressure limiting valve for pipe connection
- Adaptor plates for direct mounting onto hydraulic power packs type HC, MP, and HK (type SKC)

#### Symbol

max. 8 valve sections (type SKH) or max. 12 valve sections (type SKP) may be combined in a valve bank, dep. on size

Basic symbol				Syn	nbol					
Type SKP	G	D	Е	С	Ν	W	v	R	U	Additional versions (symbols)
						I JX				<ul> <li>Selection of positive (blocked in intermediate positions) and negative (slightly overlapping) over lapping directional spool valves</li> <li>Without check valve for P</li> </ul>
Type SKH	L	F	н	s	Y					
Alternating block-	<b></b>	•	F			Not	all flow p	attern are		
age of the P or R			₽			avai	lable as s	starting or		
duct of two valve						end	spool val	ve sectio	n!	
sections	$\sim$	$\sim$	$\sim$		<b>╼</b> ┙⊢					

#### Solenoid voltage

- 12V DC, 24V DC, 230V AC 50/60 Hz
- Other voltage on request
- Plugs with LED, improving EMC or with economy circuit (see also "Additional informations")

 Other actuations analogues to directional spool valves type SG and SP (see also "Additional informations")

#### End spool valve/end plates

Connection	mode	Symbol			
Parallel	Series	SKP	SKH		
End p (witho	lates ut coding)				

#### **Order examples**

#### SKP-3-5 UGD - ME2/MD2/24

Directional valve bank type SKP connected in parallel, size 3, starting spool valve section without pressure limiting valve (coding 5) with flow pattern U and two add-on spool valves with flow pattern symbols G, D; flow pattern U solenoid actuated (ME2), flow pattern G and D solenoid actuated (MD2), solenoid voltage 24V DC

#### SKH-2-4 LYSH - AK - 200

Directional valve bank type SKH connected in series, size 2, starting spool valve section with manually adjustable pressure limiting valve (coding 4) and flow pattern L, add-on spool valves with flow pattern symbols Y, S, H; manual actuation with protected housing version type AK and set pressure of the pressure limiting valve 200 bar

#### Dimensions

Type SKP (see order example)

#### Typ SKH (see order example)



#### **Additional informations**

• Directional spool valve type SKH(P) 0 SKH(P) 4	D 7230
type SG, SP	D 5650/1
• Plugs with LED etc.	D 7163
<ul> <li>Plugs with economy circuit</li> </ul>	D 7813

Actuations:	
Manual	D 6511/1
Solenoid	D 7055
Pressure	D 6250

• See also "Turn-key solutions out of the modular system"

For page and section of the devices additionally listed, see type index

#### **Example circuit**

R23,5/B100 A200 - V9 - SKP28 - U2/G2 E - ME3/24/MD3/24

Hydraulic power pack type R, consisting of: Pump R23,5, tank B100, connection block (coding A) with pressure limiting valve (200 bar) and drive motor (P<sub>N</sub> = 9 kW, coding V9) Valve bank connected internally in parallel, 3 valve sections and intermediate plates for solenoids with increased performance MD(E)3 (solenoids are wider than the valve sections)

┨



#### Main parameter of the example circuit

Q <sub>Pu</sub>	= 23.5 lpm (at 1450 rpm)
P <sub>max P</sub>	= 250 bar
P <sub>system</sub>	= 200 bar
V <sub>consum</sub>	= 120 I
P <sub>N drive</sub>	= 9 kW

## **Directional spool valve type SW, SWR, and SWP**

These directional spool valve are available for pipe connection (type SW), manifold mounting (type SWP) or as valve banks (type SWR, SWP). All of them are directly actuated by wet armature solenoids. Type SWS is also available with proportional control (optionally ex-proof) and stroke limitation.

A connection block with an optional, integrated pressure limiting valve may be added to the individual manifold mounting valves.

The valve bank (type SWS, SWR, and SWS) consists of a connection block (with ports P and R) or an adaptor plate for direct connection onto hydraulic power packs, the directional spool valve sections and the end plate. The whole valve bank is held together with two tension rods.

These valve sections of type SWS may be optionally equipped with throttle, orifice, pressure balance, and ancillary blocks featuring additional functions

e.g. releasable check valves, load holding valves or sequence valves.

Nomenclature:	Directional spool valve
Design:	Individual valve for pipe connection or Manifold mounting Valve banks Combination with hydraulic power packs
Actuation:	Solenoid
p <sub>max</sub> :	315 bar
Q <sub>max</sub> :	12 25 lpm



#### Basic types and general parameters

Basic type and size Individual valve Valve bank Pipe Manifold Bank Flow **Tapped ports** Oper. conection mounting cable pressure (BSPP) Q<sub>max</sub> (lpm) p<sub>max</sub> (bar) 1) 2) **SW 1** SWP 1 SWR 1 12 315 G 1/4 SWS 2 **SW 2** SWP 2 25 315 G 3/8, G 1/4

#### Connection blocks / adaptor plates for valve banks



#### Valve bank coding 3)



<sup>1</sup>) Individual manifold mounting valves or valve bank with sub-plates

<sup>2</sup>) Only with type SW, SWS, and SWR

<sup>3</sup>) Same coding layout as valve banks type SWP

#### Additional versions of connection blocks/adaptor plates for valve bank

- Connection block for pipe connection with 3-way prop. flow control valve and pressure limiting valve
- Connection block with incorporated idle circulation valve
- Individual connection block with/without pressure limiting valve, manually or tool adjustable

#### Symbols (valve sections)

max. 10 valve may be combined in a valve bank

- Adaptor plates enabling, optional connection of a pressure switch type DG3.. in port P
- (see also "Additional informations")
- Adaptor plates for direct mounting onto compact hydraulic power packs



#### Additional versions (valve sections)

- Individual connection blocks without or with pressure limiting valve, manually or tool adjustable (type SWP 1)
- Individual valve with check valve or orifice in port P and/or check valve in port R (type SWP., NSWP2)

#### Valve sections type SWS 2 with additional functions (pump side)

- · Basic block with/without provision for additional functions
- Basic valve block with orifice, throttle, check valve or flow control valve

#### Additional versions (valve sections)

(CETOP3, connection/pattern NG 6)

(see also "Additional informations")

• Type NSWP 2 with pressure switch type DG 3

- Pressure reducing valve, reducing the pressure upstream in gallery P
- Damped valve spool for consumer side A and B (type SWP 2, SWS 2)

# Value sections type SWS 2 with additional functions (consumer side) Additional function Releasable check value Shock value Sequence value Over center value Symbol Image: Additional function for the second se

#### Additional versions (additional functions type SWS, SWP 1)

- Releasable check valve consumer side A or A and B (type SWP1)
- Ancillary block without function, tapped ports G 1/4 or G 3/8 (BSPP)
- Ancillary block with shock and/or suction valves consumer side A or A and B
- Ancillary block with over center valve consumer side A or B

#### Actuation solenoid (SWS 2)

- Solenoid on/off (p<sub>max</sub> = 315 bar)
- Solenoid with detent
- Prop. solenoid

#### Solenoid voltage

- 12V DC, 24V DC, 230V AC 50/60 Hz
- Other voltage on request

#### **End plates**

Basic type	Coding	Symbol
SWR1	1	
SWP1	1	(P)
SWS2		(R)

#### **Order examples**

#### SWR1 A7 - WGZ6G - 1 - WG230 - 210

Valve bank type SWR, size 1, connection block with manually adjustable pressure limiting valve (factory set to 210 bar), valve sections W and G pressure reducing valve (coding Z6) installed between the valve sections, standard end plate (coding 1) and solenoid voltage 230V AC 50/60 Hz

#### SW1 G - G24

Indiv. directional spool valve for pipe connection, size 1, flow pattern G solenoid voltage 24V DC

#### SWS2 A7/200 - G/M/2/2RH

#### - G10/MPFAB/DW/2AL B7/180 BLC4/140 - E/M/R/2AN100 BN100-1-G 24

Valve bank type SWS, size 2, connection block with pressure limiting valve (manually adjustable, factory set on 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, pressure balance in gallery P of the basic valve body (DW), ancillary block with over center valves (factory set on 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 on 100 bar), standard end plate. All solenoids 24V DC.

- Solenoid with stroke limitation (limiting Q<sub>max</sub>)
- Double solenoid (two speed rates)
- Ex-protected solenoid (p<sub>max</sub> = 210 bar)
- Plugs with LED, improving EMC or with economy circuit (see also "Additional informations")

#### Additional versions (end plates)

- Version with additional ports P or R, (may be plugged)
- Version with idle circulation valve (on/off, proportional)
- End section spool valve
- Adaptor plates for the combination with directional seated valve banks type BWH(N)1, BWH2

#### SWP1 G - 1/4SR - G24 - 150

Indiv. manifold mounting directional spool valve, size 1, flow pattern G, mounted on indiv. connection block with manually adjustable pressure limiting valve (factory set to 150 bar) and tapped ports G 1/4 (BSPP), solenoid voltage 24V DC

#### Symbol

Valve bank type SWS, see order example below



#### Dimensions

#### Type SW

Valve bank, see order example





#### Type SWP

Manifold mounting valve, see order example



#### Type SWR1 and SWS2

Flow pattern for valve bank type SWR, see order example



Connection

Valve sections End plate



All dimensions in mm, subject to change without notice!

Basic type	н	В	т	m (kg)	
			-	Indiv. directional spool valve	Connection block
SW1, SWR1, SWP1	7790	40	4044	1.11.5	0.60.7
SW2, SWS2, SWP2	7882.5	6070	4045	1.12.4	approx. 0.8

#### **Additional informations**

<ul> <li>Directional valve banks type SWS</li> </ul>	D 7951
Directional valve type SW.1	D 7450
type SW.2, NSWP	D 7451, D 7951 N
Plugs with LED etc.	D 7163
<ul> <li>Plugs with economy circuit</li> </ul>	D 7813, D 7833
<ul> <li>Pressure switches type DG3, DG5.E</li> </ul>	D 5440, D 5440 E

• See also "Turn-key solutions out of the modular system"

• See also section "Devices for special applications" (Industrial trucks)

For page and section of the devices additionally listed, see type index.

## Directional spool valves type HSR(L), HSF, and HSL

The directional spool valves are available as individual valve for pipe connection (type HSL), manifold mounting (type HSF) or as valve banks (type HSR). These valves are utilized to control the direction of movement of hydraulic consumers. All of them are indirectly electro-hydraulically actuated. The control fluid demand is either internally taken from the main circuit or fed externally from a separate control oil circuit. These valves are equipped with adjustable thread type throttles (exception HSRL 3), prolonging the shifting operation, thereby preventing harsh shifting, which might cause pressure surges due to high pressure or consumer flow. The valve banks come with a connection block which option-



ally incorporates e.g. an idle circulation valve, a pressure limiting valve or a pressure reducing valve (control fluid supply for high primary pressure). Type HSRL 3 gives provision to select different pressure stages during operation.

Nomenclature	Directional spool valve
Design:	Individual valve for pipe connection or Manifold mounting Valve bank
Actuation:	Electro-hydraulic Hydraulic
p <sub>max</sub> :	400 bar
Q <sub>max</sub> :	80 160 lpm

#### Basic types and general parameters

Basic type and size			Flow	Oper. pressure	Control pressure	Tapped po	orts
Individual valve for	Manifold	Valve bank	Q <sub>max</sub>	P <sub>max</sub>	P <sub>contr max</sub>	(BSPP)	)
pipe connection	mounting valve		(lpm)	(bar)	(bar)	A, B, P, R <sup>1</sup> )	M, X, Z
					• •		
HSL 3	HSF 3	HSRL 3	80	400	160	G 1/2	G 1/4
HSL 4	HSF 4	HSR 4	160	400	160	G 3/4	G 1/4

<sup>1</sup>) P, R = G 1 with HSRL 3/C 3.. /...

#### Valve bank coding



#### **Connection blocks (HSR)**

Basic type	Connection	Brief description	Sym	bol
and size	block	_	A 3	C 321
HSRL 3 HSR 4	Α3	With internal control fluid supply picked up from gallery P, control pressure reduced to approx. 30 bar by pressure reducing valve		$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$
HSRL 3	C 321	With internal control fluid supply picked up from gallery P, idle circu- lation and pressure limiting valve, optional ancillary block featuring three additional pressure stages		

#### Additional versions (connection blocks)

 Connection blocks for external control fluid supply with/without pressure reducing valve

• Connection blocks with internal control fluid supply without pressure reducing valve for system pressure up to 160 bar

#### **Symbols**

max. 8 valve sections may be combined in a valve bank

#### Basic symbol



			Symp	101				
G	D	Е	С	W	В	L <sup>3</sup> )	H <sup>3</sup> )	F <sup>3</sup> )
a 0 b		X			X++	X++		XHH

All flow pattern symbols also available with adjustable shifting velocity (not for type HSRL3)

2) Here illustrated with hydraulic actuation

<sup>3</sup>) Not for type HSR..

#### Solenoid voltage

- 12V DC, 24V DC, 230V AC 50/60 Hz
- Other voltage on request
- Plugs with LED, improving EMC or with economy circuit (see also "Additional informations")
- Solenoid for valve sections in explosion-proof version (only type HSRL)

#### End plate

Brief description	Symbol		
HSR	1	2	
1 End plate with internal routing			
for leakage oil reflow	(P) (R) (R)		
2 End plate with external routing	$(Z) \xrightarrow{i} (X) \xrightarrow{i} (Z) \xrightarrow{i} ($	: + +•	
for leakage oil reflow	X <sup>±</sup> R X	R R	
HSRL			
1 End plate (standard)			

#### Order examples

#### HSF 3 G1 - G24

Indiv. manifold mounting valve, size 3, flow pattern G adjustable response time (coding 1) and solenoid voltage 24V DC

#### HSR 4/A3 - D1E - 1 - G12

Valve bank type HSR, size 4, connection block A 3 with internal control fluid supply and pressure reducing valve (approx. 30 bar control pressure), flow pattern D and E, D with adjustable response time (coding 1), end plate (coding 1) and solenoid voltage 12V DC

#### HSRL 3/C322/1D200 2D100 - DG - 1 - G 24

Example circuit (type HSRL 3)

Valve bank type HSRL, size 3, connection block with integrated pressure reducing valve, idle circulation valve, piloted pressure limiting valve, main pressure limiting valve factory set for 200 bar, second pressure stage factory set for 100 bar, two valve sections flow pattern D and G and a standard end plate, solenoid voltage 24V DC

#### Example circuit (type HSR)

2





m (kg)

#### Dimensions

Indiv. directional spool valve type HSF ..

(see order example)



Basic type	н	В	т	Indiv. spool valve
				or valve section
HSL 3	126	70	137	2 2.5
HSF 3	137	59	126	
HSL 4	136	80	182	3.7 4.2
HSF 4	157	70	184	

All dimensions in mm, subject to change without notice!

#### Valve banks type HSR 4

(see order example)



#### Valve bank type HSRL 3

(see order example)

Connection block with ancillary block Valve sections End plate





Basic type	m (kg)		
	Connection block	Valve section	
HSRL 3	1.7 4.0	2.0	
HSR 4	approx. 4.2	3.7	

#### **Additional informations**

<ul> <li>Directional spool valve</li> </ul>	type HSF
	type HSR
	type HSRL
	type HSL

D 7493 E D 7493 Sk 7493 RL Sk 7493 L

<ul> <li>Plugs with LED etc.</li> </ul>	D 7163
<ul> <li>Plugs with economy circuit</li> </ul>	D 7813, D 7833

For page and section of the devices additionally listed, see type index



## Manually actuated directional spool valves type DL

The directional spool valve banks type DL are used in mobile or stationary hydraulic systems with single and double acting consumers enabling flow control by means of manually controlled throttling.

This throttling process means closing of the by-pass gallery for idle pump circulation and simultaneously opening of the consumer duct. The consumer will start moving as soon as the required pressure level for the consumer is achieved by throttling the by-pass.

The directional spool valve versions type DLS are intended for industrial



trucks (stackers), featuring a connection block incorporating the first valve section (commonly used for the lifting cylinder). The connection block may be equipped optionally with a priority flow devider.

The other valve sections may feature many other options e.g. shock valves etc. widening the field of application even further.

Nomenclature:	Throttling directional spool valve
Design:	Valve bank, featuring integrated by-pass idle pump circulation
Actuation:	Manual • Spring return • Detent Electro-hydraulic Pressure • Hydraulic • Pneumatic
p <sub>max</sub> :	250 315 bar
Q <sub>max</sub> :	12 90 lpm

#### Basic types and general parameters

Basic type and size	Flow Q <sub>max</sub> (lpm)	Oper. pressure	Тарр	oed ports (E	ISPP)
	_	p <sub>max</sub> (bar)	Coding	А, В	H, P, R
DL 1	12 16	315		G 1/4	G 1/4
DL 2	20 30	315	1	G 1/4	G 3/8
			2	G 3/8	G 3/8
DL 3	30 60	250	2	G 3/8	G 1/2
			3	G 1/2	G 1/2
DL 4	90	250	3	G 1/2	G 3/4

#### Valve bank coding



#### Additional versions (Basic types)

- Directional spool valve type DLS for industrial trucks (e.g. stackers) (see also "Additional informations")
- Directional spool valve type DLSR for variable displacement pumps (see also "Additional informations")

#### **Connection blocks**

Basic type	Brief description	S	/mbol
DL 15		DL .5	DL .1
DL 25	Connection block without		·
DL 35	pressure limiting valve		
DL 45			
DL 11		м	
DL 21	Connection block with		· ·
DL 31	pressure limiting valve		
DL 41			

#### Additional versions (connection blocks)

- Connection block with preferential flow devider (e.g. for hydraulic steering circuit)
- Connection block with shock valve
- Connection block with drop rate braking valve

#### Symbols (valve section)

max. 10 valves may be combined in a valve bank



ц<u>г</u>.

Ч

#### Additional options for the valve sections

Secondary pressure limiting valve for consumer port A and / or B

Example: DL 21 - 1 - GDD **G71** GG-B/E1 - 2 - 180



Intermediate plate with pressure limiting valve for all subsequent valve sections

Example:

DL 21 - 2 - GG **X5** D-B/E1 - 2 - 210



#### Additional versions (valve sections)

- Valve sections for size 3 with consumer sided additional functions in ancillary block (e.g. releasable check valves, shock valves etc.)
- Reducing intermediate plate (size 3 into 2) with 3-way flow devider
- Valve section featuring stop function for all subsequent consumers
- Size 4 also available without check valve for P
- Manual actuation with autom. spring return for switching position "a" and detent for switching position "b"
- Manual actuation with detent for both switching positions
- Manual actuation in combinations with contact switch, cam and switch carrier
- Manual actuation with different mounting orientations
- Manual actuation with protected lever housing for size 3 and 4
- Pneumatic actuation for size 3 and 4
- Displacement transducer or contact switch at the valve spool

#### **End plates**



#### Dimensions

#### (see order example)

#### Order examples

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

Directional spool valve DL, size 2, pressure limiting valve

(factory set to 180 bar), port size 2 with tapped ports G 3/8 (BSPP), flow pattern G, D, E, N; flow pattern E with pressure limiting valve for port A (coding 71), valve sections with manual actuation B (standard with hand lever), mounting orientation E1 (ports A, B are directed to the front, valve spool is pushed in the valve body to achieve shifting position "a" ), end plate 2 (coding 2)



#### Additional informations

• Directional spool valve type DL, DLS type DLSR

D 7260	/1
D 7260	SR

• See also section "Devices for special applications" (Industrial trucks, Hydraulic for mobile applications)

For page and section of the devices additionally listed, see type index

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## Prop. directional spool valve type PSL and PSV

The directional spool valve bank type PSL is designed for constant delivery pump systems (pressure/flow controller) whereas the type PSV is for variable displacement pump systems. Both are available in two sizes. They serve to control the direction of motion and provide infinite control of the speed of motion of hydraulic consumers regardless of their load. Several consumers may be operated simultaneously and independantly of each other.

The main field of application is mobile hydraulics (e.g. crane controls etc.). These valve banks can be tailored to a specific application, requiring unequal max. consumer flows at port A and B as well as additional

functions such as functional cut-off.

	valve acc. to the Load- Sensing principle
Design:	Valve bank or
	Manifold mounting
_	(also as valve bank)
Actuation:	Manual
	Return spring
	Detent
	Electro-hydraulic
	Pressure
	Hydraulic
	Pneumatic
D <sub>max</sub> :	400 420 bar
Q <sub>max. consumer</sub> :	3 210 lpm

Prop. directional spool

Nomenclature



#### Basic types and general parameters

Basic type	Flow (lpm)		Oper. pressure	Tapped ports (BSPP)	
and size	Q <sub>consumer</sub>	<b>Q</b> <sub>pu max</sub>	p <sub>max</sub> (bar)	P and R	A and B
PSL 3	3 120	200	420	G 1/2, G 3/4, G 1	G 1/2, G 3/4
PSV 3	3 120	200	420	G 1/2, G 3/4, G 1	G 1/2, G 3/4
PSL 5	16 210	250	400	G 1, G 1 1/4	G 1
PSV 5	16 210	250	400	G 1, G 1 1/4	G 1

#### Additional versions

- PSLF.. valve bank, sub-plate mounted (size 3 and 5)
- Versions available with UNF-ports (valve banks) or SAE-flange (manifold mounting version)

#### Valve bank coding



#### **Connection blocks**

Basic type	Brief description	Brief description		
PSL	Connection block for constant delivery pump systems with incorporated 3-way flow controller and pressure limiting valve	·		
PSV	Connection block for variable displacement pump systems with pressure limiting valve			



#### Additional versions (connection blocks)

- Integrated piloting pressure reducing valve, supporting the electrohydraulic actuation
- 2/2-way solenoid actuated directional valve for arbitrary idle pump circulation
- Additional damping of the 3-way flow controller or pump controller
- Additional idle circulation valve minimizing the circulation back pressure
- Version without pressure limiting valve (type PSV)
- Version available where the pump gallery can be blocked arbitrarily

Additional functions

Valve sections

#### Symbol

max. 12 valve may be combined in a valve bank







**Additional functions** 

Ancillary block

#### Additional versions (valve sections)

- Load pressure signal pick-up with A, B; joint for A and B
- 3/3-directional spool valve with 2-way inflow and outflow controller
- Version without 2-way inflow controller
- Prop. pressure limitation for individual functions
- · Additional ancillary blocks for various other functions

• It is possible to achieve 120 lpm (size 3) and 210 lpm (size 5) for consumer ports A or B by raising the control pressure.

Coding for max. consumer flow

3

version with inflow controller

6

• Flow for A or B may be selected individually

10

16

16

• Coding represents the max. flow (Ipm) at consumer ports A or B for

25

25

40

40

63

63

80

80

120

160

Size 3

Size 5

#### Actuations

Basic type	Brief description
Α	Manual actuation
С	Detent (stepless)
E	Electro-hydraulic actuation
EA	in combination with manual actuation
Н, Р	Hydraulic and pneumatic actuation
HA, PA	in combination with manual actuation
HEA	Combination of actuation H, E, and A

#### Intermediate plates

**End plates** 

- Electrically or hydraulically actuated shut-off valve for all subsequent consumers
- With pressure limiting valve limiting the operation pressure for all subsequent valves

#### Symbol (example)

For combination of electro-hydraulic and manual actuation

Solenoid voltage 12V DC, 24V DC also as explosion proof version available

• Arbitrary flow reduction for all subsequent consumers

Basic type	Brief description	Symbol	
E 1	End plate (serie)	E 1	Εź
E 2	With additional Y-port for LS-input signal		
Example PSL 41/350	- 3 - 32 J 25/16 A300 F1 -42 O 80/63 C250	/EA /EA	
	-42 J 63/63 A100 B120 F3	/EA	
	-31 L 40/16	/A - E2 - G24	

#### Additional versions (end plates)

- End plate with internal drain line (without T-port)
- End plates with additional P- and R-port
- Adaptor plates enabling combination of size 5 with 3

- Valve bank type PSL for constant delivery pumps Connection block:
- Coding for port size (4, G 3/4)
- Coding for piloting pressure reducing valve (1)
- Coding for set pressure at pressure limiting valve (350 bar)

#### Size:

- Coding (-3-)
- 1. Valve section: (as an example for all additional sections)
- Valve section with coding for port size consumer (here 3, G 1/2)

- Coding for the kind of the valve section (here 2)
- Flow pattern (here J)
- Coding for max. flow rate at consumer port A and B (here 25 and 16 lpm)
- Coding for additional functions (here A 300; secondary-pressure limiting valve at port A factory set to 300 bar, shutt-off function for port A (here F1))
- Coding for the actuation (here EA )

#### End plate:

- Coding for end plate (here E 2)
- Coding for solenoid voltage 24V DC (here G24)
#### Symbol (example)



#### Dimensions

(see order example)





All dimensions in mm, subject to change without notice!

Basic type	н	H1	В	т	m (kg) per valve section <sup>3</sup> )
PSL3-	approx. 364	approx. 195	50	80	3.3 4.1
PSV3-	approx. 364	approx. 195	50	80	3.3 4.1
PSL5-	approx. 400	approx. 224	62.5	100	3.7 4.5
PSV5-	approx. 400	approx. 224	62.5	100	3.7 4.5

<sup>3</sup>) Dep. on actuation and additional functions

#### **Additional informations**

Prop. directional spool valve type PSL/PSV size 3	D 7700-3
type PSL/PSV size 5	D 7700-5
type PSLF/PSVF size 3, 5	D 7700-F
<ul> <li>Over-center valves type LHT, LHDV</li> </ul>	D 7918, D 7770
Joystick type EJ	D 7844

<ul> <li>Prop. amplifier (modul) type EV1M2</li> </ul>	D 7831/1
Prop. amplifier (board design) type EV 22K2	D 7817/1
<ul> <li>Programmable logic valve control type PLVC</li> </ul>	D 7845
<ul> <li>See also section "Devices for special applications"</li> </ul>	

(Hydraulic for mobile applications, Devices for explosion hazardous areas, Prop. valves)

For page and section of the devices additionally listed, see type index



# **Clamping modules type NSMD2**

These clamping module type NSMD2 is intended for the actuation of hydraulic clamping devices, such as draw-in collets (hollow or massive) at CNC-lathes. Type NSMD2 is designed as manifold mounting valve featuring a hole pattern conforming DIN 24340-A6. All necessary functions to be performed e.g. clamping/releasing of the clamping cylinder, pressure reduction, and electric pressure monitoring (if requested) are housed in a joint body. The adjustment of the clamping pressure and the pressure switch takes place via only one adjustment device either manually, with tools or electro-proportionally. This feature is available for consumer port A only or both A and B. A unique safety circuit monitors the mode of the 4/3- or 4/2-way directional



valve. The actuations for these directional valves are usually with spring return but the 4/2-way is also available with detent. Additional functions e.g. throttling in the spool's end position, rapid traverse and creeping for one or both consumer sides are possible. All this enables us to tailor a valve meeting exactly the requirement of the application.

Nomenclature:	<ul> <li>Valve combination consisting of:</li> <li>Directional spool valve (4/3-, 4/2-way function)</li> <li>Pressure reducing valve with tracked pressure switch</li> </ul>
Design:	Individual valve for sub-plate mounting (Valve banks with sub-plates type BA are available)
Actuation:	Solenoid
p <sub>max</sub> :	120 bar
Q <sub>max</sub> :	25 lpm

#### Basic types and main parameter

Basic type and size	Flow Q <sub>max</sub> (lpm)	Oper. pressure p <sub>max</sub> (bar)	Clamping pres- sure range (bar	Trigger flow (lpm)	Connection hole pattern <sup>1</sup> )	
NSMD2	25	120	5-50	2-4		
			8-80	3-5	Hole pattern conf.	
				4-6	DIN 24340-A6	
						<sup>1</sup> ) Port Mx; G 1/8 (BSPP)

### Symbols Basic symbols







# Symbols



#### Actuation for adjusting the clamping pressure

- Slotted screw + hexagon nut (standard)
- Wing screw + hexagon nut
- Wing screw + wing nut

- Turn knob lockable
- Electro-proportional adjustment
- Electro-proportional adjustment with additional function monitoring

#### Additional versions (further functions)

• Pressure reducing function and throttle in switching positions a and b: Example:

Coding G 166



• Rapid traverse and creeping in both directions: Example:

Example.

Coding G 2062



• 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

#### Example:

Coding G 307



#### Solenoid voltage

- 12V DC, 24V DC, 230V AC 50/60Hz
- Other voltage on request

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

Example:



 Plug with LED's or to improve the EMC (see also "Additional information")

# Order examples

### NSMD2K/GRK/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. A throttle Ø 2.5 mm is installed in the P gallery, solenoid voltage 24V DC.

#### NSMD2G1166/G4VK/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 G, 5-50 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. A throttle  $\emptyset$  1 mm is installed in the P gallery, solenoid voltage 12V DC.

#### Dimensions

Type NSMD2 K... (see order example)



### Additional information

<ul> <li>Clamping module type NSMD</li> </ul>	D 7787
Valve banks type BA2	D 7788
<ul> <li>Directional seated valve type VZP1</li> </ul>	D 7785 A
<ul> <li>Valve bank type BVZP1</li> </ul>	D 7785 B
<ul> <li>Directional valve type NSWP2</li> </ul>	D 7451 N

• Plug with LE	D's
----------------	-----

• Plug with economy circuit

D 7163 D 7813, D 7833

For page and section of the devices additionally listed, see type index

2 1

# HK 43L/1M-Z 9,8-AL 21F2-F60/70-2-BA 2 - NSMD2K/GRK/B2,5/0 - NSMD2D307/GRK/B2/0-11-G24





# **2.2 Directional seated valves**

Seated valves (solenoid actuated)	
Directional seated valves with various actuations	<b>2.2-</b> 4
Directional seated valve bank type VB	<b>2.2-</b> 6
<ul> <li>Directional seated valves type WN and WH</li> </ul>	<b>2.2-</b> 10
Directional seated valve banks type BWH and BWN	<b>2.2-</b> 12
Directional seated valves type VZP	<b>2.2-</b> 16
Directional seated valve bank type BVZP	<b>2.2-</b> 18
<ul> <li>2/2-way seated screw-in valves type EM</li> </ul>	<b>2.2-</b> 22
• Directional seated valves type BVG, BVE, and BVP	<b>2.2-</b> 24
Valve combinations	
Lifting/lowering valves type HSV	<b>2.2-</b> 26
<ul> <li>Switch units (press control valves) type CR</li> </ul>	<b>2.2-</b> 28
Lifting modules type HMT, HMC etc.	<b>2.2-</b> 30
Manually actuated seated valves	

• Directional seated valves type VH, VHR, and VHP	<b>2.2-</b> 34
<ul> <li>Shut-off valves type DA and EA</li> </ul>	<b>2.2-</b> 36



# **Directional seated valves with various actuations**

These directional seated valves use spring loaded balls as valve elements and therefore do not show any leakage. They are manifold mounting and are available with various actuations which always acts on an angled lever pushing the valve element in the desired switching position. The basic versions are designed as 2/2- and 3/2-way directional valves. 3/3-, 4/3-way functions are possible if two valves are housed in one valve body, whereas 4/2-way functions require an additional intermediate plate. These valves may be directly installed in pipe systems, when equipped with sub-plates enabling pipe connection. Many optional functions can be incorporated in these sub-plates e.g. pressure limiting valve or restric-



tor check valve widen the field of application for this valve type. Valve banks of these valves are also available featuring several valves connected in parallel (see type VB).

Nomenclature:	Directional seated valve, zero leakage
Design:	Individual valve, manifold mounting combination with sub-plates for pipe connection
Actuation:	Solenoid Pressure actuated • Hydraulic • Pneumatic Mechanical • Roller • Pin
	Manual • Hand lever • Adjusting knob
p <sub>max</sub> : Q <sub>max</sub> :	320 700 bar 6 120 lpm

Type coding: GR 2 - 3 Actuation

Size Symbols

#### Basic types and general parameters

Size	Flow	Basic typ	e (actuation) wit	h oper. pressure p <sub>r</sub>	<sub>max</sub> (bar)	Tapped ports	
	Q <sub>max</sub> (lpm)	Solenoid actuated	Pressure actuated	Mechanically actuated	Manually actuated	P, R, A, B <sup>1</sup> ) (BSPP)	
		G WG	Н Р	кт	FD		
0	6	300 500	500	_	350 500	G 1/4	1) When combined with sub-plate for pipe connection
1	12	350 500 (700)	500 700	400 700	400 700	G 1/4 and G 3/8	
2	25	350 500 (700)	500	400 500	400 500	G 3/8 and G 1/2	
3	65	350 400	400	350 400	_	G 1/2 and G 3/4	_
4	120	350	_	_	-	G 3/4 and G 1	

### **Symbols**

Coding	2/2-	way	3/2-	way	3/3-way	4/3-way	4/2-	way
	directio	nal valve	directio	nal valve	directional valve	directional valve	directio	nal valve
Flow	R2	S2	3	Z3	21	22 <sup>2</sup> )	4 <sup>3</sup> )	Z4 <sup>3</sup> )
pattern					Simplified sym	bols for 3/3-, 4/3- a	and 4/2-way	functions
(actuation					a A b	a A B b	ΔR	ΔR
symbol to		╷┌┸┻┚┤		╻┌┶╧┧╎╷	MJ & II M	᠕᠋ᠯᢆᡛᠲᢆᡘᢆᢩ᠉		M X II A
be added)	R · P	R P			P R	P R	PR	PR
							2) Not for size	4

<sup>2</sup>) Not for size 4
 <sup>3</sup>) Only size 1

#### **Actuations**



#### Additional versions

- Individual valve with orifice insert, check valve insert in port P and/or return pressure stop in port R
- Sub-plate with restrictor check valve or pressure limiting valve between ports P and R
- Sub-plate with rectifying circuit by means of check valves ensuring intended flow direction, suited for alternating direction of flow
- 2/2- and 3/2-directional seated valves, size 1, with connection hole pattern conforming CETOP3 or ISO 4401, nom. size 6<sup>4</sup>)
- Directional seated valves with DC solenoid actuation in explosion proof design (Ex)s G4 4)
- 4/3- and 3/3-way functions up to 700 bar, size 2 (type G 39-2, G49-2)

4) See also "Additional information"

**T1** 

40

50

56

70

125

#### **Order examples**

#### PR 2-1

Directional seated valve, pneumatically actuated, flow pattern R2, size 1

#### G 3-2-3/8-G24

H1 max 5)

110.5

145

156.5

202

226

H max 5)

90.5

115

126.5

162

226

Size

0

1

2

3

4

Directional seated valve, solenoid actuated, flow pattern 3, size 2, sub-plate for pipe connection G 3/8, solenoid voltage 24V DC

3/3- and

4/3-way

75

92

116

144

162

в

T <sub>max</sub>

41.5

50

62.5

91.5

127

#### **Dimensions**

Individual valve (see order example)



#### Valve with sub-plate (see order example)





80

2/2- and

3/2-way

36

45

56

70

<sup>5</sup>) Figures apply for solenoid actuation <sup>6</sup>) Individual valve with sub-plate

#### **Additional information**

<ul> <li>Directional seated valves</li> </ul>	D 7300
<ul> <li>Valve banks type VB</li> </ul>	D 7302
Plug with LED etc.	D 7163
<ul> <li>Plug with economy circuit</li> </ul>	D 7813, D 7833
<ul> <li>Directional seated valves with industrial standard</li> </ul>	D 7300 N
connection pattern (CETOP3, NG6)	

- Directional seated valves in explosion proof design D 7300 Ex
- · Directional valves with lift monitoring D 7300 H
- See also section "Devices for special applications"

(Devices for explosion hazardous areas, Devices for up to 700 bar)

For page and section of the devices additionally listed, see type index

m <sub>max</sub>

(kg) 6)

0.8/1.0

1.4/1.9

2.9/3.9

5.9/7.1

16.3/20.1



# **Directional seated valve bank type VB**

The valve bank type VB consists of a connection block (with ports P and R), the directional seated valves (acc. to D 7300) installed on subplates and connected in parallel plus the end plate. The whole valve bank is held together with one or two tension rods.

Depending on the type of sub-plate differing flow pattern of the valves mounted on them are possible as well as optional functions e.g. pressure switches for the consumer port may be incorporated in these sub-plates. These valve banks may be either directly connected to a pipe system via the connection block or installed directly onto hydraulic power packs (type HK, HC, MP, FP, R) utilizing an adapter plate.



Various end plates featuring e.g. pressure switch for gallery P or accumulator drain valve widen the field of application for this valve banks. All this, together with our hydraulic power packs enables hydraulic control systems for high pressure applications with low spatial requirements.

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

# 2

### Basic types and general parameters

Basic type	c type Flow Oper. pressure p <sub>max</sub> (bar) with actuation				
and size		Solenoid	Pressure	Manually	(BSPP)
	Q <sub>max</sub> (lpm)	actuated	actuated	actuated	
	_	м	Н Р	FD	P, R, A, B
VB 01	6	300 500	500	350 500	G 1/4
VB 11	12	350 500(700)	500 700	400 700	G 1/4 and G 3/8
VB 21	25	350 500(700)	500	400 500	G 3/8 and G 1/2
VB 31	65	350 400	400		G 1/2 and G 3/4
VB 41	120	350			G 3/4 and G 1

#### Order coding example



#### **Connection blocks / adapter plates**

Basic type	Brief description	Symbol
A1/	For pipe connection, with tool adjustable pressure limiting valve (/ pressure specification in bar)	
C, D, E	For mounting onto hydraulic power packs type R, Z and RZ, depending on tank and size $^{1}$ )	(R) (P)

 F, G
 For mounting onto hydraulic power packs type HK, HC, MP, FP)

 (also in combination with two stage valve type NE) <sup>1</sup>)



F

G

1) See also "Additional information"

#### Symbols (valve section)

max. 12 valve sections may be combined in a valve bank (depending on size), actuation symbol to be added



## Options for the valve section (only for type VB01 and VB11)

Pressure switches in gallery P or the consumer port



Example: ... **H5** ... Flow pattern H with DG 35 in the consumer port

Example: ... **H8** ... Flow pattern H with DG 35 in the gallery P



#### Example: ... - CZ1/200/5R/3 - ...

Pressure reducing valve, reducing the pressure in the subsequent P gallery

2-way pressure reducing valve type CDK 3, factory set to 200 bar, with check valve and pressure switch type DG 33 in the gallery P  $^{6}$ )

6) See also "Additional information"

The pressure switches type DG 3.. are directly mounted at the sub-plate <sup>6</sup>)

#### Additional versions (valve section)

- Individual valve with orifice in the gallery P and/or return pressure stop in the return gallery
- Sub-plate with 2-way flow control valve, by-passing to the tank (only with type VB 31)
- Sub-plate with pressure switch (only with type VB 01, VB 11)
- •Sub-plate with pressure limiting valve and throttle (only with type VB 21, VB 31)
- Sub-plate with idle circulation and/or shuttle valve for type VB 22 (only type G39-2, G49-2)

#### Solenoid voltage

- 12V DC, 24V DC, 230V AC 50/60 Hz
- Other voltage on request
- Plug with LED, improving EMC, or with economy circuit <sup>8</sup>)

#### **End plates**



• Other actuations (pressure and mechanical) analogous to "Directional seated valves with various actuations" (see also section "Additional information")

#### Additional versions (end plates)

- End plates with accumulator drain valve and pressure switches type DG 3.. <sup>8</sup>)
  - <sup>7</sup>) Only with type VB01 and VB11
  - <sup>8</sup>) See also "Additional information"

#### **Order examples**

#### VB01FM-E H3 G33/3 - 1 - G24

Valve bank type VB 01, size 0 with connection block for direct mounting onto hydraulic power packs, flow pattern E, H, G (G with pressure switches DG 33 in the consumer ports (A and B),end plate /3 (with DG 33), tapped ports G 1/4 (coding 1) and solenoid voltage 24V DC

# VB 11AM - 2/420 - R H S3/3 - 1 - WG230

Valve bank type VB 11, size 1 with connection block for pipe connection and integrated, manually adjustable pressure limiting valve (factory set to 420 bar), flow pattern D, H, S and end plate with one pressure switch DG 33, tapped ports G 1/4 (coding 1), solenoid voltage 230V AC 50/60 Hz



	_		_	per indiv. section
VB 01	110 135	38	40	0.6 1.25
VB 11	139 174	46	50	1.1 2.3
VB 21	180 220	58	63	2.0 4.6
VB 31	202 252	72	80	4.5 9.1
VB 41	265 312	82	100	8.9 14

All dimensions are in mm, subject to change without notice !

# Example circuit MP 24 - H1,39/B5 - A1/300 - VB01 FMH - FR/N/32 - 1 - WG230

Hydraulic power pack type MP size 2, connection block with pressure limiting valve (tool adjustable) Valve bank type VB size 0 with three valve sections (different actuations for the directional valves, here M (solenoid) and H (hydraulical)) and end plate here 32 with pressure switch and drain valve

#### Main parameter of the example circuit

p <sub>syster</sub>	n	= 300 bar
(set p	ressure of	the pressure limiting valve)
Q <sub>pu</sub>		= approx. 1.39 lpm at 1450 rpm
p <sub>max p</sub>	ou	= 400 bar
Tank	V <sub>usable</sub>	= approx. 6 l
	V <sub>total</sub>	= approx. 7.7



#### **Additional information**

• Directional seated valves with va	rious actuations	D 7300
<ul> <li>Valve banks type VB</li> </ul>		D 7302
Compact hydraulic power packs	type MP, MPW	D 7200, D 7200 H
	type HC, HCW, HCG	D 7900, D 7900 G
	type HK, HKF	D 7600 ++
	type FP	D 7310
<ul> <li>Hydraulic power packs</li> </ul>	type R	D 6010, D 6010 H
	type RZ	D 6910, D 6910 H
	type Z	D 6820

<ul> <li>Connection blocks type A</li> </ul>	D 6905 A
<ul> <li>Two-stage valves type NE</li> </ul>	D 7161
Plug with LED etc.	D 7163
<ul> <li>Plug with economy circuit</li> </ul>	D 7813
Pressure switches type DG3, DG5E	D 5440, D 5440 E
<ul> <li>Pressure reducing valves type CDK</li> </ul>	D 7445
• See also section "Devices for special appli	ications"
(Devices for up to 700 bar)	

• See also "Turn-key solutions out of the modular system"

For page and section of the devices additionally listed, see type index



# **Directional seated valves type WN and WH**

These directional seated valves type WN and WH use spring loaded balls as valve elements and therefore do not show any leakage. They are manifold mounting and are available in four sizes. These valves are very compact as the functional valve parts are partly integrated in the solenoid body. The basic versions are designed as 2/2- and 3/2-way directional valves. Whereas 3/3- , 4/3-way functions require two valves to be installed on one valve sub-plate.

These valves may be directly installed in pipe systems, when equipped with sub-plates enabling pipe connection. Many optional functions incorporated in these sub-plates e.g. pressure limiting valve or restrictor check valve



widen the field of application for this valve type.

The type WN (size 1 only) is more simply designed as type WH making its pricing more competitive but the max. permissible pressure is reduced as there are no moving seals and the armature cavity is not separately depressurized.

Valve banks of these valve type are also available featuring several valves connected in parallel (see type BWN and BWH).

Design:       Individual valve, manifold mounting combination wir connection blocks for pip connection         Actuation:       Solenoid
Actuation: Solenoid
p <sub>max</sub> : 350 450 bar
<b>Q</b> <sub>max</sub> : 5 60 lpm

#### Basic types and general parameters

Basic type and size	Flow Q <sub>max</sub> (Ipm)	Oper. pressure p <sub>max</sub> (bar)	Tapped ports <sup>1</sup> ) (BSPP) P, R, A
WN 1	5	320350	G 1/4
WH 1	8	450	G 1/4
WH 2	15	350	G 3/8
WH 3	30	350	G 1/2
WH 4	60	350	G 3/4

#### When combined with sub-plate for pipe connection

#### **Symbols**

(symbols show type WH)

	, s,						
D	Q	F	E	н	Ν	М	R

Type WN 1 without de-pressuring duct for the solenoid (leakage duct is apparent)

#### Solenoid voltage

- 12V DC, 24V DC, 230V AC 50/60 Hz
- Other voltage on request

#### **Additional versions**

- 3/3- and 4/3-way functions, if two valves are combined on one sub-plate (only version for pipe connection)
- 4/2-way function (directional spool valve)
- Two separate 3/2-way functions mounted on one sub-plate (twin directional valve)

#### **Order examples**

#### WH2 M - G24

Directional seated valve type WH, size 2 with flow pattern M, solenoid voltage 24V DC

#### **Dimensions**

#### Individual valve

(see order example)





Basic type	н	В	т	m (kg)
WN 1	86.5	35	35	0.6
WH 1	86.5	35	35	0.6
WH 2	97.0	35	35	0.65 0.7
WH 3	95.5	45	45	1.2 1.3
WH 4	118.0	60	60	2.7 3.0

- Plug with LED, improving EMC or with economy circuit (see also section "Additional information")
- Individual valve with orifice insert, check valve insert in port P and/or return pressure stop in port R
- Sub-plate with restrictor check valve or pressure limiting valve between ports P and R

#### WH1 H - 1/4 - WG230

Directional seated valve type WH, size 1 with flow pattern H, sub-plate for pipe connection G 1/4 and solenoid voltage 230V AC 50/60 Hz

### Valve with sub-plate for pipe connection

(see order example)





Basic type	H1	B1	T1	m (kg)
WN 11/4	111.5	40	35	0.9
WH 11/4	111.5	40	35	0.9
WH 21/4	125	40	40	1.0
WH 33/8	128	50	50	1.8
WH 41/2	158 173	70	70	3.6 4.0

#### Additional information

<ul> <li>Directional seated valves type WN, WH</li> </ul>	D 7470 A/1
<ul> <li>Valve banks type BWN, BWH</li> </ul>	D 7470 B/1

<ul> <li>Plug with LED etc.</li> </ul>	D 7163
<ul> <li>Plug with economy circuit</li> </ul>	D 7813, D 7833

For page and section of the devices additionally listed, see type index



The valve bank types BWN and BWH consist of a connection block (with ports P and R), the directional seated valves types BWN and BWH installed on sub-plates and connected in parallel plus the end plate. The whole valve bank is held together with one tension rod.

Depending on the type of sub-plate differing flow pattern of the valves mounted on them are possible as well as optional functions e.g. pressure switches or pressure limiting valve for the consumer port may be incorporated in these sub-plates.

These valve banks may be either directly connected to a pipe system via the connection block (with or without pressure limiting valve) or installed



directly onto hydraulic power packs (type HK, HC, MP, FP, and R) or other valve banks utilizing an adapter plate.

Various end plates featuring e.g. pressure switch for gallery P or accumulator drain valve widen the field of application for this valve banks.

All this, together with our hydraulic power packs enables hydraulic control systems with low spatial requirements.

Nomenclature:	Directional seated valve, zero leakage
Design:	Valve bank • For pipe connection • For combination with hydraulic power packs
Actuation:	Solenoid
p <sub>max</sub> :	350 450 bar
Q <sub>max</sub> :	5 60 lpm
i.c	

### Basic types and general parameters

Basic type and size	Flow Q <sub>max</sub> (lpm)	Pressure p <sub>max</sub> (bar)	Tapped ports (BSPP) P, R, A, B
BWN 1	5	350	G 1/4
BWH 1	8	450	G 1/4
BWH 2	15	350	G 1/4
BWH 3	30	350	G 3/8
BWH 4	60	350	G 1/2

#### Order coding example



#### **Connection blocks / adapter plates**

Basic type	Brief description	_	Symbol	
A-1/	For pipe connection, with tool adjustable pressure limiting valve	A-1/	C	-
С	For mounting onto hydraulic power packs type R			(R) +
F	For mounting onto hydraulic power packs with connection block (type HK, HC, MP, FP)		(P)	(P) <del> </del>

- **Additional versions**
- · Connection block for pipe connection without pressure limiting valve
- · Connection block for pipe connection with manually adjustable pressure limiting valve
- Connection block for pipe connection with prop. pressure limiting valve
- Adapter plates to the combination with directional valves type BVZP or SWR/SWP (see also section "Additional information")

#### **Symbols**

(symbols show type BWH!)

max. 12 valve sections may be combined in a valve bank



Pressure switches in gallery P or the consumer port



Example: ... H5 ... Flow pattern H with DG 35 in the consumer port

Example: ... H8 ... Flow pattern M with DG 35 in the gallery P

(R) (P)

The pressure switches type DG 3.. are directly mounted at the subplate<sup>3</sup>)



(for 3/2- or 3/3-way valves)

Pressure limiting valves in the consumer duct

Flow pattern H with return pressure stop (1) and directly mounted pressure limiting valve, factory set to 150 bar

The pressure limiting valve is directly integrated in the sub-plate

flow is only  $0.5 \times Q_{max}$ Not available in size 4 2) Only available in size 1

Pressure reducing valve, reducing the pressure in the subsequent P gallery



Example: ... - CZ1/200/5R - ... 2-way pressure reducing valve type CDK 3 3), factory set to 200 bar, with check valve

3) See also "Additional information"

#### Solenoid voltage

- 12V DC, 24V DC, 230V AC 50/60 Hz
- Other voltage on request

#### Additional versions (valve section)

• Individual valve with orifice in port P and/or return pressure stop in the port R

#### End plates

Basic type	Brief description	Symbol
1	Standard end plate	3 and 3/
2	End plate with accu-	2
	mulator drain valve	
3	End plate with one or	
3/3	two pressure switches	
	connected to the P	
	gallery	
<b>•</b> •		

#### **Order examples**

#### BWH 1A-1/420 - F H4 N4 S - 1 - 1 - G24

Valve bank type BWH, size 1 with connection block A1/.. for pipe connection including integrated pressure limiting valve (factory set to 420 bar), flow pattern F, H, N and S, valves H and N with pressure switches DG 34 in the consumer duct (coding 4), end plate 1, tapped ports G 1/4 (coding 1), solenoid voltage 24V DC

- Plug with LED, improving EMC, or with economy circuit (see also section "Additional information")
- Sub-plate with pressure switch DG 3.. <sup>4</sup>) for blocking the P gallery

#### Additional versions (end plates)

- End plates with accumulator drain valve and pressure switches
- End plates with additional pressure limiting valve connected to the P gallery (also version with unit approval (TÜV))



Valve bank type BWH, size 2 with adapter plate for mounting onto connection blocks of hydraulic power packs (type HK, HC, MP, FP) <sup>4</sup>) and flow pattern H, R, H, R, end plate 1, tapped ports G 1/4 (coding 1), solenoid voltage 230V AC 50/60 Hz

### Dimensions

#### Design for pipe connection

(acc. to the order example on the left side)



Basic type	н	т	В	m (kg) <sup>5</sup> )
BWH(N) 1	116.5131.5	38	40	0.80.9
BWH 2	122157.5	38	50	0.91.1
BWH 3	155.5168	50	60	1.92.4
BWH 4	158213	70	92	4.16.1



All dimensions in mm, subject to change without notice!

4) See also "Additional information"

<sup>5</sup>) Per valve section

#### **Example circuit**

### HC 24/0,64 - A2/400 - BWH1F1 - D H5 R/150 - 36 - 1 - G24

Hydraulic power pack type HC, size 2, connection block with pressure limiting valve (manually adjustable) Valve bank type BWH, size 1 with three valve sections and end plate with pressure switch







#### Main parameter of the example circuit

 $Q_{pu} = 0.64 \text{ lpm} (at 1450 \text{ rpm})$ 

- p<sub>max pu</sub> = 700 bar
- p<sub>system</sub> = 400 bar (setting of the pressure limiting valve)
- V<sub>usable</sub> = approx. 1.5 I

#### **Additional information**

• Directional seated valves type WI	H, WN	D 7470 A/1
• Pressure switches type DG3, DO	D 5440, D 5440 E	
• Pressure reducing valves type CE	Ж	D 7745
Compact hydraulic power packs	type MP, MPW	D 7200, D 7200 H
	type HC, HCW, HCG	D 7900, D 7900 G
	type HK, HKF	D 7600 ++
	type FP	D 7310
<ul> <li>Connection block type A</li> </ul>		D 6905 A
Hydraulic power packs type R		D 6010, D 6010 H

<ul> <li>Directional seated valve banks type BWH, BWN</li> </ul>	D 7470 B/1
• Plug with LED etc.	D 7163
<ul> <li>Plug with economy circuit</li> </ul>	D 7813, D 7833

• See also "Turn-key solutions out of the modular system"

For page and section of the devices additionally listed, see type index



# **Directional seated valves type VZP**

These type VZP use spring loaded balls or cones as valve elements and therefore do not show any leakage. They are manifold mounting and are available in one size only. The twin lay-out of the 3/2- and 2/2-way directional seated valve elements, identical or similar to valves with single lay-out, and the actuation solenoids are housed in a shared valve body, making them very compact.

Depending on pairing, these valves can fulfill either one 4/4-, 4/3-, 3/3-way function or two independent 3/2- and 2/2-way functions. When compared with single valves of conventional lay-out, the twin design is more advantageous due to lower spatial requirements and the



possibility to mount pressure switches monitoring the consumer pressure. Especially the valve banks type BVZP consisting of several valves of this type, connected in parallel, propel these features and benefits.

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

# 2

#### Basic types and general parameters



### **Symbols**





\_\_\_\_ The 4. shifting position illustrates mode when both solenoids are energized

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



#### Solenoid voltage

- 12V DC, 24V DC, 230V AC 50/60 Hz
- Other voltage on request
- Plug with LED, improving EMC,
- (see also section "Additional information")

# Additional versions

- 4/2-way function, directional spool valve
- Individual valve with orifice in port P and/or return pressure stop in the port R
- Pressure switches connected to the consumer port

## Basic symbols 4/3- (4/4-), 3/3- (3/4-) way function



#### **Order examples**

#### VZP 1 G32 - G24

Directional seated valve type VZP, size 1, flow pattern G with pressure switch type DG 33 in port A (coding 3), prepared for retrofitting of a pressure switch type DG 3.. in port B (coding 2), solenoid voltage 24V DC

#### 3/2- (2/2-) way function



#### VZP 1 H4 N2 - G24

Directional seated valve type VZP size 1, flow pattern H with pressure switch type DG 34 am port A (coding 4), flow pattern N, prepared for retrofitting of a pressure switch type DG 3.. in port B (coding 2), solenoid voltage 24V DC

#### Dimensions



All dimensions in mm, subject to change without notice!



#### **Additional information**

Directional seated valves type VZP
Valve banks type BVZP
Plug with LED etc.
Pressure switches type DG3.., DG5E
D 5440, D 5440 E

For page and section of the devices additionally listed, see type index



# **Directional seated valve bank type BVZP**

The valve bank type BVZP consist of a connection block (with ports P and R), the directional seated valves type VZP installed on sub-plates and connected in parallel plus the end plate. The whole valve bank is held together with two tension rods.

Depending on the type, the sub-plate feature optional functions e.g. restrictor check valves and/or pressure reduction valves covering only the corresponding valve section. Pressure switches may be incorporated directly at the valve section.

These valve banks may be either directly connected to a pipe system via the connection block (with or without pressure limiting valve) or installed

directly onto hydraulic power packs (type HK, HC, MP, FP, and R) or other valve banks utilizing an adapter plate. Various end plates featuring e.g. pressure switch for gallery P etc. widen the field of application for this valve banks. All this, together with our hydraulic power packs enables hydraulic control systems with low spatial requirements.

Nomenclature:	Directional seated valve, zero leakage				
Design:	Valve bank • For pipe connection • Combination with hydraulic power packs				
Actuation:	Solenoid				
p <sub>max</sub> :	450 bar				
Q <sub>max</sub> :	15 lpm				

Basic types and	d general parameters	S Onor	Topy of payto	Order coding exa	ample
and size	FIOW	pressure	(BSPP)		- <u>G 33/22</u> - 1- 1- <u>G 24</u>
	Q <sub>max</sub> (lpm)	p <sub>max</sub> (bar)	A, B, P, R, M		Solenoid voltage
BVZP 1	15	450	G 1/4		End plate Valve section
					Connection block / adapter plate     Basic type

#### **Connection blocks / adapter plates**

Basic type	Brief description	Syr	nbol
A-1/	For pipe connection, with tool adjustable pressure limiting valve (/ pressure specification in bar	A-1/	F
F	For direct mounting onto hydraulic power packs with connection block (type HK, HC, MP, FP), prepared for retro- fitting of one or two pressure switches connected to gallery P		(R) (P) (P) (R) (R) (R) (R) (R) (R) (R) (R) (R) (R

#### Additional versions von connection blocks / adapter plates

- · Connection block for pipe connection with pressure limiting valve and/or accumulator drain valve prepared for retrofitting of a pressure switch
- Connection block for pipe connection with manually adjustable pressure limiting valve





- Connection block for pipe connection without pressure limiting valve
- · Connection blocks for direct mounting on to hydraulic power packs with 3-way prop. flow control valve and optional sequence valve in gallery R

#### **Symbols**

max. 10 valve sections may be combined in a valve bank

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



## Example: -.../CZ 5/100/5R

2-way pressure reducing valve type CDK 3 1) factory set to 100 bar with check valve and thread type throttle

M

Example: -CZ 2/150/4R/2

2-way pressure reducing valve type CDK 3 1) factory set to 150 bar with check valve

M3

consumer gallery

Example: .../6/ADKR/200/4R...

Pressure reducing valve with tracked pressure

switch, throttle and Bypass check valve in the

1) See also "Additional information"

В

#### Additional versions (valve section)

- Individual valve with orifice in the gallery P and/or return pressure stop in the return gallery
- Individual valve type WH with sub-plate, may be integrated in a valve bank
- Sub-plate for 4/3-way valves with ancillary blocks at the consumer side featuring a pressure reducing valve with tracked pressure switch and throttles

#### End plates

	Brief description	Symbol		
Basic type	Standard end plate			33 to 37
1	End plate prepared for	-		
32	retrofitting of a pressure	1	32	
	switch type DG 3 2)		r T	
	End plate with pressure	- (R)+		
33 to 37	switch type DG 3 2)			

### Order examples

#### BVZP1 A-1/200 - G 52/22

#### - R5 M2/0 - 1 - 1 - G24

Valve bank type BVZP, size 1, with connection block for pipe connection and tool adjustable pressure limiting valve, factory set to 200 bar (coding A-1/200), valve section 1 with flow pattern G, pressure switch type DG 35 at port A, (coding 5), prepared for retrofitting of a second pressure switch type DG 3.. at port B (coding 2), valve mounted on a sub-plate with restrictor check valves type QR 20 in ports A and B (coding 22), Valve section 2 with flow pattern R, pressure switch type DG 35 (coding 5) at port A, flow pattern M, prepared for retrofitting of a pressure switch type DG 3.. (coding 2) at port B, valve mounted on a sub-plate without additional elements (coding 0), end plate (standard, coding 1), tapped ports G 1/4 (coding 1), solenoid voltage 24V DC

<sup>2</sup>) See also "Additional information"





#### Dimensions



All dimensions in mm, subject to change without notice !

#### **Solenoid voltage**

- 12V DC, 24V DC, 230V AC 50/60 Hz
- Other voltage on request
- Plug with LED, improving EMC, or with economy circuit (see also section "Additional information")

#### Additional versions (end plates)

 Adapter plates for mounting of valve banks type BWN(H)1 / BWH2 (see also section "Additional information")

#### **Example circuit**

#### HK 448/1 - H7,0 - AS1/150 - BVZP1 FEH10F V15/G12 - G22/0 - R5 M2/20 - CZ5/80/5R - H12 H12/0 - 1 - 1 - G24

Hydraulic power pack type HK, size 4; connection block with integrated idle circulation valve and pressure limiting valve

#### Valve bank type BVZP

with 5 individually controlled valve functions housed in 3 valve sections, two functions are supplied with reduced pressure (pressure reducing valve section).

The flow can be arbitrarily adjusted via a prop. flow control valve.



### Main parameter of the example circuit

- = 7.0 lpm (at 1450 rpm) Q<sub>Pu</sub>
- $p_{max Pu} = 215 bar$
- p<sub>system</sub> = 150 bar (setting of the pressure limiting valve)
- V<sub>consum</sub> = approx. 3.7 l



#### **Additional information**

- Valve banks type BVZP
- Directional seated valves type VZP1
- Valve banks type BWN, BWH
- Pressure switches type DG3.., DG5E
- Pressure reducing valves type CDK type DK

D 7785 B
D 7785 A
D 7470 B/1
D 5440, D 5440 E
D 7745
D 7941

<ul> <li>Slot type throttle type Q.</li> </ul>	QR. QV	D 7730
olor type in othe type d,		01100

• Plug with LED etc.

Þ

• See also "Turn-key solution out of the modular system"

For page and section of the devices additionally listed, see type index

D 7163



These 2/2-way ball seated directional valves are either directly or pilot actuated by a solenoid. With the directly actuated version the valve passage is opened or closed by a cone whereas with the piloted a piloting duct of a stepped piston is opened or closed generating a pressure difference at the opposing facial areas of the piston forcing it in the open or closed position.

Type EMP is a proportional valve, acting like a throttle but with zero leakage in blocked position. The dampened version will increase the switching time for on/off controls (hydraulic ramp). The wet armature solenoids for the valve actuation are pressure resistant, where all moving internal



parts are flushed by oil.

There is a wide range of connection blocks either for pipe connection or for banjo bolt mounting, which may feature optional elements such as drain valve, bypass throttle, pressure switch, 2-way flow control valve etc.

Nomenclature:	Directional seated valve, zero leakage				
Design:	Screw-in valve Combination with connec- tion blocks • For pipe connection • For banjo bolt mounting				
Actuation:	Solenoid				
p <sub>max</sub> :	450 bar				
Q <sub>max</sub> :	1 120 lpm				

#### Basic types and general parameters

Operation mode		Basic type / size and symbol			Oper. pressure	Flow	Tapped ports	
	_	Flow in arrowed direction	Arbitrary fl	ow direction	p <sub>max</sub> (bar) ¹)	Q <sub>max</sub> (lpm)	(BSPP) A and B <sup>2</sup> )	
Energized	directly actuated	EM11D/EM21D EM11D0,8 a			<u>450/400</u> 100	<u> </u>	G 1/4 G 1/4	
open		EM11V EM21V, EMP21V(G) <sup>4</sup> ) <sup>a</sup>	EM12V	° A~	450	20	G 1/4, G 3/8	
	pilot	EMP21VG10(20) <sup>4</sup> ) A	B EM22V		400	40	G 3/8, G 1/2	
	actuated 3)	EMP21V10(20)	EM32V	FY	400	60	G 1/2, G 3/4	
		EM31V, EMP31V(G) 4) <sup>a</sup> [ EM41V	EM42V	a	400	160	G 3/4, G 1	
	directly	EM11DS/EM21DS A			450/400	1/3	G 1/4	
Energized					100	2.5	G 1/4	
closed		EM11S EM21S, EMP21S(G) <sup>4</sup> ) <sup>a</sup>	EM12S	a	450	20	G 1/4, G 3/8	
	pilot	EMP21SG10(20) <sup>4</sup> )	EM22S		400	40	G 3/8, G 1/2	
	actuated	EMP21S10(20)	B EM32S	A	400	60	G 1/2, G 3/4	
		EM31S, EMP31S(G) <sup>4</sup> ) EM41S	EM42S		400	160	G 3/4, G 1	

 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. iron, light alloy) 2) When combined with connection blocks for pipe connection

3) Free flow  $\mathsf{B}\to\mathsf{A}$  in idle position

4) "G" dampened version

#### Solenoid voltage

- 12V DC, 24V DC, 230V AC 50/60 Hz
- Other voltage on request

#### **Additional versions**

Connection blocks for pipe connection

- Without additional functions
- With drain valve
- With drain valve and restrictor check valve
- With drain valve and drop rate braking valve type SB <sup>5</sup>)
- With pressure switch type DG 3.. 5)
- With 2-way flow control valve type SJ 5)

<sup>5</sup>) See also "Additional information"

#### Dimensions



Basic type	G	m (kg)		
EM1	M 14 x 1.5	0.3		
EM2, EMP2	M 18 x 1.5	0.35		
EM3, EMP3	M 26 x 1.5	0.4		
EM4	M 32 x 2	0.6		

All dimensions in mm, subject to change without notice !

#### Additional information

- Directional seated valves type EM, EMP
- Plug with LED etc.
- Plug with economy circuit
- Prop.-Amplifier type EV1M2 (module)
   type EV1G2 (module)

- Plug with LED, improving EMC, or with economy circuit (see also section "Additional information")
- Design with Kostal-plug (special plug)

#### **Order examples**

#### EM11 S - G12

Directional seated valve type EM, size 1, flow pattern 1S (energized closed) and solenoid voltage 12V DC

#### EM21 V - 3/8 D - G24

Directional seated valve type EM, size 2, flow pattern 1V (energized open), connection block with by-pass throttle and throttle (coding D), tapped ports G 3/8, solenoid voltage 24V DC

# Valve with connection block for pipe connection

(acc. to the order example)



Basic type	H1	H2	В	т	m (kg)
EM11/4	40	approx. 120	20	35	0.6
EM13/8	40	approx. 120	25	40	0.6
EM(P)23/8	50	approx. 120	30	45	0.7
EM(P)21/2	50	approx. 120	30	50	0.7
EM(P)31/2	60	approx. 133	40	55	1.0
EM(P)33/4	60	approx. 133	40	60	1.0
EM43/4	70	approx. 150	40	65	1.2
EM41	70	approx. 150	50	70	1.2

- Drop rate braking valve type SB, SQ, SJ
- D 6920, D 7395 D 5440, D 5440 E
- Pressure switches type DG3.., DG5E

D 7490/1

D 7163

D 7831/1

D 7837

D 7813, D 7833

• See also section "Devices for special applications" (Screw-in valves and installation kits)

For page and section of the devices additionally listed, see type index



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

The directional cone seated valves types BVG, BVE, and BVP are 2/2- and 3/2-way directional valves which are available in two sizes. All ports are equally pressure resistant due to an internal, static pressure balance. The valves may be connected directly via pipes (type BVG) or mounted on customer furnished manifolds (type BVP and BVE). Various actuation modes (BVE only with solenoid actuation) enable use of these valves in a wide field of applications.

Additional elements (e.g. screw-in orifices, restrictor check valves) incorporated in the valve body allow tailoring of the valve to special requirements of the customer.



Nomenclature:	Directional seated valve, zero leakage
Design:	Individual valve for pipe connection Individual valve, Manifold mounting
Actuation:	Solenoid Hydraulic Pneumatic Manual
p <sub>max</sub> :	400 bar
Q <sub>max</sub> :	20 50 lpm

### Basic types and general parameters

Basic type and size		Flow	Oper. pressure	Tapped ports		Symbol	
Individual valve for	Manifold	Q <sub>max</sub> (lpm)	p <sub>max</sub> (bar)	(BSPP)			
pipe connection	mounting valve			A, B, C <sup>2</sup> )	R	S	Z
	•						
BVG 1	BVP 1	20	400 / 250 <sup>1</sup> )	G 1/4, G 3/8			
BVG 3	BVP 3	50	320	G 1/2			
BVE 3 <sup>4</sup> )		70	400	G 1/2			<u>∼</u> <b>(4 (1</b> ) B

1) With electical actuation: GM.. and WGM

<sup>2</sup>) With type BVG

<sup>3</sup>) Only size 1 and only with solenoid actuation

<sup>4</sup>) Cartridge valve, also available with connection block for pipe connection

#### Actuations

Solenoid	Available for	Actuation parameter	Symbol
	All types	Solenoid voltage:	Q
		12V DC; 24V DC;	
Hydraulic		230V AC 50/60 Hz	
	All types	Control pressure:	<b>\</b>
		$p_{contr min} = 24 bar$	
Pneumatic		p <sub>contr max</sub> = 320 bar	
	All types	Control pressure:	
		$p_{\text{contr min}} = 2 \dots 3.5$	L L
Manual		bar	
	Only	p <sub>contr max</sub> = 15 bar	<u>م</u> ړ
	BVG 1	Actuation moment	분국
		max. 70 Ncm	╘╶╙



#### Solenoid voltage

- 12V DC, 24V DC, 230V AC 50/60 Hz
- Other voltage on request
- BVP1 with ex-proof design
- Plug with LED, improving EMC, or with economy circuit (see also section "Additional information")

#### Additional versions

- Individual valve with orifice in one port
- 2/2-way valve with by-pass check valve

Individual valve, manifold mounting type BVP,

• Twin valve version

BVP 1 - Z - H

• Individual valve type NBVP16 (CETOP3, NG6-standardized connection hole pattern)  $Q_{max} = 20$  lpm,  $p_{max} = 400$  bar (see also section "Additional information")

size 1, flow pattern Z (3/2-way function) and hydraulic actuation

#### **Order examples**

#### BVG 1 - R/B2 - 3/8 - WG230

Valve for pipe connection type BVG, size 1, flow pattern R (2/2-way function) and orifice- $\emptyset$  2 mm in the port A (coding B2), tapped ports G3/8, solenoid voltage 230V AC 50/60 Hz

#### **Dimensions**

#### Type BVG for pipe connection

(solenoid actuation, see order example)





Type BVP for manifold mounting

(hydraulic actuation, see order example)

All dimensions in mm, subject to change without notice !

Basic type	H <sub>max</sub> <sup>5</sup> )	T <sub>max</sub>	<b>B</b> <sub>max</sub>	m <sub>max</sub> (kg)
BVP 1	115 (130)	35	39	1.0
BVP 3	155	50	76	2.4

<sup>5</sup>) Max. figures apply to solenoid actuation, figures in brackets for flow pattern symbol "G"

40

50

1.6

3.3

#### **Additional information**

145

<ul> <li>Directional seated valves</li> </ul>	type BVG, BVP	D 7400
	type BVG1, BVP1, NBVP16	D 7765
	type VP	D 7915
	type BVE	D 7921

60

80

<ul> <li>Plug with LED etc.</li> </ul>	D 7163
<ul> <li>Plug with economy circuit</li> </ul>	D 7813, D 7833

For page and section of the devices additionally listed, see type index

BVG 3



# Lifting/lowering valves type HSV

The lifting/lowering valves type HSV are intended for the control of lifting equipment utilizing single acting cylinders. This valve combines the functions of a solenoid actuated 2/2-way directional seated valve for lowering the lifted load, a pressure limiting valve for limiting the permissible load and the option for either an adjustable throttle limiting the lowering rate or a 2-way flow control valve enabling a rather constant lowering rate independent of the lifted load.

Additionally there is a check valve preventing unintended lowering of the load.

The valves are designed for direct pipe connection but may be mounted

on customer furnished manifolds as well.



Nomenclature:	Valve combination consisting of: • 2/2-way directional seated valve, solenoid actuated • Pressure limiting valve • Check valve Optional: • Throttle or 2-way flow control valve
Design:	Individual valve for pipe connection
Actuation:	Solenoid
p <sub>max</sub> :	315 400 bar
Q <sub>max</sub> :	20 120 lpm

# 2 2

### Basic types and general parameters

Basic type	Flow	Oper. pressure	Tapped ports (BSPP)			
and size	Q <sub>max</sub> (lpm)	p <sub>max</sub> (bar)	Р	A, R		
HSV 21	20	315	G 3/8	G 3/8		
HSV 22	30	315	G 3/8	G 1/2		
HSV 41	40	400	G 1/2	G 1/2		
HSV 61	60	350	G 1/2	G 1/2		
HSV 71 <sup>1</sup> )	120	315	G 3/4	G 3/4		

### Symbols

Basic type	With the	rottle	Without throttle		With/without	With 2-way
					throttle	flow control valve
	R 1	R 2	R 3	R 4	S 1 S 4	R 6
HSV 21						only HSV 21
HSV 41 HSV 61 HSV 71 <sup>1</sup> )					<sup>1)</sup> Only versionR 4, port A, only availabl limiting valve	with additional filter in the e tool adjustable pressure

#### Solenoid voltage

- 12V DC, 24V DC, 230V AC 50/60 Hz
- Other voltage on request

# • Plug with LED, improving EMC, or with economy circuit (see also section "Additional information")

#### **Additional versions**

Twin version of the lifting/lowering valve for two single acting consumers (type HZV 2 ..)

#### Order examples

#### HSV 21 - R4R - 150 - G24

Lifting/lowering valve type HSV, size 21, flow pattern R 4 without throttle, manually adjustable pressure limiting valve, coding R (set to 150 bar), solenoid voltage 24V DC

#### Dimensions

#### Type HSV 21-.. and HSV 22-..

(see order example)



Туре	н	т	T1	m (kg)
HSV 41	112	50	140	2.2
HSV 61	100	63	166.5	2.5
HSV 71	100	80	160	3.1

# HSV 41 - R2 - 220 - WG230

Lifting/lowering valve type HSV, size 41, with flow pattern R2, tool adjustable pressure limiting valve (set to 220 bar), solenoid voltage 230V AC 50/60 Hz

### Type HSV 41-.., HSV 61-.. and HSV 71-.

(see order example)



#### Additional information

<ul> <li>Lifting/lowering valves type HSV, HZV</li> </ul>	D 7032
Plug with LED etc.	D 7163
<ul> <li>Plug with economy circuit</li> </ul>	D 7813, D 7833

Connection blocks type B

D 6905 B

• See also "Turn-key solution out of the modular system"

For page and section of the devices additionally listed, see type index



# Switch units (press control valves) type CR

The switch units type CR, available in three sizes, are intended for the control of bottom and top ram presses, which are driven by dual stage pumps. They consist of a 2/2-way ball seated directional valve, a ball type check valve and pressure valves.

Low pressure and high pressure circuit are joined during rapid transverse, as soon as the set pressure is achieved or exceeded the low pressure circuit is switched in idle circulation mode, whereas the high pressure circuit continues feeding the press cylinder. An automatic pre-release ensures decompression without pressure

surges. These switch units are designed for direct mounting onto our

hydraulic power packs type MP and RZ.

Nomenclature:	<ul> <li>Valve combination consisting of:</li> <li>2/2-directional seated valve</li> <li>Ball type check valve</li> <li>Pressure valve</li> </ul>				
Design:	Individual valve for pipe connection				
Actuation:	Solenoid Manual				
o <sub>max</sub> :	LP 30 60 bar HP 400 bar				
Q <sub>max</sub> :	LP 80 160 lpm HP 8 20 lpm $A \rightarrow R$ 160 300 lpm				



# Basic types and general parameters

Basic type and size		Flow Q <sub>max</sub> (lpm)	)	Oper. P <sub>ma</sub>	pressure <sub>ix</sub> (bar)	Tapped ports (BSPP)			Application	
CR 4M	HP 8	NP 80	$A \rightarrow R$ 200	HP 400	NP 30 60	A and R G 1	HP G 1/4	NP G 3/4	M G 1/4	Bottom ram press, selfreturn-
CR 4H CR 5M	8 20	80 160	200 300	400 400	30 60 30 60	G 1 G 1 1/4	G 1/4 G 3/8	G 3/4 G 1	G 1/4 G 1/4	ing due to its weight (min. load pressure > 2 bar)

#### Symbols

CR 4M and CR 5M

CR 4H



#### Solenoid voltage

- 24V DC; 230V AC 50/60 Hz
- Other voltage on request
- Plug with LED, improving EMC, (see also also section "Additional information")

#### **Order examples**

### CR 4M - G24

Switch unit CR, size 4, solenoid actuated solenoid voltage 24V DC

#### **Dimensions**

(see order example)

#### Additional versions

• Press control valve for bottom ram press with differencial circuit (type CR44M), retracting with high pressure stage only, cylinder area ratio  $A_1: A_3 \ge 8: 1$ 

#### CR 4H

Switch unit size 4, manually actuated



#### **Additional information**

Switch units type CR	D 7150
<ul> <li>Two-stage valves type NE</li> </ul>	D 7161
Plug with LED etc.	D 7163

Hydraulic power packs type RZ	D 6920, D 6920 H
Hydraulic power packs type MP, MPW	D 7200, D 7200 H
See also section "Devices for special applications"	**
(Press controls, Devices for up to 700 bar)	

For page and section of the devices additionally listed, see type index



# Lifting modules and lifting/lowering valves type HMB, HMC, HMT and HSV, HZV etc.

These lifting modules and lifting/lowering valves were developed especially for the actuation of hoists e.g. turret trucks, order pickers, reach trucks and walkie stackers. They consist of a combination of various valve types (flow control valves, throttles, directional valves) suited for the control of the main lift and for other additional functions. The internal control layout of the main valve is very flexible and can be tailored to meet exactly the requirements of the drive concept (constant delivery or speed controlled pump) as well as the intended application.



This valve design can cope also with additional functions being required by simply adding directional seated or directional spool valve sections (e.g. type SWR or SWS) to the main valve body.

Nomenclature:	Valve combination consist-			
	ing of (depending on type):			
	<ul> <li>3-way flow control valve</li> </ul>			
	<ul> <li>2-way flow control valve</li> </ul>			
	<ul> <li>2-way seated valves</li> </ul>			
_	Directional spool valves			
Design:	Individual valve, connec-			
_	tion block for valve banks			
Actuation:	Solenoid			
p <sub>max</sub> :	315 bar			
Q <sub>max</sub> :	120 lpm			

### Selection table

Field of application and drive concept

**Device type** Drive concept

				Scissor lift	Miniature stacker,	Counter balance	Reach truck	Order picker	(warehouse)
	1	2	3		Walkie stacker	truck		(no man aloft)	(man aloft)
HSV	•				•				
HZV	•			•	•				•
HSN			•					•	•
HST	•				•	(●)			•
НМВ	(•)				(●)			•	•
НМС	•				(●)			•	•
нмт		٠				•	•		•
HMS	•	٠	٠					•	•
HMF	٠	٠	٠					•	•
HMR		٠	٠					•	•
SWRSE	•	٠					•	•	•

Application

(1) Constant delivery pump, lifting/lowering via flow controller (throttle)

Lifting via speed controlled pump, lowering via flow controller (throttle) (2)

(3) Lifting/lowering via speed controlled pump

#### Basic types and main parameter

Туре	Flow	Pressure	Note		Tapped ports
_	Q <sub>max</sub> (lpm)	p <sub>max</sub> (bar)		DIN	ISO 228/1 (BSPP)
HSV 21	20			P, R, A	= G 3/8
HSV 22	30	•		Р	= G 3/8; A, R = G 1/2
HSV 41	40			P, R, A	= G 1/2
HSV 61	60	315	Individual devices	P, R, A	= G 1/2
HSV 71	120	•		P, R, A	= G 3/4
HZV 21	20			P, R, H, J	= G 3/8
HSN	50 100			H, R	= G 3/4; P1 = G 3/8; P = (flange connection)
HST 2	20 40			P, R, H	= G 1/2; M = G 3/8
HST 3	30 60		Connection blocks	P, R, H	= G 3/4; M = G 3/8
HMB 2 <sup>1</sup> )	30		of lifting module	P, R	= G 1/2; M = G 1/4
HMB 33	90		Add-on components:	P, R	= G 3/4; M, R1 = G 1/4
HMC 2 <sup>1</sup> )	30		• SWR/SWS -	P, R, A	= G 1/2; M = G 1/8
HMC 3 (33)	90		Valve sections	P, R	= G 3/4; M, R1 = G 1/4; C = G 3/8
НМТ З	70 - 90	315	<ul> <li>Intermediate</li> </ul>	H, P, R	= G 1/2; M = G 3/8
HMT 34	70 - 90		blocks	Н	= G 3/4; P, R = G 1/2; M = G 3/8
НМК 33	70 - 90		<ul> <li>End plates</li> </ul>	H, P, R	= G 1/2; A, B, A1, B1 = G 1/4; M = G 3/8; H1, R1 = G 1/8
HMK 34	70 - 90			H, R	= G 3/4; P = G 1/2; A, B, A1, B1 = G 1/4; M = G 3/8
HMS 4	100			R	= G 3/4; C, R1 = G 3/8; M = G 1/4
HMF 4	100			R	= G 3/4; C, R1 = G 3/8; M = G 1/4
HMR 4	100			P, R1, R2	2 = G 3/4; P1, D = G 3/8; M = G 1/4
SWR 1 SE <sup>1</sup> ) <sup>2</sup> )	12			P, R, R1	= G 1/4; M = G 1/8
SWR 2 SE <sup>2</sup> )	25			P, R	= G 3/8; M = G 1/4

<sup>1</sup>) Hole pattern SWR 1, T2; adaptor plates from X12 to SWR 2 <sup>2</sup>) Also for external additional functions

#### **Symbols**













#### **Further versions**

- Connection blocks type SWR... with flow divider
- Connection blocks type SWR... with/without pressure limiting valve

• Connection blocks type SWR... with shut-off valves for P and H (lifting)

#### **Symbols**

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



#### Additional versions (intermediate blocks)

- Various intermediate blocks for turret forks at order pickers; function rotate / reach
- Directional spool valve sections type SWR1 with additional functions; Directional spool valve sections type SWS 2 (see also unter "Additional information")



## **End plates**



### Additional versions (end plates)

Main lift

- · End plates with two pump ports and one return port
- End plates with proportional idle circulation valve
- End plate with solenoid valves to the control of a parking brake

Reach

Rotate

# **Order examples**

#### HMT 34-1/200-70F -G/M/0/2 AN40 BN130 -30E-P12/G 24 -D/M/0/02

Lifting module type HMT, size 3, port size 4 with pressure limiting valve (set for 200 bar), outflow controller with 70 lpm metering throttle (blocked in idle position); section G with shock and suction valves is part of the ancillary block (settings 40 and 130 bar); end plate with idle circulation valve (open in idle position), proportional-solenoid voltage for the flow control valve 12V DC, solenoid voltage for directional spool valve and directional seated valves 24V DC.

### HMC 33-1/150-50/80F-T3 T3/D-20E-G 24

Lifting module type HMC, size 3, port size 3 (G 3/4") with pressure limiting valve (set for 150 bar), 3-way flow control valve with metering throttle up to 50 lpm, 2-way flow controller up to 80 lpm (blocked in idle position), two intermediate blocks type T3 with seated valves and one directly added directional spool valve section type SWR 2 flow pattern D, end plate with additional port P and R as well as a shut off valve for port P, solenoid voltage 24V DC.




### **Dimensions**

(see order examples)





### Туре НМС 33 ..

Intermediate blocks (T3)

Directional spool valve sections



approx. 70
70
max. 91

All dimensions in mm, subject to change without notice!

Basic type	m (kg)	Note
HMT 34	approx. 3.8	Main dimension
HMC 33	approx. 5.0	lifting modules (I

is and weight of the missing (basic types) on inquiry!

### **Additional information**

<ul> <li>Lifting module</li> </ul>	type HI	VIC	D 7650
	type HI	TM	Sk 7758 HMT
	type HI	MB	Sk 7650 B2, Sk 7650 B2
<ul> <li>Directional spool</li> </ul>	ol valve	type SW.1	D 7450
		type SW.2	D 7451
		type SWS 2	D 7951

• Plugs with LED's and others

D 7163

- Plugs with economy circuit
- D 7813, D 7833 • See also section "Devices for special applications"

(Devices for industrial trucks and hoists)

For page and section of the devices additionally listed, see type index



The directional seated valves types VH, VHR and VHP operate leakage free and are available in two different sizes.

They are operated via a hand lever on an eccentric shaft transfering the switching moment to an actuation pin acting on the valve elements (balls). The actuation either features a detent or is self returning to its idle position.

Valve banks type VHR are also available, featuring individual valves (type VH) connected in parallel and held together with tension rods. Valves type VHP size 1 is also available as individual manifold mounting version.



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

### Basic types and general parameters

Basic type and s	ize	Flow	Oper. pressure	Tapped ports (BSPP)
Individual valve	Valve bank	Q <sub>max</sub> (lpm)	p <sub>max</sub> (bar)	P, R, A, B
VH 1, VHP 1	VHR 1	12	700	G 1/4
VH 2	VHR 2	25	500	G 3/8

### Order coding example



### **Symbols**



Max. 7 or 5 valves for type VHR, (size 1 or 2) may be combined



 Self return to idle position only up to approx. 50 bar. The hand lever has to be returned manually for pressure above 50 to 700 bar.

### **Additional versions**

• Actuation with contact switch, option for individual valves and valve banks

### Order examples

### VH 2 - G1 K

Directional seated valve type VH, size 2, flow pattern G, hand lever with spring return (coding 1) and contact switch monitoring idle position (coding K)

### Dimensions

### Type VH.., individual valve



Basic type	н	H1	В	т	m (kg) <sup>2</sup> )
VH1, VHP1	50	approx. 172	50	90	1.6
VHR1	50	approx. 172	50	90	1.6
VH2	60	approx. 162	60	120	3
VHR2	60	approx. 162	60	120	3

All dimensions in mm, subject to change without notice !

2) Indiv. section

### Additional information

<ul> <li>Directional seated valves type VH, VHR, VHP</li> </ul>	D 7647
type BVG1, BVP1, NBVP 16	D 7765
<ul> <li>Shut-off valves type DA, EA</li> </ul>	D 1741

• Directional seated valve, manifold mounting type VHP (see also section "Additional information")

### VHR 1 - G1 / N1 / E2

Valve bank type VHR, size 1, flow pattern G, N, E, hand lever with spring return (coding 1) or detent (coding 2)

### Type VHR.., valve bank

# (see order example)



• See also section "Devices for special applications" (Devices for up to 700 bar)

For page and section of the devices additionally listed, see type index



### Shut-off valves type DA and EA

The shut-off valves types DA and EA are of ball seated design and are available in two sizes. They are used in hydraulic systems for blocking the flow in one or both directions.

They are available with hand lever or with eccenter shaft for customer furnished hand lever. Both versions can be ordered either with or without detent.

Nomenclature:	Directional seated valve, zero leakage
Design:	Individual valve for pipe connection
Actuation:	Manual
p <sub>max</sub> :	500 bar
Q <sub>max</sub> :	60 150 lpm



2

2

### Basic types and general parameters

Basic type	Flow	Oper. pressure	Tapped ports (BSPP)
and size	Q <sub>max</sub> (lpm)	p <sub>max</sub> (bar)	А, В
DA 2, EA 2	60	500	G 3/4
DA 2B, EA 2B	60	500	G 3/4
DA 3, EA 3	150	500	G 1

### Symbols and actuations



### **Order example**

DA 3 double acting shut-off valve type DA, size 3

### **Additional information**

<ul> <li>Shut-off valves type DA/EA</li> </ul>	D 1741
<ul> <li>Directional seated valves type VH, VHR, VHP</li> </ul>	D 7647

For page and section of the devices additionally listed, see type index

**Dimensions** 

(see order example)



All dimensions in mm, subject to change without notice!

Basic type	L	SW	m (kg)
EA 2 (B)	165	a/f 36	1.3 1.5
DA 2 (B)	165	a/f 36	1.3 1.5
EA 3	200	a/f 50	3.0 3.2
DA 3	200	a/f 50	3.0 3.2



con

### **2.3 Pressure valves**

Pressure limiting valves, sequence valve

(also proportional)		
<ul> <li>Directly controlled pressure limiting valves,</li> </ul>	<b>2.3-</b> 4	
sequence valve type MV, SV etc.		
<ul> <li>Pressure limiting valves type CMV and CSV</li> </ul>	<b>2.3-</b> 6	
<ul> <li>Piloted pressure limiting valves</li> </ul>	<b>2.3-</b> 8	
type DV, AS etc.		
<ul> <li>Sequence valves with check valve type VR</li> </ul>	<b>2.3-</b> 10	
<ul> <li>Proportional pressure limiting valves</li> </ul>	<b>2.3-</b> 12	
type PMV and PDV		
Pressure reducing valves (also proportional)		
Miniature pressure reducing valves type ADC,	<b>2.3-</b> 14	
AM etc.		
<ul> <li>Pressure reducing valves type ADM and VDM</li> </ul>	<b>2.3-</b> 16	
Pressure reducing valves type CDK, DK, and DZ	<b>2.3-</b> 18	
Miniature proportional pressure reducing valves	<b>2.3-</b> 20	
type PM		
Proportional pressure reducing valves type PDM	<b>2.3-</b> 22	

### Externally pressure controlled relieve valves

(switch-off, follow-up valves)

•	Idle circulation valve type CNE 2	<b>2.3-</b> 24
•	Two-stage valves type NE	<b>2.3-</b> 26
•	Switch-off valves type LV and ALZ	<b>2.3-</b> 28

• Pressure dependent closing valve 2.3-30 type DSV and CDSV

**2.3-**32

100

Load holding valves (over center valves)

Load holding valves type LHK, LHDV, and LHT



# **Directly controlled pressure limiting and sequence valves type MV, SV etc.**

Pressure valves gover the pressure within a hydraulic system. The types below are intended for the following purposes:

- Pressure limiting valve (safety valve): Safeguarding the system against excessive pressure or for the limitation of working pressure.
- Sequence valves:

Generates a constant pressure difference between inlet and outlet of the flow.



Directly controlled valves feature a dampening device to ensure quiet operation, but also available without it if necessary for an application. There is also a version of the pressure limiting valve, which features a type approval (TÜV) in case they are used as safety valves for accumulators.

Nomenclature:	Pressure limiting valve, sequence valves (directly controlled)
Design:	Individual valve for pipe connection Screw-in valve Individual manifold mounting valve Assembly kit
Adjustability:	Tool adjustable Manually adjustable
p <sub>max</sub> :	700 bar
Q <sub>max</sub> :	5 160 lpm

### Basic types and general parameters

Basic type	MV 1) 5)	MVS 1) 5)	MVE <sup>5</sup> )	SV 1)	MVP <sup>5</sup> )	DMV <sup>1</sup> )	MVCS <sup>2</sup> )	SVC <sup>1</sup> )	MVB <sup>1</sup> ) <sup>4</sup> )
	_	MVG <sup>3</sup> )					MVGC <sup>3</sup> )		
Symbol	т	P	R				P -		P R C
Function	Pressure	Press	sure limiting	valve and diff	erential	Pressure limit-	Pressure lim	iting valve with	Pressure limit-
	limiting		presure	e regulators		ing valve	free reflow F	$R \rightarrow P$ via a by-	ing valve a.dif-
	valve						pass check	valve	ferential pres-
									sure regulators
Brief	Corner	Corner	Screw-in	Straight-way	Manifold	Twin valve as	Corner	Straight-way	Assembly kit 4)
description	valve for	valve for	valve	valve for	mount-	shock valve for	valve for	valve for	
	pipe con-	pipe		straight pipe	ing valve	hydraulic motors	pipe	straight pipe	
	nection	connec-		installation			connec-	installation	
		tion		1	1	1	tion		
p <sub>perm R</sub> (bar)	20	500	500	500	500	350	500	500	200
Size		13	_ 14	4	5	6	8	<sup>1</sup> ) Only size 4	, 5, 6 and 8
Pressure range:		H: 700	0/5 N: 5	60/8 F: 80/	/20 F: 80,	/40 F: 80/75	E: 160/160	<ol> <li><sup>2</sup>) Only size 4</li> <li><sup>3</sup>) Only size 1</li> </ol>	, 5 and 6 3 and 14
Pressure p <sub>max</sub> (bar)/			M: 20	00/8 E: 160/	/20 E: 160,	/40 E: 160/75	C: 315/160	4) For other ty	ypes of assembly kits
Flow Q <sub>max</sub> (Ipm)			H: 40	0/8 C: 315	/20 C: 315	/40 C: 315/75		see also "A 5) Also versio	Additional information"
				B: 500	/20 B: 500	/40 B: 500/75		(TÜV) avail	able (size 4, 5 and 6)
				A: 700	/12 A: 700	/20 A: 700/40		<sup>6</sup> ) Version for	pipe connection
Tapped ports (	BSPP) <sup>6</sup> )	G 1/	′4 G 1	/4 G 1/4	4 G 3/	8 G 1/2	G 3/4		
				G 3/8	8 G 1/2	2 G 3/4	G 1		

### **Additional versions**

- Multiple pressure limiting valves (2, 3, 4, 5 valves in parallel)
- Twin pressure limiting valves with suction valve
- Pressure limiting valves with type approval (TÜV)
- Actuation option of the piloting valve with ball head actuation e.g. for cam, lever or other curve controlled systems (only type MVG13(14) and MVP13(14))
- Adjustament via self-locking turn knob or one with lock

### **Dimensions** (examples)

### Type MV, MVS

(see order example)



m



В



**Order examples** 

MVS 52 BR

(coding R)

MVP 13 HR

All dimensions in mm, subject to change without notice!

D 7000/1

D 7000 E/1

D 7000 M

D 7710

D 7000 TÜV

D 3726

Basic type	Size	H <sub>max</sub>	в	T <sub>max</sub>	m <sub>max</sub> (kg)
MV,	4	126	24	48	0.3
MVS,	5	142	29	60	0.4
MVCS,	6	164	36	70	0.7
MVE	8	208	40	60	2.0
DMV	4	107	40	52	0.7
	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
	5	113	32	40	0.5
	6	133	35	50	0.8
	8	172	50	60	1.6

Basic type	Size	н <sub>тах</sub>	B/SW	max	m <sub>max</sub> (кg)
	4	_	a/f 22	87	0.2
SV, SVC	5	-	a/f 27	108	0.4
	6	-	a/f 32	132	0.9
SV	8	-	a/f 41	157	0.9
MVP	13, 14	82	29	50	0.3
MVG(C)	13, 14	94	20	42	0.3
MVE	13, 14	75	a/f 27	-	0.1

### **Additional information**

- Pressure limiting valves type MV etc.
- Miniature pressure limiting valves
- Pressure limiting valves (assembly kits)
- Multiple pressure limiting valves type MV.
- Pressure limiting valves
   with type approval (TÜV) type MVX etc.
- Screw-in pressure valves type CMV, CSV

<ul> <li>Piloted pressure valves type DV</li> </ul>	D 4350
type A	D 6170

• See also section "Devices for special applications" (Devices for up to 700 bar)

For section and pages No. of the additionally listed devices, see type index

### 

Pressure limiting valve and sequence valve as corner valve for pipe con-

pressure range up to 500 bar (coding B), pressure manually adjustable

Manifold mounting valve, size 13, pressure range H (20 ... 700 bar)

Type MVG

nection, size 5, tapped ports G 3/8 (coding 2),

Type SV, SVC





### Pressure limiting valves type CMV and CSV

Pressure valves gover the pressure within a hydraulic system. The types listed are intended for the following purposes:

- Pressure limiting valve (safety valve):
- Safeguarding the system against excessive pressure or for the limitation of working pressure.
- Sequence valves: generating a constant pressure difference between inlet and outlet of the flow. The flow in opposite direction (reflow) is unhindered via a by-pass check valve.

A significant advantage of these valves is their easily to manufacture mounting hole (see dimensions).



Type CMV is also available as a pressure limiting valve with type approval (TÜV), e.g. required for safety valves for accumulators.

Nomenclature:	Pressure limiting valve, sequence valves (directly controlled)	
Design:	Screw-in valve	
Adjustability:	Tool adjustable Manually adjustable	
p <sub>max</sub> :	500 bar	
Q <sub>max</sub> :	60 lpm	

### Basic types and general parameters

Basic type	СМУ	CSV	5	Symbol
Function	Pressure limiting valve	Sequence valves with	СМУ	CSV
	(port R pressure	by-pass check valve	<	Ş
	resistant)		<u> </u>	P
Pressure range:	F: 80	F: 80		
Pressure p <sub>max</sub> (bar)	E: 160	E: 160		ليميا
	C: 315	C: 315		
	B: 500			
Flow			-	
Q <sub>max</sub> (lpm)				
Size 1	20	_	**	
Size 2	40	40	-	
Size 3	60	60		

### **Additional versions**

• Connection blocks for pipe connection also available

**Order examples** 

### CMV 2 CR - 200

Pressure limiting valve type CMV, size 2, pressure range C (0 to 315 bar), manually adjustable (coding R), adjusted to 200 bar,

 Version with type approval (TÜV) type CMVX, (see also "Additional information")

### CSV 3F - 60

Sequence valve type CSV, size 3, pressure range F (0 ... 80 bar), tool adjustable (no coding), adjusted to 60 bar

### Dimensions

Type CMV

1

2

3

Type CSV



see type index



### **Piloted pressure limiting valves** type DV, AS etc.

Pressure valves gover the pressure within a hydraulic system. The types listed below are intended for the following purposes:

- Pressure limiting valve (safety valve): Safeguarding the system against excessive pressure or for the limitation of working pressure.
- Sequence valves:

Generating a constant pressure difference between inlet and outlet of the flow.

• Follow-up valve (release valve):



Basic types and	general parameters				
Basic type	DV	DVE	DF	AS	AE
Symbol					
Function	Pressure limiting,	Follow-up valve	Pressure limiting,	Pressure limiting	Release valve
	sequence valve		sequence valve, follow-up	valve	(remote controlled),
			valve or 2/2-way directional		combined function
4			valve (remote controlled, de-		as pressure limiting
			pending on the kind of valve		valve possible (type
			connected to port X		ASE)
Add. function	Additional 2/2-way sole	noid valve for arbitrary idl	e circulation		
Pressure range:	N: 100	N: 100	N: 100	M: 200	M: 200
Pressure p <sub>max</sub>	H: 420	H: 420	H: 420	H: 350	H: 300

### Size

(bar)

Coding	Flow	Tapped ports (BSPP)
	Q <sub>max</sub> (lpm)	(versions for pipe connection)
3	50	G 1/2
4	80	G 3/4
5	120	G 1

### Additional versions

- Additional 2/2-way solenoid valve for arbitrary idle circulation (type DV, AS, and AE)
- Orifice in the control circuit to limit the leakage flow (type DVE)
- Additional function combination between type AS and AE
- · Actuation option of the piloting valve with ball head actuation e.g. for cam, lever or other curve controlled systems (only type DV, DVE)

2.3-	8
	-

Nomenclature:	Pressure limiting valve Sequence valve Follow-up valve (piloted)
Design:	Individual valve for pipe connection Individual valve, Manifold mounting
Adjustability:	Tool adjustable Manually adjustable
p <sub>max</sub> :	420 bar
Q <sub>max</sub> :	120 lpm

### **Order examples**

### DV 3G HR - WH1F - G24 - 400

Pressure limiting valve type DV, size 3 for pipe connection (coding G), pressure range H (up to 420 bar), manually adjustable version, 2/2-way solenoid valve type WH1F (24V DC) for arbitrary idle circulation, pressure limiting valve set to 400 bar

### Dimensions

Type DV..G (see order example)

### AE 4 PM - 180

Externally pressure controlled relief valve type AE, size 4, manifold mounting (coding P), pressure range M (to 200 bar), pressure limiting valve set to 180 bar (no coding)





### Type DV...P



H

30

40

50

В

60

65

80

**B1** 

60

88



m (kg) 1)

1.1/-

1.5 / 2.0

2.0/2.5

Type A...P (see order example)

Type A...G



All dimensions in mm, subject to change without notice!

Basic type	н	H1	В	B1	т	T1	m (kg) <sup>1</sup> )
AS (AE) 3	40	_	60	_	80	_	1.8
AS (AE) 4	40	40	70	80	94	60	2.2
AS (AE) 5	63	40	100	94	85	80	4.1

1) Versions for pipe connection / manifold mounting (with installed solenoid valve + 0.6 kg)

т

66

71

73

**T1** 

78

81

### **Additional information**

- Piloted pressure valves type DV D 4350Piloted pressure valves type A D 6170
- Pressure limiting valves type MV, SV etc.
   D 7000/1

• IV	liniature	pressure	limiting	valves	type	MVG	etc.	D	37	(26	S
------	-----------	----------	----------	--------	------	-----	------	---	----	-----	---

Pressure limiting valves type CMV D 7710

For section and pages No. of the additionally listed devices, see type index

Basic type



### Sequence valves with check valve type VR

Pressure valves gover the pressure within a hydraulic system. The type illustrated below is a sequence valves which generates a constant pressure difference between inlet and outlet of the flow. The flow in opposite direction (reflow) is unhindered via a by-pass check valve. This valve shows minor leakage like other spool valves in flow direction  $V \rightarrow F$ . They are widely used as e.g. drop safety device for fork lift trucks, safeguarding the lifting cylinder during lowering to prevent continued travel if the fork accidently gets caught (accident protection) or preventing undesired oscillations by increasing the back pressure when used as sequence valve in return pipes.



# Nomenclature:Sequence valveDesign:Screw-in valve<br/>Combination with housing<br/>for pipe connectionAdjustability:Fixed (non-adjustable)Pmax:<br/>Δpmax:300 bar<br/>15 barQmax:120 lpm

### Basic types and general parameters

Basic type and size	Flow Q <sub>max</sub> (lpm)	Pre-load pressure Δp <sub>max</sub> (bar) <sup>1</sup> )	5	Symbol	
VR 1	15	3, 5, 7, 9, 12, 15	Screw-in	Version with housing for	
VR 2	40	3, 5, 7, 9, 12, 15	valve	pipe connection	
VR 3	65	3, 5, 7, 9, 12	\$		1) The selected pre-load pressure
VR 4	120	3, 5, 7, 9, 12	V F	V S F L J	e.g. opening pressure cannot be altered

### Order examples

### VR 3 3 C

Sequence valve size 3, opening pressure 3 bar, screw-in valve (coding C)

### VR 1 15 G

Sequence valve size 1, opening pressure 15 bar, version with housing (coding G)

### VR 4 9 E

Sequence valve size 4, opening pressure 9 bar, version with housing (coding E)

### Dimensions

(see order examples) Screw-in valve "C"



### Version with housing "G"



Version with housing "E"



D 7710

see type index

Pressure limiting valves type CMV, CSV



# Proportional pressure limiting valves type PMV and PDV

These pressure limiting valves are electrically remote controlled and rule the hydraulic pressure within the system. This enables arbitrary control of the maximum pressure in the circuit thereby protecting it depending on the momentarily required condition.

These valves are either directly actuated (type PMV) or piloted (type PDV). There is a minimum pressure necessary of 3 bar up-stream to ensure flawless operation of the integrated prop. pressure reducing valve.



# Nomenclature:Prop. pressure limiting valve<br/>(direct or pilot operated)Design:Individual valve for pipe<br/>connection<br/>Individual valve,<br/>Manifold mountingAdjustability:Electro-proportional $\mathbf{p}_{max}$ :700 barQmax:120 lpm

### Basic types and general parameters

Basic type	_	Р	MV			PDV		Sym	ibol
Function		Pressure li (direct d	miting valve		Pres	sure limiting (piloted)	valve	Pipe connection	Manifold mounting valve
Size	4	5	6	8	3	4	5		
Flow Q <sub>max</sub> (lpm)	16	16 60	60 75	120	40	80	120		
Pressure range:								∽┨═┛╢	
Pressure p <sub>max</sub>	41: 180	41: 110	41:80	41: 45	N: 130	N: 130	N: 130		
(bar)	42: 290	42: 180	42: 130	42: 70	M: 200	M: 200	M: 200		i — K
	43: 440	43: 270	43: 190	43: 110	H: 350	H: 350	H: 350		
	44: 700	44: 450	44: 320	44: 180					
Tapped ports	G 1/4	G 1/4	G 3/8	G 3/4	G 1/2	G 3/4	G 1	•	
(BSPP) <sup>1</sup> )	G 3/8	G 3/8	G 1/2	G 1					
		G 1/2	G 3/4					1) Version for pipe c	onnection

### **Additional versions**

- Version for separate control oil supply, enabling flawless pressure reduction starting from almost 0 bar, no leakage of the main pump circuit (type PMVS or PMVPS)
- (see also "Additional information")
- Additional 2/2-way solenoid valve for arbitrary idle circulation (only type PDV)

### Solenoid voltage

- 12V or 24V DC
- Control via proportional amplifier (see also"Additional information")

### **Order examples**

### PMVP4 - 44 - 24

Prop. pressure limiting valve type PMV, manifold mounting version (coding P), size 4, adjustable pressure range 5 ... 700 bar (coding 44), solenoid voltage 24V DC

### Dimensions

Type PMV





### Type PMVP (see order example)





Basic type	н	В	т	m (kg)
PMV 4	97	35	135	1.2
PMV 5	98	35	140	1.2
PMV 6	102	40	150	1.5
PMV 8	107	45	160	1.9
PMVP 4	95	35	135	1.1
PMVP 5	95	40	140	1.2
PMVP 6	95	50	140	1.3
PMVP 8	97	60	150	1.7

### **Additional information**

<ul> <li>Prop. pressure limiting valves type PMV(S), PMVP(S)</li> </ul>	D 7485	
Prop. pressure valves type PDV		
<ul> <li>Piloted pressure limiting valves type DV</li> </ul>		
Pressure limiting valves type MV, SV etc.	D 7000/1	
Prop. amplifier type EV1M (module)	D 7831/1	
type EV1G (module)	D 7837	

### PDV 5 GH - 12

Prop. pressure limiting valve type PDV, version for pipe connection (coding G), size 5, adjustable pressure range 5 to 350 bar (coding H), solenoid voltage 12V DC

### Type PDV..G (see order example)





Type PDV..P



Basic type	н	В	т	m (kg)
PDV 3G	96	66	150	1.8
PDV 4G	99.5	71	155	2.2
PDV 5G	104.5	73	170	2.7
PDV 4P	99.5	78	150	2.7
PDV 5P	104.5	81	178	3.2

All dimensions in mm, subject to change without notice!

 Prop. amplifier type EV1SA (plug) D 7818 type EV22K (card version) D 7817, D 7817/1
 See also section "Devices for special applications"
 (Proportional valves, Devices for up to 700 bar)

For section and pages No. of the additionally listed devices, see type index



# Miniature pressure reducing valves type ADC, AM etc.

The task of pressure reducing valves in a hydraulic circuit is to maintain a rather constant outlet pressure despite a higher and changing inlet pressure. They are used when an hydraulic circuit with a higher pressure level (primary side) is to supply another circuit with a lower pressure level (secondary side), without affecting the higher pressure in the primary circuit. These valves are intended for the supply of control circuits with low flow requirements.

There is a design related leakage flow which has to be led pressureless



via port R to the tank. A reversal of the direction of flow is possible up to approx. 30% of  $Q_{max}$ . A by-pass check valve has to be provided for higher reversed flow. These pressure reducing valves feature a override compensation i.e. acting like a pressure limiting valve, if the pressure on the secondary side exceeds the set pressure e.g. due to external forces.

Nomenclature:	Pressure reducing valve
Design:	Screw-in valve Valve for pipe connection
Adjustability:	Fixed (non-adjustable)
р <sub>max P</sub> : р <sub>max A</sub> :	300 400 bar 15 70 bar
Q <sub>max</sub> :	2 10 lpm

### **Basic types and general parameters**

Basic type	ADC 1	AM 1	ADM 1 <sup>1</sup> )	ADME 1
Flow	2	2	8 10	8
Q <sub>max</sub> (lpm)	2	2	010	0
max. inlet pressure	300	400	300	300
p <sub>max</sub> (bar) at P				
Outlet pressure	15	20	15	15
(bar) at A	25	50	20	20
			30	30
			70	
Tapped ports (BSPP) 2)	G 1/4	G 1/4	G 1/4	_



Screw-in valve

Pipe installation





1) Only in version for pipe connection

<sup>2</sup>) Version for pipe connection

### **Additional versions**

- Type AM 1 also available as manifold mounting valve
- Type ADM 1 also available with manual adjustment

### **Order examples**

### ADC 1 - 25

Pressure reducing valve type ADC 1, screw-in valve, pressure at A approx. 25 bar

### ADM 1 - 70

Pressure reducing valve type ADM 1, version for pipe connection, pressure at A approx. 70 bar

### AM 1 - 20 - 1/4

Pressure reducing valve type AM 1, version for pipe connection (tapped ports G 1/4 ), pressure at A approx. 20 bar

### **Dimensions**

Type ADC 1-... (see order example)

Type AM 1 - ...-1/4 (see order example)



Basic type	m	(kg)
	Screw-in valve	Design for pipe connection
ADC 1	0.03	0.32
AM 1	0.03	0.3
ADM 1	-	0.34
ADME 1	0.05	_

### **Additional information**

• Miniature pressure reducing valves type ADC etc.	D 7458
<ul> <li>Pressure reducing valves type ADM</li> </ul>	D 7120
type VDM	D 5579
type CDK	D 7745
<ul> <li>Prop. pressure reducing valves type PDM</li> </ul>	D 7584/1, D 7486

- Miniature prop. pressure reducing valves type PM, PMZ D 7625
- See also section "Devices for special applications" (Screw-in valves and installation kits)

For section and pages No. of the additionally listed devices, see type index



The task of pressure reducing valves in a hydraulic circuit is to maintain a rather constant outlet pressure despite a higher and changing inlet pressure. They are used when an hydraulic circuit with a higher pressure level (primary side) is to supply another circuit with a lower pressure level (secondary side), without affecting the higher pressure in the primary circuit.

These valves are either directly controlled (type ADM) or hydraulically piloted (type VDM).

There is a design related leakage flow which has to be led pressureless via port L to the tank. A reversal of the direction of flow is possible up to



approx. 50% of Q<sub>max</sub>. A by-pass check valve has to be provided for higher reversed flow. The pressure reducing valves type ADM feature a override compensation i.e. acting like a pressure limiting valve, if the pressure on the secondary side exceeds the set pressure e.g. due to external forces.

Nomenclature:	Pressure reducing valve (directly controlled or piloted)
Design:	Individual valve for pipe connection Individual valve, Manifold mounting
Adjustability:	Tool adjustable Manually adjustable
p <sub>max p</sub> : p <sub>max A</sub> :	300 400 bar 250 400 bar
Q <sub>max</sub> :	120 lpm

### Basic types and general parameters

Basic type		ADM			VDM		Syn	nbol
Function		Directly control	led	Ну	draulically pilo	ted	ADM	VDM
Size	1	2	3	3	4	5	Valve for pip	e connection
Flow Q <sub>max</sub> (lpm)	12	25	60	40	70	120		
Pressure p <sub>max P</sub> (bar)	300	300	300		400		— P <u> </u>	<u>S</u>
Pressure range:	F: 30	F: 30	F: 25		N: 100		_	ا بان
p <sub>max A</sub> (bar)	D: 120	D: 120	D: 100		H: 400 1)		Manifold mo	ounting valve
	C: 160	C: 160	C: 160					
	A: 250	A: 250	A: 250				┆┌╴╴╎	┆┎╂╼╠┧┆
Tapped ports (BSPP) <sup>2</sup> )	G 1/4	G 1/4, G 3/8	G 3/8, G 1/2	G 1/2	G 3/4	G 1		
Leakage flow	approx.	approx.	approx.		approx.			片.[그] 부
Q <sub>leak</sub> (Ipm)	< 0.05	< 0.05	< 0.07		< 0.4			
							1) Max, pressure diffe	rence is

### Additional versions

 Hydraulically piloted pressure reducing valve type VDX (pressure limiting valve at port L)
 (see also "Additional information")

Order examples

### ADM 22 DR

Directly controlled pressure reducing valve type ADM size 2, for pipe connection (tapped ports G 3/8, coding 2), pressure range 30 to 120 bar (coding D), pressure manually adjustable (coding R)

### 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 tool adjustable to 250 bar

300 bar between inlet and outlet

2) Design for pipe connection

### Dimensions

Version for pipe connection (see order example)

### Type ADM



Version for manifold mounting

Type ADM..P



Basic type	н	H1	В	B1	т	m (kg) ³)
ADM 1	30	35	45	35	141	0.6 / 0.6
ADM 2	30	40	50	40	162	0.7 / 0.85
ADM 3	30	40	50	40	174	1.0 / 1.1

<sup>3</sup>) Version for pipe connection / manifold mounting

Version for pipe connection
Type VDM..G





Type VDM..P

Pilotventil





Basic type	н	H1	В	B1	т	T1	m (kg) <sup>3</sup> )
VDM 3	30	]	60		66		1.1 /
VDM 4	40	40	65	60	71	78	1.5 / 2.0
VDM 5	50	50	80	88	73	81	2.0 / 2.5

All dimensions in mm, subject to change without notice!

### **Additional information**

<ul> <li>Pressure reducing valves type ADM</li> </ul>	D 7120	
type VDM, VDX	D 5579	
Miniature pressure reducing valves type ADC etc.		
Miniature prop. pressure reducing valves type PM, PMZ	D 7625	

<ul> <li>Pressure reducing valves type CDK</li> </ul>	D

• Prop. pressure reducing valves type PDM

D 7745 D 7584/1, D 7486

For section and pages No. of the additionally listed devices, see type index



The task of pressure reducing valves in a hydraulic circuit is to maintain a rather constant outlet pressure despite a higher and changing inlet pressure. They are used when an hydraulic circuit with a higher pressure level (primary side) is to supply another circuit with a lower pressure level (secondary side), without affecting the higher pressure in the primary circuit.

The pressure reducing valve illustrated here is directly controlled. This valve type CDK does not show any leakage when closed and therefore a leakage port is not required as is with other conventional pressure reducing valves which act like a spool valve and always do have design related



leakage. A override compensation is not possible with type CDK, as this valve is designed as a seated valve. A reversal of the direction of flow is possible up to approx.  $2 \times Q_{max}$ . A further benefit of type CDK is the mounting hole, which can be easily manufactured (see dimensions).

Special feature of type DK is the tracked pressure switch, where setting of pressure and switch takes place simultaneously via only one adjustment device.

Nomenclature:	Pressure reducing valve (2-way valve)
Design:	Screw-in valve Combination with a connection block for: • Pipe connection • Manifold mounting
Adjustability:	Tool adjustable Manually adjustable
p <sub>max P</sub> : p <sub>max A</sub> :	500 bar 400 bar
Q <sub>max</sub> :	15 lpm

### Basic types and general parameters

Basic type and size	Brief description	Pressure range: p <sub>max A</sub> (bar)	Flow Q <sub>max</sub> (lpm)	Tapped ports (BSPP)	Symbol
CDK 3	Screw-in valve	T T		T T	P Å
CDK 31/4-DG3.	Version for pipe connection, a pressure switch type DG 3. May be installed as option (see also "Additional information"), additional port for pressure gauge	<b>08</b> : 400 <b>1</b> : 300 <b>2</b> : 200 <b>5</b> : 130	15	G 1/4 version for pipe connec- tion	
CDK 3P	Manifold mounting valve	_			
DZ	Manifold mounting valve, optional with orifice/throttle and by-pass check valve	_			
DK	Manifold mounting valve with tracked pressure switch	_			

### **Additional versions**

• Version with reduced dependancy on varying pump pressure intended for low set pressure (type CDK 32)

### **Order examples**

### CDK 3 - 2 - 180

Pressure reducing valve, screw-in valve, pressure range 20 to 200 bar (coding 2), tool adjustable version pre-set to 180 bar

### CDK 3 - 1 - P

Dimensions

Pressure reducing valve, manifold mounting, pressure range 30 to 300 bar (coding 1), tool adjustable version pre-set to max. pressure (300 bar; no pressure specification)

CDK 3 - 5R - 1/4 - 100

Pressure reducing valve, pipe connection (G 1/4), pressure range 15 to 130 bar (coding 5), manually adjustable version (coding R), pre-set to 100 bar

• Version with reduced back pressure (type CDK 35)

### DK 2/160/4R

Pressure reducing valve with tracked pressure switch as manifold mounting valve, pressure range 30 to 200 bar (coding 2, set to 160 bar), with throttle in port P (coding 4) and by-pass check valve (coding R)





All dimensions in mm, subject to change without notice!

### **Additional information**

<ul> <li>Pressure reducing valves type CDK</li> </ul>	D 7745
type ADM	D 7120
type VDM, VDX	D 5579
• Miniature pressure reducing valves type ADC etc.	D 7458
<ul> <li>Pressure reducing valve with tracked pressure</li> </ul>	D 7941
switch type DK	

Version	Mass m (kg)
Screw-in valve	0.7
Combination with connection block for pipe connection	1.25
Combination with connection block for manifold mounting	1.1

- Prop. pressure reducing valves type PDM D 7584/1, D 7486
- Pressure switch type DG 3.., DG 5 E D 5440, D 5440 E
- · See also section "Devices for special applications" (Screw-in valves and installation kits)

For section and pages No. of the additionally listed devices, see type index



# Miniature proportional pressure reducing valves type PM

These proportional pressure reducing valves are used for circuits, where other devices i.e. directional spool valves should be controlled with a low flow and varying pressure. The pressure on the secondary side (port A) can be adjusted, independently from the pressure on the primary side, according to an electrical signal.

The reduced pressure at port A will change proportional to alternation of the electrical input signal.

There is a design related leakage flow which has to be led pressureless



via port R to the tank. These pressure reducing valves feature a override compensation i.e. acting like a pressure limiting valve, if the pressure on the secondary side exceeds the set pressure e.g. due to external forces.

Nomenclature:	Prop. pressure reducing valve
Design:	Assembly kit Individual valve, Manifold mounting
Adjustability:	Electro-proportional
p <sub>max P</sub> : p <sub>max A</sub> :	40 bar 19 bar
Q <sub>max</sub> :	approx. 2 lpm

### Basic types and general parameters

Basic type	PM 1	PMZ 1	PM 11	PM 12
Design	Assembly kit		Manifold mo	unting valve
	Single valve	Twin valve	Single valve	Twin valve
Pressure range				
(prop. adjustable		0 4.5 bar,	0 7.5 bar	
nom. pressure diffe	r-	0 11.5 bar,	0 19 bar	
ence $\Delta p = p_A - p_R$ )				







### Additional versions

- Type PM 11 and PM 12, with orifices Ø 0.6 mm in port A and B to dampen oscillations and/or return pressure stop in port R
- Valve bank type PMZ 1-A5, up to 10 pressure reducing valve sections and a main pressure reducing valve
- Type PMZ.. in explosion proof design (EExmIIT4) also available

### Solenoid voltage

- 12V DC and 24V DC
- (control current 0 ... 0.63 A (24V DC); 0 ... 1.2 A (12V DC))
- Control via proportional amplifier (see also "Additional information")



**PM 1** 

PM7 1

PM 12

(P



### **Order examples**

### PM 1 - 11 - G24

Proportional pressure reducing valve (assembly kit) type PM 1, max. controllable pressure difference 11.5 bar, solenoid voltage 24V DC

### PM 12 - 7 - G24

Twin proportional pressure reducing valve (manifold mounting valve) type PM 12, max. controllable pressure difference 7.5 bar, solenoid voltage 24V DC

### **Dimensions**

### Type PM 1



Twin proportional pressure reducing valve (assembly kit) type PMZ 1, max. controllable pressure difference 19 bar, solenoid voltage 12V DC



### **Additional information**

- Miniature prop. pressure reducing valves type PM, PMZ
- Prop. pressure reducing valves type PDM • Prop. amplifier type EV1M (module) type EV1G (module)

D 7625	
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D	7486, D 7584/1
D	7831/1
D	7837

- Prop. amplifier type EV22K (card version)
- D 7817, D 7817/1

approx.

· See also section "Devices for special applications" (Proportional valves)

For section and pages No. of the additionally listed devices, see type index



# Proportional pressure reducing valves type PDM

The task of pressure reducing valves in a hydraulic circuit is to maintain a rather constant outlet pressure despite a higher and changing inlet pressure. They are used when an hydraulic circuit with a higher pressure level (primary side) is to supply another circuit with a lower pressure level (secondary side), without affecting the higher pressure in the primary circuit.

There is a design related leakage flow which has to be led pressureless via port R to the tank. A reversal of the direction of flow is possible up to



approx. 50% of  $Q_{max}$ . A by-pass check valve has to be provided for higher reversed flow. The pressure reducing valves size 11 and 21/22 feature an override compensation i.e. acting like a pressure limiting valve, if the pressure on the secondary side exceeds the set pressure e.g. due to external forces.

Nomenclature:	Prop. pressure reducing valve (directly controlled or piloted)
Design:	Individual valve for pipe connection Individual valve, Manifold mounting
Adjustability:	Electro-proportional
p <sub>max P</sub> : p <sub>max A</sub> :	420 bar 5 350 bar
Q <sub>max</sub>	120 lpm

### Basic types and general parameters

Basic type			PDM		
and Function	Directly	controlled		Piloted	
	•			_	
Size	11	21/22	3	4	5
Flow	12	20	40	70	120
Q <sub>max</sub> (lpm)					
Pressure range:	41: 80	41: 45		N: 130	
p <sub>max A</sub> (bar)	42: 130	42: 70		M: 200	
	43: 200	43: 110		H: 350	
	44: 320	44: 180			
Tapped ports <sup>1</sup> )	G 1/4	G 1/4	G 1/2	G 3/4	G 1
(BSPP)		G 3/8			
Leakage flow	< 0.5	< 0.5		< 0.8	
Q <sub>leak</sub> (Ipm)					

Sym	bol
Directly controlled	Piloted
Valve for pipe	
Manifold mo	unting valve
— · — · —	



<sup>1</sup>) Version for pipe connection

### Solenoid voltage

• 12V DC, 24V DC

• Control via proportional amplifier (see also "Additional information ")

### **Order examples**

### PDMP 11 - 43/24

Prop. pressure reducing valve, manifold mounting (coding P), size 1, adjustable pressure range 5 ... 200 bar (coding 43), solenoid voltage 24V DC

### Dimensions

Version for pipe connection

Type PDM 11, PDM 21 and PDM 22



### Version for manifold mounting

Type PDM 11P and PDM 22P



Basic type	Н	В	т	m (kg)
PDM 11	113	35	135	1.5
PDM 21/22	113	35	142	1.6
PDMP 11	108	35	135	1.4
PDMP 22	108	40	142	1.3

### Additional information

- Prop. pressure reducing valves type PDM
- Miniature prop. pressure reducing valves type PM, PMZ
- Prop. amplifier type EV1M, EV1G (module)
   type EV1SA (plug)

D 7625	

D 7486, D 7584/1

D 7831/1, D 7837 D 7818 PDM 4G H - 12

Prop. pressure reducing valve, version for pipe connection (coding G), size 4, adjustable pressure range 15 ... 350 bar (coding H), solenoid voltage 12V DC

Version for pipe connection

Type PDM 3 to 5





Version for manifold mounting Type PDM 4P and PDM 5P





All dimensions in mm, subject to change without notice!

Basic type	н	В	т	m (kg)
PDM 3	96	66	150	1.8
PDM 4	99.5	71	155	2.2
PDM 5	104.5	73	170	2.7
PDM 4 P	99.5	78	150	2.7
PDM 5 P	104.5	81	178	3.2

Prop. amplifier type EV 22K (card version)

D 7817, D 7817/1

 See also section "Devices for special applications" (Proportional valves)

For section and pages No. of the additionally listed devices, see type index



### **Circulation valve type CNE 2**

The pressure controlled 2-way directional valve automatically switches one (low pressure) of two circuits feeding a hydraulic system into idle circulation as soon as the adjusted pressure is achieved or exceeded by the high pressure circuit.

The valve is retained in this shifting position, enabling idle circulation, via the higher pressure being picked up and transmitted by a control oil duct. This valve also serves as a pressure limiting valve for the low pressure circuit. A significant advantage of this valve type CNE 2 is the easily to manufacture mounting hole (see dimensions).

Nomenclature:	2-way circulation valve
Design:	Screw-in valve
Adjustability:	Tool adjustable
p <sub>max</sub> : p <sub>max adjust</sub> :	500 bar 450 bar
Q <sub>mav</sub> i	30 lpm



### Symbol Basic type Flow Oper. pressure p<sub>max</sub> (bar) with Q<sub>max</sub> (lpm) and size Ρ E: 30 D: 45 C: 60 CNE 2 B: 75 500 A: 90 M: 120 L: 150 **CNE 22** 30 C: 320 500 B: 450

### Basic types and general parameters

### **Additional versions**

• Additionally sealed tapped journal to minimize leakage losses (type CNE 21 and CNE 23)

### **Order example**

### CNE 2 C - 50

Circulation valve type CNE 2, pressure range 45...60 bar (coding C) factory set to 50 bar

### Dimensions





All dimensions in mm, subject to change without notice!

### **Additional information**

- Circulation valves type CNE
- Two stage valves type NE
- Two stage connection block type NA
- Switch unit type CR
- Shut-off valves type ALZ
- Externally pressure controlled relieve valves type AE
- Shut-off valves type LV

D 7161 D 6905 A D 7150 D 6170 ALZ

D 6170

D 7529

D 7710 NE

 Connection blocks type AN, AL D 6905 A Compact hydraulic power packs type HK, D 7600-4, D 7600-3L HKF, HKL D 7200, D 7200 H

• Hydraulic power packs type MP, MPW

· See also section "Devices for special applications" (Screw-in valves and installation kits, Devices for up to 700 bar)

For section and pages No. of the additionally listed devices, see type index

### **Example circuit** HK448/1-HH..-AN21F2



compact hydraulic power packs type HK with two pump circuits

Circulation valve integrated in connection block type AN 21 F2 for



### Two stage valves type NE

Two stage valves are used for hydraulic systems fed by two stage pumps (low and high pressure). They unit the flow from both pumps, automatically switch the low pressure circuit to idle circulation as soon as the adjusted pressure is achieved or exceeded by the high pressure circuit and safeguard both pumps from excessive pressure above the set figures.

These valves are intended for use together with 3/3- or 4/3-way directional valves controlling hydraulic cylinders. Bottom ram presses and single acting hydraulic cylinders are better controlled by switch units type CR.



### Basic types and general parameters

Basic type	Press	sure	Flo	w	Т	apped por	ts	Sy	vmbol
and size	p <sub>max</sub>	(bar)	Q <sub>max</sub>	(lpm)		(BSPP)		NE 20	NE 70, NE 80
	HP	LP	HP	LP	A, R	HP	NP		
NE 20	20 700	16 80	10	40	G 1/2	G 1/4	G 1/2		
NE 70	(0) 500	(0) 60	16	100	G 1	G 1/4	G 3/4	╷┝┤ <u>╸</u> ┝┽┑╷	
NE 80	(0) 500	(0) 30	25	180	G 1 1/4	G 3/8	G 1		

### **Additional versions**

- For direct mounting of valve banks type VB (type NE 21)
- For direct mounting onto hydraulic power packs type MP and RZ

### Order examples

### NE 20 - 650/20

Two stage valve NE 20, factory set to 650 bar (high pressure), 20 bar (low pressure)

### NE 70 - 500/10

Two stage valve NE 70, factory set to 500 bar (high pressure), 10 bar (low pressure)

Iomenclature:	Two stage valve
	(high pressure (HP) /
	low pressure (LP) stage)
Design:	Individual valve for
	pipe connection
djustability:	Tool adjustable
max	500 700 (HP) /
	30 80 (LP) bar
Q <sub>max</sub> :	25 (HP) / 180 (LP) lpm

### Type NE 70, NE 80



Dimensions Type NE 20





Basic type	н	В	т	m (kg)
NE 20	110	70	50	2.1
NE 70	131	100	50	3.4
NE 80	259	120	60	7.0

Additional	information
Additional	mormation

- Two stage valves type NE
- Hydraulic power packs type MP, MPW
- Two stage pump type RZ
- Circulation valve type CNE
- Two stage connection block type NA

D 7161 D 7200, D 7200 H D 6910, D 6910 H

D 7710 NE

D 6905 A

- Switch unit (for presses) type CR
   D 7150
- Directional seated valves type VB
   D 7302
- See also section "Devices for special applications" (Press control, Devices for up to 700 bar)

For section and pages No. of the additionally listed devices, see type index



### Shut-off valves type LV and ALZ

These shut-off valves automatically switches the pump delivery flow into idle circulation as soon as the adjusted pressure is achieved. There is a check valve upstream of the consumer port A preventing any return flow via the port R. The idle circulation switching position is interrupted as soon as the pressure in the consumer port drops approx. 13% under the set pressure figure. The self controlled valves type LV do not require any flow pulsation whereas type ALZ is a piloting valve.

Both types are mostly used as accumulator charge valves, and should be installed as near to the pump as possible.



Nomenclature:	Shut-off valve (idle circulation valve, direct controlled or piloted)		
Design:	Individual valve for pipe connection Individual valve, Manifold mounting		
Adjustability:	Tool adjustable Manually adjustable		
p <sub>max</sub> :	350 bar		
Q <sub>max</sub> :	120 lpm		

### **Basic types and general parameters**

Basic type and size		/		ALZ	-	
Control	T Dire	ect		Piloted	т	Fo
Size	10	20	3	4	5	[
Flow	12	25	50	80	120	_
Q <sub>max</sub> (Ipm)						
Pressure range:	E: 140	E: 135	E: 140	E: 140	E: 140	
Pressure p <sub>max</sub> (bar)	D: 250	D: 220	D: 250	D: 250	D: 250	
	C: 350	C: 350	C: 350	C: 350	C: 350	Mani
Tapped ports <sup>1</sup> ) (BSPP)	G 1/4	G 3/8	G 1/2	G 3/4	G 1	

Symbol

For pipe connection



Manifold mounting valve



<sup>1</sup>) Version for pipe connection

### **Additional versions**

- Manually adjustable pressure setting, only type ALZ
- Arbitrary idle circulation via a 2/2-way solenoid valve, only type ALZ

### **Order examples**

LV 10 D - 180

Shut-off valve type LV, size 10 , pressure range 130...250 bar (coding D), pressure factory set to 180 bar

### Dimensions

Type LV..



Type ALZ..G..





Basic type	В	н	т	m (kg)
ALZ 3 G	40	80	99	2.0
ALZ 4 G	40	94	109	2.4
ALZ 5 G	63	105	135	4.3
ALZ 4 P	40	60	119	2.1
ALZ 5 P	40	80	133	4.3

### Additional information

<ul> <li>Shut-off valves</li> </ul>	type LV	D 7529
	type ALZ	D 6170 ALZ
	type AL	D 6170
Release valves	type AE	D 6170

### ALZ 4 PC - 250

Shut-off valve type ALZ, size 4, manifold mounting valve (coding P), pressure range 241...350 bar, (coding C) pressure factory set to 250 bar



All dimensions in mm, subject to change without notice!

For section and pages No. of the additionally listed devices, see type index



# Pressure controlled shut-off valves type DSV and CDSV

These pressure controlled shut-off valves block the flow to consumers located down stream without any leakage as soon as the adjusted pressure is achieved or exceeded in the consumer port B. The valve will open the passage again if the pressure in port A drops under the set figure. A significant advantage of the screw-in valve type CDSV is the easily to manufacture mounting hole (see dimensions). It is frequently used to safe guard pressure gauges.



Nomenclature:	Shut-off valve
Design:	Individual valve for pipe connection Individual valve, Manifold mounting Screw-in valve
Adjustability:	Tool adjustable Manually adjustable
p <sub>max</sub> :	600 bar
Q <sub>max</sub> :	60 lpm

### Basic types and general parameters

Basic type	CDSV 1	DSV	DSV 2 and DSVP 2 <sup>1</sup> )	
Design	Screw-in valve	Version for pipe connection of		ection or
		manino	iu mounting	vaive
Size	1	1	2	3
Flow	10	20	40	60
Q <sub>max</sub> (lpm)				
Pressure range:	C: 120	D: 40	D: 20	D: 20
Pressure p <sub>max</sub> (bar)	B: 350	C: 100	C: 60	C: 60
	A: 600	B: 220	B: 120	B: 120
	l .	A: 600	A: 400	A: 400
Tapped ports	M 16 x 1.5	G 1/4	G 3/8	G 1/2
		(BSPP)	(BSPP)	(BSPP)

0	Cymbol		
CDSV 1	DSVP 2		
DSV 2			

Symbol



1) Manifold mounting valve only in size 1

• Type CDSV also available with connection block for pipe connection

**Additional versions** 

Manually adjustable pressure setting

### Order examples

### CDSV 1 A - 550

Shut-off valve (screw-in valve) type CDSV, pressure range 20 ... 600 bar (coding A), pressure factory set to 550 bar

### DSV 2 - 2 BR

Shut-off valve (version for pipe connection), size 2, pressure range (0)...120 bar (coding B), manually adjustable pressure setting (coding R)

### Dimensions

Type CDSV 1

(see order example)

### Type DSV 2

(see order example)





Type DSVP 2 - 1



All dimensions in mm, subject to change without notice!

Basic type	H <sub>max</sub>	SW	m (kg)	
CDSV 1	69	a/f 22	0.13	
DSV 2-1	185	a/f 36	0.7	
DSV 2-2	193	a/f 36	0.9	
DSV 2-3	193	a/f 46	7,1	
DSVP 2-1	181	-	1.1	

### **Additional information**

Shut-off valves type DSV, DSVP
 type CDSV 1

D 3990 D 7876

 See also section "Devices for special applications" (Screw-in valves and installation kits, Devices for up to 700 bar)

For section and pages No. of the additionally listed devices, see type index



Load holding valves are pressure valves, which act always on the return flow side of double acting consumers. They block the return duct according to their set pressure (setting approx. 15% above the max. load pressure) generating a counter force to a pushing (negative) load. Therefore the pump will have to feed the inflow side, e.g. pressurizing the cylinder enough to overcome the set pressure of the load holding valve, thereby dropping the load.

Type LHK is intended for applications which are hardly prone for oscillations.

Type LHT features simple, whereas type LHDV an elaborate special



dampening equipment making them especially suited for applications together with prop. directional spool valves ("Load Sensing" spool valves) e.g. type PSL/PSV. Many additional options are available such as shock valves, shuttle valves with or without by pass check valve (e.g. delayed release of hydraulic brakes) etc.

Nomenclature:	Load holding valve (over center valve, for one sided or alternating load direction) Single or twin valve
Design:	Individual valve for pipe connection Individual valve, Manifold mounting Screw-in valve Version for banjo bolt mounting
p <sub>max</sub> :	360450 bar
Q <sub>max</sub> :	250 lpm

### Basic types and general parameters

Basic type	Flow	Oper. pressure	Release	Tapped ports
and size	Q <sub>max</sub> (lpm)	p <sub>max</sub> (bar)	ratio	(BSPP)
LHK 22	20	400	1:4.6	G 3/8
LHK 33	60	360	1:4.4	G 1/2
LHK 44	100	350	1:4.4	G 3/4
LHDV 33	80	420	1 : 81 : 1.2 <sup>1</sup> )	G 1/2
LHT 21	20	400	1 : 81 : 0.58 <sup>1</sup> )	G 1/4
LHT 33	130	450	1:71:0.98 1)	G 1/2
LHT 50	250	450	1 : 61 : 0.89 <sup>1</sup> )	G 1

 Release ratio can be altered simply by changing the orifice

### Symbols (examples)





LHK 44 G-21-...







LHT 21 H-14-...



### LHDV 33 G-25WD-...


## Additional versions

- Some available with release ratio 1 : 2 and 1 : 7 (type LHK)
- Release ratio may be altered with different orifice combinations in the range between 1 : 1.2 and 1 : 8.9 (type LHDV and LHT)
- Various housing designs available

## **Order examples**

## LHK 44 G - 11 - 160

Load holding valve (single valve no shock valve) type LHK 44, damped version (coding G, standard) Load holding pressure factory set to 160 bar

Dimensions

Many differing versions are available, therefore only two versions (acc. to the order examples) are illustrated below





Type LHT 33 P - 15





max.

24

All dimensions in mm, subject to change without notice!

## **Basic type**

(single valve)	н	В	т	m (kg)
LHK 22 G-11	97	32	32	0.5
LHK 33 G-11	123	40	40	1.0
LHK 44 G-11	170	45	45	1.6
LHDV 33 P-11 <sup>1</sup> )	170	50	40	1.8
LHT 33 P-11 <sup>1</sup> )	128	70	40	1.6
LHT 50 G-11 <sup>1</sup> )	113	50	50	1.0

## **Additional information**

• Load holding valves type	e LHK	D 7100
type	e LHDV	D 7770
type	D 7918	
• Prop. directional spool va	D 7700-3	
		D 7700-5
	type PSLF/PSVF	D 7700-F

- Type LHT is also available completely load pressure independant (line rupture function)
- Versions with shock and suction valves
- Versions with shuttle valve for hydraulic brakes
- Screw-in valves
- Assembly kits

## LHDV 33 - 25 WD - B 6 - 200/200 - 240/240

Load holding valve (twin valve) type LHDV 33, with shock valve and shuttle valve / by-pass check valve (coding WD), valve suited for approx. 60 lpm (coding B), orifice D2  $\varnothing$  0.6 mm (resulting release ratio 1:2.9 (standard), coding 6), load holding pressure factory set to 200 bar for both, shock valve factory set to 240 bar for both.

## Type LHDV 33 - 25 WD - B 6 - 200/200 - 240/240





Basic type				
(twin valve)	H1	B1	T1	m (kg)
LHK 22 G <sup>1</sup> )	98	60	30	0.9
LHK 33 G <sup>1</sup> )	125291	80	4060	2.7
LHK 44 G <sup>1</sup> )	170	90	50	3.5
LHDV 33	170	88	70	4.7

<sup>1</sup>) Note: Design may be significantly different to the illustrated version!

 See also section "Devices for special applications" (Industrial trucks, Mobile hydraulics, Screw-in valves and installation kits)

For section and pages No. of the additionally listed devices, see type index



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## **2.4 Metering valves**

Flow control valves	_
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• 2-way Flow control valves type SB, SQ, and SJ	<b>2.4-</b> 6
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## Flow control valves type SF, SD, SK, and SU

The SF, SD, SK, and SU type flow control valves are available in 2- and 3-way flow versions. They are utilized to smoothly adjust the consumer flow in hydraulic circuits. With type SU it is possible to choose between two previously selected flows.

The amount of flow is accurately maintained even if the system pressure or viscosity varies.

Additional control functions enable adaptation to special application requirements e.g. pressure limiting valve and idle circulation valve. Both can be integrated in the valve body or externally via a Z-port.

The 2-way flow control valves can work in any flow direction when

ordered with a by-pass check valve and bridge circuit.

These flow control valves may be used in a wide field of application due to the various actuation options available.

Nomenclature:	2-way flow control valve 3-way flow control valve
Design:	Individual valves for pipe mounting or Manifold mounting
Adjustability:	Mechanical • Adjusting knob • Roller • Set screw Solenoid (switching between two constant consumer flows)
p <sub>max</sub> :	315 bar
Q <sub>max</sub> :	0.3 130 lpm



### **Basic types and general parameters**

Basic type and size		Flow Tapped ports <sup>2</sup> )			Symbol			
2-way	3-way	Q <sub>max</sub> (lpm) <sup>1</sup> )	(BSPP)		2-way 3-way			
S. 2-3	S. 3-3	0.3 60	G 1/2	Pipe				
S. 2-4	S. 3-4	0.6 90	G 3/4	mounting	17-1	LIK LR		
S. 2-5	S. 3-5	1.0 130	G 1		·	·		
SU 2-3	SU 3-3	0 50	G 1/2	Manifold mounting				

## Actuations

Basic types	Brief description	Symbol
SF	Set screw a/f 10,	
	adjustment travel 5 mm	
SD	Adjusting knob,	L/= ]
	adjustment travel 3.8 turns	
SK	Roller actuation	
SKR	Unshielded version (SK)	Ŷ
	Shielded version (SKR)	┍╫╶┵╶┐ ─╎ <del>╶╪╼</del> ╎─
	Actuation travel 15.5 17 mm	
	Actuation force 30 70 N	
SU	Solenoid	Ν
	12V DC, 24V DC, 230V AC 50/60 Hz	

## Available orifices

Q <sub>max</sub> (l/min)	3	15	30	36	50	60	70	90	130
		(c	orifice	open w	hen d	eenerg	jized)		

1) Q<sub>max</sub> can be selected, see "Available orifices"

<sup>2</sup>) With version for pipe mounting

## **Additional versions**

## 2-way flow control valve

- Flow control valve with by-pass check valve
- Version for arbitrary flow direction with bridge circuit utilizing check valves

## **Order examples**

## SF 3-3/15 S - WN1F - G12 - 120

3-way flow control valve adjustable orifice (by means of a set screw), size 3, metering orifice for  $Q_{max} = 15$  lpm, version for pipe mounting with pressure limiting valve (coding S, pressure setting 120 bar) and idle circulation valve (coding WN1F)

## Dimensions

### Version for pipe mounting

(see order examples)



## 3-way flow control valve

- Version with pressure limiting valve
- (only available with version for pipe mounting)
- Flow control valve with pressure limiting valve and idle circulation valve (only available with version for pipe mounting)

## SD 2-3/50 P

2-way flow control valve adjustable with adjusting knob, size 3, metering orifice for  $Q_{max} = 50$  lpm, manifold mounted valve (coding P)

Manifold mounting valve (see order examples)



All dimensions are in mm, and subject to change without notice !

Basic type	н	H1	В	B1	т	T1	m (kg) dep. on actuation
S. 2-3	50	40	80	60	50	60	1.4 2.1
S. 2-4	60	50	88	70	60	70	2
S. 2-5	70	50	100	80	70	80	3.1
S. 3-3	50	40	80	60	50	60	1.4 2.1
S. 3-4	60	50	88	70	60	70	2.0 2.6
S. 3-5	70	50	100	80	70	80	2.8 3.7

D 7557/1

D 7163

## **Further information**

- 2-way and 3-way flow control valves type S D 6233
- Drop rate braking valves type SB, SQ
   D 6920
- Prop. flow control valves type SE, SEH
- Plugs with LED etc.



These 2-way flow valves (drop rate braking valves), type SB or SQ, are used for flow control purposes with single acting cylinders. They maintain a constant drop rate irrespective of the size of the load. There is an integrated sliding metering orifice enabling free flow in the other direction. Type SB features load sensing to prevent oscillations (e.g. required with fork lift trucks) whereas type SQ has load independent characteristics .

Flow control valves type SJ (no sliding metering orifice) are used to limit control flows in consumer circuits. Version DSJ limits the flow both directions and is therefore intended for double acting consumers applications.



Nomenclature:	2-way flow control valve (drop rate braking valve)
Design:	Screw-in type with housing for in-line installation
Adjustability:	Fixed (pre-set) Tool adjustable from outside
p <sub>max</sub> :	315 bar
Q <sub>max</sub> :	0.25 400 lpm

## Basic types and general parameters

Basic type	Coc	ding for	adjustm	nent ran	ge of the	set	Tapped ports	Syn	nbol
and size	res	ponse f	low fror	n to .	Ipm belo	w	(standard)		
	1	3	5	7	9	90	(BSPP)	SB, SQ	SJ
	1								
SB 0	1	1.6	2.5	4	6.3	10	G 1/4 (A)		
SJ 0 <sup>1</sup> )	1.6	2.5	4	6.3	10	15		×!	<b>`</b>
SB 1	2.5	4	6.3	10	16	25	G 3/8 (A)	F B	₽ <b>└────</b> ₽
SQ 1	4	6.3	10	16	25	35			
SB 2	16	21	28	37	50		G 1/2 (A)	-	
SQ 2	21	28	37	50	67 <sup>2</sup> )				
SB 3	37	50	67	90	120		G 3/4 (A)		
SQ 3	50	67	90	120	150 <sup>2</sup> )				
SB 4	80	100	125	160	200		G 1 (A)		
	100	125	160	200	250				
SB 5	170	200	236	280	335		G 11/4 (A)		
	200	236	280	335	400				

### **Additional versions**

- Version with metric and UNF thread
- Version with thread reduction
- Version with housing for in-line installation
- · Version with swivel housing or as banjo bolt

- Version with housing, externally adjustable and idle position can be locked
- Version type DSJ ( $Q_{max} = 20$  lpm,  $p_{max} = 300$  bar) flow control function for both flow directions suited for double acting consumers <sup>3</sup>)
  - <sup>1</sup>) Type SJ 0 without coding: adjust. range 0.25 ... 1.2 lpm
  - <sup>2</sup>) Not for type SQ..
  - <sup>3</sup>) See also "Further information"

## **Order examples**

## SJ 05 C-4

Flow control valve type SJ 05, adjustment range 5 (2.5 ... 4 lpm) screw-in valve (coding C), response flow 4 lpm

## SB 27 C-40

Flow control valve type SB 2, adjustment range 7 (37...50 lpm) screw-in valve (coding C), response flow 40 lpm

## Dimensions

Type SB, SQ

## Type SJ

## Type G, version with housing





D 6920

D 7395

D 7736 D 7825

Basic type	G	G L L1 <sub>max</sub>		SW	m (g)
•	(BSPP)				
SJ 0	G 1/4 (A)	24			35
SB 0	G 1/4 (A)	39	78	a/f 19	13
SB 1, SQ 1	G 3/8 (A)	43	82	a/f 22	23
SB 2, SQ 2	G 1/2 (A)	49	96	a/f 27	40
SB 3, SQ 3	G 3/4 (A)	61	106	a/f 32	80
SB 4	G 1 (A)	78	145	a/f 41	150
SB 5	G 1 1/4 (A)	94	160	a/f 50	300

All dimensions are in mm, and subject to change without notice!

## **Further information**

- Drop rate braking valves type SB, SQ
- 2-way flow control valves type SJ

	type CSJ	
•	Double acting 2-way flow control valves type DSJ	

• See also "Devices for special applications" (Industrial trucks, Screw-in valves and installation kits)



## Flow control valves type SE and SEH with electro-proportional actuation

The SE and SEH type flow control valves are intended for smooth velocity control of hydraulic actuators independent of pressure. They may be utilized as 2-way or 3-way flow control valves and are available with an adjustable metering orifice. The adjustment of this orifice is either directly electro-proportional (type SE) or electro-proportional piloted (type SEH). The orifice can be open or blocked in the idle position. This feature enables pre-defined acceleration and braking sequences within automatic working cycles.



A piloted pressure limiting valve, a solenoid actuated idle circulation valve (for 3-way controllers only), and a by-pass check valve are available. In addition, a bridge circuit utilizing check valves to enable arbitrary flow direction (for 2-way controllers only) is available as an option.

Nomenclature:	2-way flow control valve 3-way flow control valve
Design:	Individual valve for pipe mounting or manifold mounting
Adjustability:	Electro-proportional
p <sub>max</sub> :	315 bar
Q <sub>max</sub> :	0.1 120 lpm

## Basic types and general parameters

Basic type and size		Flow	Oper. pressure	Tapped ports	Symbol		
	2-way	3-way	Q <sub>max</sub> (lpm) <sup>1</sup> )	p <sub>max</sub> (bar)	(BSPP) <sup>3</sup> )	2-way	3-way
Directly	SE 2-3	SE 3-3	0.3 50	315	G 1/2	Pipe r	mounting
actuated	SE 2-4		0.6 70	315	G 3/4		
		SE 3-4	0.6 90	315	G 3/4		
Hydraulically	SEH 2-2	SEH 3-2	0.1 30	315	G 3/8		$L_R I_Z 2$
piloted	SEH 2-3 4)	SEH 3-3	0.3 50	315	G 1/2	Manifold	d mounting
		SEH 3-4	0.6 90	315	G 3/4		
		SEH 3-5	1.0 120	315	G 1		
<ol> <li>Different Q<sub>max</sub></li> <li>No 7-port with</li> </ol>	available, see "A	vailable orifices	5"				

2) No Z-port with type SEH 3-2

3) For pipe mounting versions only

4) For manifold mounting versions only

### Available orifices

Q <sub>max</sub> (lpm)	3	6	10	15	22	30	36	50	70	90	120	Open orifice, when deenergized
	3 F	6 F	10 F	15 F	22 F	30 F	36 F	50 F	70 F	90 F	120 F	Blocked orifice, when deenergized

## Solenoid voltage

• 12V DC, 24V DC

• Other voltage on request

· Control via proportional amplifier (see also "Further information")

## Options for flow control valves

## 2-way flow control valve

- Version with by-pass check valve
- Version with bridge circuit utilizing check valves for arbitrary flow direction

## **Order examples**

## SEH 3-4/90F - G24

Proportional 3-way flow control valve type SEH, size 4 for pipe mounting, metering orifice blocked in idle position ( $Q_{max} = 90$  lpm) and solenoid voltage 24V DC

## Dimensions

Pipe mounting valve (see order example)





(only available for	r pipe mounting	versions only)

 Version enforced economy position of the flow controller, when not actuated type ...FO <sup>5</sup>)

• Version with pressure limiting valve and idle circulation valve

• Version with automatic idle circulation type ...-B 0.6 5)

## SE 2-3/30F P - G24

3-way flow control valve

• Version with pressure limiting valve

Proportional 2-way flow control valve type SE, size 3 for manifold mounting, metering orifice blocked in idle position ( $Q_{max} = 30$  lpm) and solenoid voltage 24V DC

## Manifold mounting valve (see order example)



Basic type		н	В	т	m (kg)
SE 2-3	SE 3-3	110 120	80 91	50 60	2.2
SE 2-4	SE 3-4	120 130	85 100	60 70	2.2
SEH 2-2	SEH 3-2	115	55 70	40	1.6 3.3
SEH 2-3 <sup>4</sup> )	SEH 3-3	92.5	80 93	50 60	1.6 3.3
	SEH 3-4	102.5	95 100	60 70	1.6 3.3
	SEH 3-5	112.5	100	70	1.6 3.3

D 7557/1

D 6233

D 7831/1

<sup>4</sup>) For manifold mounting versions only
 <sup>5</sup>) See also "Further information"

All dimensions are in mm, and subject to change without notice !

### **Further information**

- Prop. flow control valves type SE, SEH
- Flow control valves type SD etc.
- Prop. amplifier type EV1M (module)
  - type EV1G (module)D 7837type EV1SA (plug)D 7818

<ul> <li>Prop. amplifier</li> </ul>	type EV22K1 (card version)	D 7817
	type EV22K2 (card version)	D 7817/1
<ul> <li>See also section</li> </ul>	on"Devices for special applications"	
(Proportional v	alves)	



## Flow dividers type TQ and TV

The flow dividers type TQ divide (collect) total flow entering (exiting) port C. The distribution is independent of working pressure at ports A and B, and may be divided equally or unequally in predetermined portions. The flow divider type TV features priority division, i.e. variable flow entering port C is divided where partial flow  $Q_A$ , through port A, is kept constant and the residual flow,  $Q_B$ , exits port B. As soon as one actuator's movement is stopped the flow to the other is either reduced to a minimal flow (type TQ) or completely reduced to leakage flow (type TV). It is possible to overcome this design feature by creating flow via a pressure limiting valve.



These valves are used for applications where one pump is required to supply two unevenly loaded consumers, which must be driven simultaneously and independently (type TQ) or if one actuator requires priority flow (type TV).

Nomenclature:	Flow dividers with or without priority division
Design:	Individual valve for pipe mounting or manifold mounting
Adjustability:	Non-adjustable
p <sub>max</sub> :	300 350 bar
Q <sub>max</sub> :	7.5 200 lpm (nom. total flow)

## **Basic types and general parameters**

Basic type Flow Oper. pressure		Тар	ped ports (BSPP) 1	)	Symbol		
and size	Q <sub>max</sub> (lpm)	p <sub>max</sub> (bar)	A	В	С	Pipe mounting	Manifold mounting
TQ 2	7.5 70	350	G 1/4, G 3/8	G 1/4, G 3/8	G 3/8	TQ	TQ.P
TQ 3	7.5 70	350	G 3/8, G 1/2	G 3/8, G 1/2	G 1/2	A B	
TQ 3P	7.5 70	350					
TQ 4	80120	350	G 1/2	G 1/2	G 3/4	, /ŧ <u>\/</u> ŧ\_	
TQ 4P	80 120	350					
TQ 5	140 200	350	G 3/4	G 3/4	G 1	ту	TV.P
TQ 5P	140 200	350					·
TV 3	60	300	G 3/8	G 1/2	G 1/2		
TV 3P	60	300					

1) For pipe mounting versions only

## **Additional versions**

• Flow divider type TQ without reflow feature

• Flow divider type TQ with by-pass check valves enabling reflow

## **Order examples**

## TQ 32 - A3

Flow divider type TQ, size 3, tapped port size 2 (C = G 1/2; A,B = G 3/8), version A (dividing or collecting), with a nominal total flow  $Q_{CN} = 45$  lpm (coding 3) • Flow divider type TQ with unequal division

## TV 3 - 2,5

Flow divider with priority division type TV, size 3, flow coding 2.5 ( $\ensuremath{\text{Q}_{\text{A}}}\xspace=5.8$  lpm)

Type TQ...

Type TQ.P









Type TV3P

т



All dimensions are in mm, and subject to change without notice !

Туре	тvз



Basic type	н	В	т	m (kg)
TQ 2	79	30	50	0.6
TQ 3	85	30	60	0.6 0.7
TQ 3P	79	30	50	0.7
TQ 4	110	40	60	1.5
TQ 4P	110	40	60	1.6
TQ 5	134	50	80	3
TQ 5P	134	50	80	3.1
TV 3	109	30	60	1.0
TV 3P	106	35	50	1.0

## **Further information**

<ul> <li>Flow divider (flow distributor) type TQ</li> </ul>	D 7381
<ul> <li>Flow divider type TV</li> </ul>	D 7394



# **Orifices and restrictor check valves type EB, BE, and BC**

The orifice inserts type EB are part of the flow valves, whereas the restrictor check valves type BE and BC are a combination of a flow and check valve.

They are used to limit the flow during switching operations of directional valves (flow restriction preventing too rapid discharging of accumulators). The restrictor check valves type BC and BE, feature an orifice or slot design. They enable free flow in direction  $F \rightarrow B$  and throttle the flow in the reverse direction.



Type BC can be installed in both flow directions. The incorporated check valve is spring loaded. The mounting hole may be shaped with a simple drill (point angle 118°). The orifice inserts, type EB, can be

installed in the P-ports of indiv. sub-plate

mounted directional valves.

	Restrictor check valve
Design:	Orifice insert Screw-in valve Version with housing for in-line installation
p <sub>max</sub> :	400 700 bar
Q <sub>max</sub> :	0.5 120 lpm

Orifice

Nomenclature:

## Basic types and general parameters

Size		Basic type and flow pattern			Tapped ports
		Screw	-in valve	Orifice insert	(BSPP)
			F B	B V F	(screw-in valves only - not type EB)
		BC	BE	EB	
0	Q <sub>max</sub>		12	6	G 1/8 A
	p <sub>max</sub>		500	500	
1	Q <sub>max</sub>	20	25	10	G 1/4 A
	p <sub>max</sub>	700	500	500	
2	Q <sub>max</sub>	35	40	40	G 3/8 A
	p <sub>max</sub>	700	500	500	
3	Q <sub>max</sub>	60	70	100	G 1/2 A
	p <sub>max</sub>	500	450	500	
4	Q <sub>max</sub>		120	120	G 3/4 A
	p <sub>max</sub>		400	500	

Available orifices diameter depending on type and size from 0.4 to 4.2 mm

## **Additional versions**

- Type BC and BE with metric connection thread
- Type BC with housing for in-line installation

## **Order examples**

BC 1 - 0.8

Restrictor check valve type BC, size 1 with hole type orifice  $\varnothing$ 0.8 mm

## EB 2 - 1.7

Orifice insert type EB, size 2 with hole type orifice  $\emptyset$ 1.7 mm

## Dimensions

Type BC.. (screw-in direction arbitrary)







Type BE..

BE 2 - 2.0



Restrictor check valve type BE, size 2 with hole type orifice Ø2.0 mm

Type EB..



All dimensions are in mm, and subject to change without notice !

### G/D SW1/Ød SW2 Basic type н m (g) a/f 8 BC 1 13 G 1/4 A a/f 8 6 BC 2 15 G 3/8 A a/f 9 a/f 9 10 BC 3 a/f 12 18 G 1/2 A a/f 12 24 BE 0 G 1/8 A a/f 4 5 2 BE 1 6 G 1/4 A a/f 5 4 BE 2 G 3/8 A 7 a/f 8 6 BE 3 a/f 10 7.5 G 1/2 A 10 BE 4 a/f 12 9 G 3/4 A 18 EB 0 1.8 6.1 5.5 2 EB 1 7.4 1.8 8.1 4 EB 2 9 14 8 6 EB 3 11.5 17 10 10 EB 4 10 28 27 18

## **Further information**

Restrictor check valves type BC	D 6969 B
type BE	D 7555 B
Orifice inserts type EB	D 6465
Check valves type ER	D 7325
Screw-in check valves type RE	D 7555 R
type RC	D 6969 R
type RK, RB	D 7445

- Restrictor check valves type RD, ED, RDF
- See also section "Devices for special applications" (Screw-in valves and installation kits)

For page and section of the devices additionally listed, see type index

D 7540



## Throttles type Q, QR, QV, and FG

Throttles are flow valves. These valves type Q, QR, and QV are available in five sizes and are used to limit the flow in accumulator and control circuits. They feature a slotted throttle section which is much less sensitive to contamination than throttles with annular gaps (no edge filter effect). The fine throttles type FG are preferred for applications where the switching periods of directional valves have to be adjusted, the prevention of pressure surges is required, or for the dampening of oscillations etc. The throttle effect can be adjusted via the thread, altering the effective slot length.

These valves are only available as "tool adjustable" versions.



Nomenclature:	Throttle Restrictor check valve
Design:	Cartridge Individual valve for pipe mounting • Corner housing • Banjo bolt • Swivel housing
Adjustability:	Tool adjustable
p <sub>max</sub> :	300 400 bar
Q <sub>max</sub> :	0 80 lpm

## Basic types and general parameters

Basic type and size	Flow Q <sub>max</sub> (lpm) <sup>1</sup> )	Oper. pressure p <sub>max</sub> (bar)	Schematic drawings of the devices			Symbol
			Standard	Banjo bolt	Swivel	FG, Q
			screw-in throttle	<u>itta</u>	housing	<u>A.¥. B</u>
FG, FG1, FG2	0.15	300	Ē		(В)	FG1, QR
				(A)		
			<b>+</b>	$( \vdots )$	$\square$	
Q20, QR20, QV20	12	400				FG2, QV
Q30, QR30, QV30	25	400				A
Q40, QR40, QV40	50	400	Ų	]⊕[(В)	( <u> </u> ) (B)	
Q50, QR50, QV50	90	400	Ψ	┝╀╢		
Q60, QR60, QV60	120	315		╙─┬─╜	(A)	

 This figures apply for valves fully opened (observe red indicator) with a back pressure of approx. 50 bar (throttled direction of flow)

### **Additional versions**

• Throttles for in-line installation.

• All sizes available as banjo bolt or swivel housing versions.

• Size Q..20 to Q..50 also available with corner housing, accepting pipes Ø6, Ø8, Ø10, Ø12, Ø16, Ø20 mm; type FG Ø6, Ø8 mm only)

## **Order examples**

## QR 50

Screw-in throttle valve type QR, size 50, free flow in direction  $A \rightarrow B$ 

## Dimensions

Type FG..

Type Q...



Basic type	н	G	SW	SW 1	m (g)
FG, FG1, FG2	30	M 8	a/f 4	a/f 13	15
Q(R,V) 20	32	M 8 x 1	a/f 4	a/f 13	15
Q(R,V) 30	36	M 10 x 1	a/f 5	a/f 17	25
Q(R,V) 40	41	M 12 x 1.5	a/f 6	a/f 19	40
Q(R,V) 50	46	M 14 x 1.5	a/f 8	a/f 22	55
Q(R,V) 60	58	M 16 x 1.5	a/f 10	a/f 24	100

All dimensions are in mm, subject to change without notice !

В

D 6465

## **Further information**

- Throttle valves type Q, QR, QV
- Fine throttle type FG
- Throttle and restrictor check valves type ED, RD, RDF
- Restrictor check valves type BC

D 7730 D 7275

- D 7540

D 6969 B

Restrictor check valves type BE     D	7555
---------------------------------------	------

Orifice inserts type EB

FG 2

Restrictor check valve type FG,

free flow in direction  $B \rightarrow A$  (coding 2)

• See also section "Devices for special applications" (Screw-in valves and installation kits)



# Throttles and restrictor check valves type ED, RD, and RDF

Throttles type ED, RD, and RDF are metering valves. They are used in hydraulic circuits to control the flow of single and double acting actuators.

The two smaller sizes (type ED and RD) are a combination of slotted and annular gap design to improve adjustability. The larger sizes feature an annular gap design only. The restrictor check valves type RDF make use of an orifice for throttling.

A shim, which is very sensitive to the slightest flow, functions as the



check valve in restrictor check valves type RD and RDF. The type ED valves are pure throttles.

Nomenclature:	Throttle and shut-off valve with or without by-pass check valve
Design:	Individual valve for pipe mounting Screw-in valve
Adjustability:	Manually adjustable (handle, adjusting knob) Tool adjustable
p <sub>max</sub> :	500 630 bar
Q <sub>max</sub> :	12 130 lpm

## Basic types and general parameters

Basic type and size <sup>1</sup> )	Flow Q <sub>max</sub> (lpm) ²)	Oper. pressure p <sub>max</sub> (bar)	Tapped ports (BSPP)	Symbol
ED 11	Т		Т	ED
RD 11	12		G 1/4	FGGG
RDF 11/				
ED 21				
RD 21	30		G 3/8	RD
RDF 21/				F G
ED 31				
RD 31	60	500	G 1/2	
RDF 31/				RDF
ED 41				F G
RD 41	80		G 3/4	ز لے خ
RDF 41/				
ED 51				
RD 51	130		G 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.
 These figures correspond to completely opened throttle and represent a back

pressure of approx. 50 bar (throttled

Order examples

## ED 31 K

Throttle type ED, size 31, tool adjustable (K)

## RD 11

Restrictor check valve type RD, size 11, throttle is manually adjustable

## RDF 41/1,4

Restrictor check valve type RDF, size 41, with a throttle diameter of 1.4 mm

direction of flow)

Type ED... and RD...



Type RDF...



All dimensions are in mm, and subject to change without notice !

Basic type	н	в	sw	m (g)
ED 11	23.5		I	
RD 11	23.5	52	a/f 10	180
RDF 11/	15.5			
ED 21	24			
RD 21	24	52	a/f 10	215
RDF 21/	16.5			
ED 31	32.5			
RD 31	32.5	62	a/f 13	340
RDF 31/	21.5			
ED 41	40.5			
RD 41	40.5	72	a/f 17	655
RDF 41/	25			
ED 51	46.2			
RD 51	46.2	82	a/f 19	835
RDF 51/	26			

## **Further information**

• Throttle and restrictor check valves type ED, RD, RDF

- Restrictor check valves type Q, QR, QV
- Fine throttle type FG
- Restrictor check valves type BC

D 7540 D 7730 D 7275

D 6969 B

Restrictor check valves type BE D 7555 B
Orifice inserts type EB D 6465
See also section "Devices for special applications" (Devices up to 700 bar)

## Throttle and shut-off valves type AV, AVT, and CAV

The throttle and shut-off valves types AVT, AV, and CAV, which can be completely blocked, are available in various sizes and belong to the flow valve group. Versions AV...E and CAV are screw-in valves. They generate a pressure drop between inlet and outlet to control the speed of cylinders in accumulator circuits, the flow in control circuits, or can function as a saveguard for a pressure gauge.

The throttles type AV.. restrict the flow via an annular gap i.e. a cone enters a valve seat hole (needle valve). Throttles type CAV create backpressure by means of a slot with a constant width where the area of opening varies proportionally with the distance of the adjustment travel.



Valves using this throttling principle are much less sensitive to contamination. Additional versions are available with an integrated check valve to enable free flow in the opposite direction.

Nomenclature:	Throttle and shut-off valve with or without by-pass check valve
Design:	Individual valve for pipe mounting Screw-in valve
Adjustability:	Manually adjustable (handle, adjusting knob) Tool adjustable
p <sub>max</sub> :	500 630 bar
Q <sub>max</sub> :	50 lpm

## Basic types and general parameters

Basic type and size	Version	Flow Q <sub>max</sub> (lpm) 1)	Oper. pressure p <sub>max</sub> (bar)	Connection size	Symbol
AV 2	Valve for pipe	40	500	G 1/2	AV, AV.E, AVT, CAV
AV 3	connection	100	400	G 3/4	<u>A</u> , <u>K</u> , <u>B</u>
AV 2E		40	500	M 28 x 1.5	CAV B
AV 3E	Screw-in valve	100	400	M 40 x 1.5	
AV 3RE		100	400	M 40 x 1.5	Al I B
AVT 6		12	630	6 mm	
AVT 8	Valve for pipe	25	630	8 mm	
AVT 12	connection	50	630	12 mm	CAVV, AVR, AVRE
AVT 16		100	400	16 mm	
CAV 1	Screw-in valve	30	500	M 16 x 1.5	
CAV 2		50	500	M 20 x 1.5	

1) This figures do apply with a back pressure of approx. 10 bar (throttled flow direction)

## **Additional versions**

• Shut-off valve AVM 8 with a short pipe at one end

## Order examples

## AV 3R

Throttle and shut-off valve type AV, size 3 with check valve, blocked flow direction  $A \to B$ 

## **AVT** 8

Throttle and shut-off valve type AVT, with short connection pipe at one side diameter 8 mm

Т

## Dimensions

Type AV..

Type AVT..







Screw-in throttle and shut-off valve type CAV, size 2

CAV 2



Type AV..E



Basic type	н	В	т	D	m (kg)
AV 2	145	45	30	_	0.6
AV 3	198	60	40	-	1.7
AVT 6	91	31	-	6	0.14
AVT 8	94	32	-	8	0.18
AVT 12	114	38	-	12	0.32
AVT 16	123	43	-	16	0.44

Basic type	H1	H2	м	SW	SW1	m (kg)
CAV 1	42	19	M 16 x 1.5	a/f 17	a/f 22	0.05
CAV 2	51	21	M 20 x 1.5	a/f 22	a/f 24	0.07
AV 2E	115	25	M 28 x 1.5	a/f 36		0.6
AV 3E	143	38	M 40 x 1.5	a/f 46		1.0

All dimensions are in mm, and subject to change without notice !

## **Further information**

Shut-off valves type AVT	D 7690
Throttles and shut-off valves type AV	D 4583
type CAV	D 7711
• Throttles and restrictor check valves type ED, RD, RDF	D 7540
Throttles type Q, QR, QV	D 7730

<ul> <li>See also section "Devices for special applications"</li> </ul>	
(Screw-in valves and installation kits, Devices for up to 700 ba	r)



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## **2.5 Check valves**

Check valves	_
Check valves type RK/RB, RC, RE, and ER	<b>2.5-</b> 4
<ul> <li>Check valves type CRK and CRB</li> </ul>	<b>2.5-</b> 6
Check valves type B	<b>2.5-</b> 8
Releasable check valves	
<ul> <li>Screw-in check valves with hydraulic release</li> </ul>	<b>2.5-</b> 10
type CRH and RHC	
<ul> <li>Releasable check valves type HRP</li> </ul>	<b>2.5-</b> 12
Releasable check valves type RH and DRH	<b>2.5-</b> 14
Pre-fill valves	
<ul> <li>Check valves and pre-fill valves type F</li> </ul>	<b>2.5-</b> 16
Line rupture safety valve, Shuttle valves	_
Line rupture safety valve type LB	<b>2.5-</b> 18
Shuttle valves type WV and WVC	<b>2.5-</b> 20



## Check valves type RK/RB, RC, RE, and ER

The check valves type RK/RB, RC, RE, and ER are used to block the flow in one direction and enable free flow in the opposite direction.

The check valves type RK/RB are ball seated valves, where the valve element is spring loaded. They are sturdy and contamination tolerant due to their design.

The screw-in check valves type RC may be installed in both directions with the spring loaded valve shim enabling rapid switching sequences. There are also versions available featuring metric thread or a housing. The screw-in check valves type RE is a shim type check valve also but without spring pre-load. This enables a very compact and simple method



of blocking the oil flow in one direction. This valve can be used as a "foot valve" in the suction pipe of pumps. The mounting hole for all screw-in check valves can be easily machined with a standard drill (point angle 118°). The check valve inserts type ER feature a ball seated design and are commonly installed in the ports of ball seated directional valves or other manifold mounted valves.

Nomenclature:	Check valve
Design:	Screw-in valve Valve insert with housing for in-line installation
p <sub>max</sub> :	400700 bar
Q <sub>max</sub> :	6120 lpm

## Basic types and general parameters

Size	9	Ball seate	d valves	Shim type valves		Ball seated valves	Connection thread <sup>1</sup> ) (BSPP)
Syn	nbol	-F¢₩₩ <sup>B</sup>		-¢₩₽	B F	-\$	
Bas	ic type	RK	RB	RC	RE	ER <sup>1</sup> )	
0	Q <sub>max</sub> (lpm)	10	10		12	6	G 1/8 A
	p <sub>max</sub> (bar)	700	700		500	500	
1	Q <sub>max</sub> (lpm)	20	20	20	25	12	G 1/4 A
	p <sub>max</sub> (bar)	700	700	700	500	500	
2	Q <sub>max</sub> (lpm)	50	50	35	40	30	G 3/8 A
	p <sub>max</sub> (bar)	700	700	700	500	500	
3	Q <sub>max</sub> (lpm)	80	80	60	70	65	G 1/2 A
	p <sub>max</sub> (bar)	500	500	500	450	500	
4	Q <sub>max</sub> (lpm)	120	120		120	120	G 3/4 A
	p <sub>max</sub> (bar)	500	500		400	400	

## Additional versions

- Type RK/RB and RC with housing for in-line installation
- Type RK/RB, RC, and RE also available with metric thread

## Order examples

RK 1	RB 2	RC 1	RE 4	ER 31
Screw-in check valve	Screw-in check valve	Screw-in check valve	Screw-in check valve	Check valve insert
type RK, size 1	type RB, size 2	type RC, size 1	type RE, size 4	type ER, size 31

1) Type ER is a valve insert

Type RK..



Type RB..

+

SW

−<sup>B</sup>₩Ò



F

## Type ER...



All dimensions in mm,

subject to change without notice!

Basic type	L	G 1)	SW	m (g)
RK 0 / RB 0	7.2	G 1/8 A	a/f 4	5
RK 1 / RB 1	10	G 1/4 A	a/f 7	5
RK 2 / RB 2	11.5	G 3/8 A	a/f 6	15
RK 3 / RB 3	13.5	G 1/2 A	a/f 8	15/20
RK 4 / RB 4	17	G 3/4 A	a/f 12	35/40

Basic type	L	G <sup>1</sup> )	SW	m (g)
RC 1	13	G 1/4 A	a/f 4	6
RC 2	15	G 3/8 A	a/f 5	13
RC 3	18	G 1/2 A	a/f 8	24
RE 0	5	G 1/8 A	a/f 4	2
RE 1	6	G 1/4 A	a/f 5	4
RE 2	7	G 3/8 A	a/f 8	6
RE 3	7.5	G 1/2 A	a/f 10	10

G 3/4 A

a/f 12

18

Basic type	L	D	D1
ER 01	5.6	6.1	4.6
ER 11	5.5	8.1	6.5
ER 21	8	14	10.5
ER 31	10	17	13
ER 41	17.5	28	21

9

1) G = BSPP

RE 4

## **Further information**

Check valve inserts type ER	D 7325
Check valves type RE	D 7555 R
type RC	D 6969 R
type RK, RB	D 7445
type CRK, CRB	D 7712
type B	D 1191

<ul> <li>Restrictor check valves</li> </ul>	type BE	D 7555 B
	type BC	D 6969 B
<ul> <li>Orifice inserts type EB</li> </ul>		D 6465

• See also section "Devices for special applications"

(Screw-in valves and installation kits, Devices for up to 700 bar)

For page and section of the devices additionally listed, see type index



В

F

Type RC.. (arbitrary installation direction)

Type RE..





## **Check valves type CRK and CRB**

The check valves type CRK and CRB are used to block the flow in one direction and allow free flow in the opposite direction.

The check valve type CRK is a spring pre-loaded ball seated valve and is intended to block the flow into the manifold. Whereas type CRB is a shim type check valve, intended to block the flow out of the manifold. Both types can be screwed in mounting holes which can be easily machined with a standard drill (point angle 118°).

These mounting holes can be easily blocked by means of two different plugs.

Nomenclature:	Check valve
Design:	Screw-in valve
p <sub>max</sub> :	500 bar
Q <sub>max</sub> :	30 80 lpm



## Basic types and general parameters

Basic type	Flow	Oper. pressure	Mounting	Sym	npol
and size	Q <sub>max</sub> (lpm)	p <sub>max</sub> (bar)	thread	CRK	CRB
CRK 1 / CRB 1	30	500	M 16 x 1.5	·	
CRK 2 / CRB 2	50	500	M 20 x 1.5	Å	$\downarrow^{B}$
CRK 3	80	500	M 24 x 1.5	$\bigvee_{A}$	₩ <sub>A</sub>

## Additional versions

- Tapped plug
- Tapped plug (blocking also internal ducts)

## Order examples

CRK 1 Check valve type CRK, size 1

## CRB 2

Check valve type CRB, size 2

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## Dimensions



All dimensions in mm, subject to change without notice!

## **Further information**

• Check valves type CRK, CRB type RK, RB type RC

D 7712
D 7445
D 6969 R

• See also section "Devices for special applications" (Screw-in valves and installation kits, Devices for up to 700 bar)

For page and section of the devices additionally listed, see type index

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## **Check valves type B**

These check valves type B are available in three housing designs enabling in-line installation for any requirement. It is also possible to use these valves as foot valves in the suction line of pumps due to their low response pressure.

Nomenclature:	Check valve
Design:	Individual valve for in-line installation
p <sub>max</sub> :	500 bar
Q <sub>max</sub> :	15 160 lpm



## Basic types and general parameters

Basic type	Size	Flow Q <sub>max</sub> (Ipm)	Oper. pressure p <sub>max</sub> (bar)	Connection thread (BSPP)	Symbol
	- 1	15	Т	G 1/4 (A)	
	- 2	20		G 3/8 (A)	
B 1	- 3	30		G 1/2 (A)	
B 2	- 4	45	500	G 3/4 (A)	-0+-
В 3	- 5	75		G 1 (A)	
	- 6	120		G 1 1/4 (A)	
	- 7	160		G 1 1/2 (A)	

- Additional versions
  - Version with open-up pressure 3 bar

## Order examples

B 1 - 2

Check valve type B, housing design 1, size 2

## B 2 - 4

Check valve type B, housing design 2, size 4

B3-5

Check valve type B, housing design 3, size 5

Туре В1 - ..

Туре В 2 - ..

Туре ВЗ - ..







All dimensions in mm, subject to change without notice!

Basic type	Size	L	SW	G	G1	m (kg)	
				(BSPP)	(BSPP)		
	- 1	50 60	a/f 19	G 1/4	G 1/4 A	0.11	
	- 2	58 67	a/f 24	G 3/8	G 3/8 A	0.16	
B 1	- 3	60 66	a/f 27	G 1/2	G 1/2 A	0.19	
B 2	- 4	70 78	a/f 36	G 3/4	G 3/4 A	0.36	
B 3	- 5	94 114	a/f 41	G 1	G1A	0.65	
	- 6	110 130	a/f 55	G 1 1/4	G 1 1/4 A	1.3	
	- 7	115 136	a/f 60	G 1 1/2	G 1 1/2 A	1.5	

## **Further information**

- Check valves type B
  - type RE type RC type RK, RB

D 1191 D 7555 R D 6969 R D 7445

• See also section "Devices for special applications" (Devices for up to 700 bar)



# Screw-in check valves with hydraulic release type CRH and RHC

The screw-in check valves with hydraulic release type CRH and RHC are used in hydraulic circuits together with design related, leaking directional valves, as a hydraulically actuated drain, or idle circulation valves. The valves type RHC with or without pre-release (for high pressure and high consumer flows) are designed as screw-in valves. Type CRH valves are designed as a valve cartridge. Many different versions are available to cover all requirements.

Both types can be screwed in mounting holes which can be easily

machined with a standard drill (point angle 118°).

Nomenclature:	Check valve with hydraulic release
Design:	Screw-in valve
Actuation:	Hydraulic
p <sub>max</sub> :	400 500 bar
Q <sub>max</sub> :	8 200 lpm

## Basic types and general parameters

Basic type and size	Flow Q <sub>max</sub> (lpm)	Oper. pressure p <sub>max</sub> (bar)	Release ratio p <sub>A</sub> / p <sub>Z</sub>	Mounting thread	Symbol
CRH 1	T 30	500	2.6	M 16 x 1.5	T
CRH 2	50	500	2.6	M 20 x 1.5	
CRH 3	80	500	2.5	M 24 x 1.5	
RHC 1	15	500	2.6	M 16 x 1.5	
RHC 3	25	500	2.6	M 20 x 1.5	$\downarrow \bigcirc \frac{1}{2}$
RHC 3	55	500	2.5	M 24 x 1.5	
RHC 4	100	500	2.5	M 30 x 1.5	
RHC 5	150	400	2.8	M 36 x 1.5	
RHC 6	200	400	2.5	M 42 x 1.5	

## Additional versions

- $\bullet$  Valve types with differing release ratio (approx. 4.2 : 1)
- Valve types with additional seals for the actuation piston and mounting thread
- Valve types with hydraulically assisted actuation piston, tolerant to residual pressure in the return duct (type RHCE)
- Valve types with pre-release

## Order examples

## CRH 3

Check valve with hydraulic release type CRH, size 3

## RHC 5

Check valve with hydraulic release type RHC, size 5

Type CRH

## SW1 SW2



## Type RHC



All dimensions in mm, subject to change without notice!

Basic type	Mounting thread	L	SW1	SW2	m (g)
CRH 1	M 16 x 1.5	47	a/f 8	a/f 22	60
CRH 2	M 20 x 1.5	53	a/f 10	a/f 24	90
CRH 3	M 24 x 1.5	61	a/f 12	a/f 30	150
RHC 1	M 16 x 1.5	32	a/f 6		20
RHC 2	M 20 x 1.5	37.5	a/f 8		40
RHC 3	M 24 x 1.5	47	a/f 10		70
RHC 4	M 30 x 1.5	56	a/f 12		140
RHC 5	M 36 x 1.5	67.5	a/f 14		250
RHC 6	M 42 x 1.5	97	a/f 19		500

## **Further information**

Check valves with hydraulic release	type CRH	D 7712
	type RHC	D 7165
	type RHV	D 3056
	type HRP	D 5116
	type RH	D 6105

• See also section "Devices for special applications" (Screw-in valves and installation kits, Devices for up to 700 bar)

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The check valves type HR with hydraulic release, are designed as manifold mounting valves and are available in six sizes. These valves are used in hydraulic circuits with design related, leaking directional valves, as hydraulically actuated drain, or idle circulation valves. The check valve type HRP can be ordered also with a pre-release to suppress decompression surges for circuits with high pressure and high consumer flows. This valve is tolerant to residual pressure in the return duct (port B) as the rear side of the actuation piston is depressurized via a leakage port. Another option allows opening of the check valve via the load pressure on the consumer side, controlled by a directly mounted solenoid valve.

Nomenclature:	Check valve with hydraulic release
Design:	Individual manifold mounting
Actuation:	Hydraulic
p <sub>max</sub> :	700 500 bar
Q <sub>max</sub> :	20 400 lpm



## Basic types and general parameters

Basic type and size	Flow Q <sub>max</sub> (lpm)	Pressure p <sub>max</sub> (bar)	Release ratio p <sub>A</sub> / p <sub>Z</sub>	Symbol
HRP 1	20	700	2.9	
HRP 2	35	700	3.9	
HRP 3	50	500	4.3	
HRP 4	80	500	3.8	"      
HRP 5	140	500	4.0	
HRP 7 V	400	500	3.0	

## Additional versions

- Check valve with pre-release type HRP..V
- $\bullet$  Orifice inserts installed in port Z to prevent decompression surges
- Check valve with directly mounted 3/2-way directional solenoid valve enabling arbitrary release

## Order example

## HRP 5

Check valve with hydraulic release type HRP, size 5



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Basic type	L	В	н	m (kg)
HRP 1	74.5	25	20	0.25
HRP 2	78	30	25	0.4
HRP 3	83	35	35	0.7
HRP 4	103.5	50	35	1.2
HRP 5	110.5	60	40	1.9
HRP 7 V	190	100	63	8.0

All dimensions in mm, subject to change without notice!

## **Further information**

А

• Check valves type HRP

• See also section "Devices for special applications" (Devices for up to 700 bar)

D 5116



The check valves with hydraulic release type RH and DRH are used for blocking one or two consumer lines, as hydraulically actuated drain valves, or idle circulation valves. The valves may be optionally equipped with a pre-release, for one or both connection sides, to prevent decompression surges in the event of high pressure and high consumer flows. The type DRH has many variations and options such as in-line design, manifold mounting design, shock valves, pressure limiting valves to prevent slow pressure rises, and a leakage port to prevent unintended opening of the valve due to pressure rises, caused be leaking spool valves.



Nomenclature:	Check valve with
	hydraulic release
Design:	Individual valve for in-line installation Manifold mounting valve
Actuation:	Hydraulic
p <sub>max</sub> :	700400 bar
Q <sub>max</sub> :	15160 lpm

## Basic types and general parameters

Basic type and size	Flow Q <sub>max</sub> (lpm)	Oper. pressure p <sub>max</sub> (bar)	Release ratio	Tapped p (BSPF	oorts ?)	Symbol
			р <sub>А(В)</sub> / р <sub>Z</sub>	A, B, C, D	z	
RH 1	15	700	2.7	G 1/4	T T	
RH 2	35	700	3	G 3/8		
RH 3	55	500	2.4	G 1/2	G 1/4	Z¦≹¦
RH 4	100	500	2.4	G 3/4		B
RH 5	160	500	3	G1		
DRH 1	16	500	2.5	G 1/4		
DRH 2	30	500	2.5	G 3/8		AL IB
DRH 3	60	500	2.5	G 1/2		$\diamond \diamond$
DRH 4	90	400	2.5	G 3/4		CI D
DRH 5	140	400	2.5	G1		

## **Additional versions**

- Check valves with release and pre-release type RH.V
- Double check valve with shock valves suited for hydraulic motors to prevent slow pressure rises
- Manifold mounting double check valve type DRH3P

## **Order examples**

RH 2

Releasable check valve type RH, size 2

• Double check valves with leakage port to prevent unintended opening of the valve due to pressure rises, caused be leaking spool valves.

Type RH..

Type DRH..



All dimensions in mm, subject to change without notice!



Basic type	L	а	b	SW	m (kg)
RH 1	84	31.5	27	a/f 24	0.4
RH 2	90	32	28.5	a/f 27	0.4
RH 3	100	36.5	31	a/f 32	0.6
RH 4	126	45	35.5	a/f 41	1.3
RH 5	143	52	38	a/f 46	1.8

Basic type	L	в	Н	с	m (kg)
DRH 1	70	45	20	8	0.5
DRH 2	89	60	30	10	1.2
DRH 3	115	60	30	13	1.6
DRH 4	150	70	40	15.5	2.9
DRH 5	195	80	50	17	5.5

## **Further information**

- Releasable check valves type RH
- Releasable double check valves type DRH
- Releasable check valves type RHV
  - type RHC type HRP type CRH

D 6105 D 6110 D 3056 D 7165 D 5116 D 7712

 See also section "Devices for special applications" (Devices for up to 700 bar)



## Check valves and pre-fill valves type F

The check and pre-fill valves type F utilize a spring pre-loaded valve head.

The check valves type F enable free flow in one direction and block the flow in the opposite direction.

This valve is used as a high flow valve (check valve with hydraulic release) in top ram presses for quickly draining and replenishing press cylinders during opening and closing in rapid traverse mode.

The smaller sizes may be equipped with a pre-release device as an option to prevent pressure surges during decompression (high volume and high pressure surge).



# Nomenclature:Check valve<br/>Check valve with<br/>hydraulic release<br/>(pre-fill valve)Design:Intermediate section<br/>between pipe flangesActuation:Hydraulic $\mathbf{p}_{max}$ :400 bar $\mathbf{Q}_{max}$ :100...7000 lpm

## Basic types and general parameters

Basic type and siz	e	Flow	Oper. pressure	Release ratio	Symbol
Check valve	Pre-fill valve	Q <sub>max</sub> (lpm)	p <sub>max</sub> (bar)	p <sub>A</sub> /p	_
F 25	F 25-12	100	400	4.3	Pre-fill valve
F 32	F 32-16	160	400	3.6	Z A
F 40	F 40-20	250	400	3.9	
F 50	F 50-25	400	400	4.2	
F 63	F 63-30	630	400	4.2	
F 80	F 80-36	1000	400	4.5	Check valve
F 100	F 100-45	1600	400	4.3	
F 125	F 125-60	2500	400	4.3	
F 160	F 160-76	4000	400	4.3	· · · · · · · · · · · · · · · · · · ·
F 200	F 200-100	7000	350	4.0	

## **Additional versions**

• Pre-fill valves with pre-release (size 25 bis 80)

• Servo-suction and return control valves type N used as simple check valves or as check valves with hydraulic release (response pressure may be lower or higher than in the main duct) for bottom ram presses

Order examples F 100 - 45

Pre-fill valve size 100

Check valve

Pre-fill valve





Basic type	_	D	H1	H2	НЗ	m	(kg)
F 25	F 25-12	83	26	36	43	1	1.1
F 32	F 32-16	93	27	45	55	1	1.2
F 40	F 40-20	108	28	48.5	60	1.4	1.7
F 50	F 50-25	128	29	59	72	2	2.4
F 63	F 63-30	143	33.5	69	83	2.8	3.4
F 80	F 80-36	169	38.5	83	97.5	4.4	5.2
F 100	F 100-45	212	44	97	118	9.9	11.7
F 125	F 125-60	248	51	127	155	15.8	19.6
F 160	F 160-76	310	70	182	233	43	50
F 200	F 200-100	420	150	250	300	114	120

All dimensions in mm, subject to change without notice!

## **Further information**

<ul> <li>Check valves and pre-fill valves type F</li> </ul>	D 6960
<ul> <li>Servo-suction and return control valves type N</li> </ul>	D 4416

• See also section "Devices for special applications" (Press controls)



## Line rupture safety valves type LB

The line rupture safety valves type LB are check valves. They are available as screw-in valves or with housing for in-line installation. The line rupture safety valves are best installed directly on the actuator (cylinder) which is to be safeguarded. This will prevent an uncontrollable, accelerated movement (drop) of a loaded cylinder when the hydraulic back-pressure is lost as a result of a rupture of the pressurized line or pipe connection.

When the flow through the valve increases above the pre-set limit, the flow forces will exceed the opposing spring force and the valve will block the flow immediately. The valve element in these valves is a shim.



There are two different versions available. One valve design completely blocks the flow when actuated, whereas the other one allows a minimum flow (via an orifice) to slowly drop the load.

Nomenclature:	Line rupture safety valve
Design:	Screw-in valve with housing for in-line installation
Adjustability:	Tool adjustable
p <sub>max</sub> :	500 bar
Q <sub>max</sub> :	4 160 lpm

## Basic types and general parameters

Basic type and size	Flow Q <sub>max</sub> (lpm)	Pressure p <sub>max</sub> (bar) ⁴	Connection thread (BSPP)		Symbol	
LB 1	4 25		G 1/4 (A)		Simplified	Detailed
LB 2	6.3 50	500	G 3/8 (A)	Standard	F wo B	
LB 3	16 80		G 1/2 (A)			
LB 4	25 160		G 3/4 (A)	with add. by-pass		F B
Available orifice	e diameters 0.5 / 0 depe	0.8 / 1.0 / 1.2 / nding on type	<b>/ 1.5 / 2.0</b> and size			

## Additional versions

• Line rupture safety valve with housing featuring a thread reduction for special applications

Order examples

## LB 4 C - 40

Line rupture safety valve size 4 as screw-in valve (coding C), factory set for a response flow of 40 lpm

Versions with metric and UNF thread

## LB 2 G - 25

Line rupture safety valve size 2 with housing (coding G), factory set for a response flow of 25 lpm
com

#### Dimensions

#### Screw-in valve type LB..C





Valve with housing type LB..F

G

#### Valve with housing type LB..G





Basic type	L	L1	L2	(BSPP)	SW	m (g) <sup>1</sup> )	
LB 1 (C, G, F)	17.5	48	50	G 1/4 (A)	a/f 19	6 / 70	All dimensions in mm, subject to change without notice
LB 2 (C, G, F)	21	52	58	G 3/8 (A)	a/f 22	12 / 100	
LB 3 (C, G, F)	25	60	65	G 1/2 (A)	a/f 27	21/170	
LB 4 (C, G, F)	30.5	72	78	G 3/4 (A)	a/f 36	45 / 375	

<sup>1</sup>) Dimensions for screw-in valve and versions with housing

#### **Further information**

• Line rupture safety valve type LB

D 6990

For page and section of the devices additionally listed, see type index

 See also section "Devices for special applications" (Industrial trucks, Hydraulics for mobile applications, Screw-in valves and installation kits)



# Shuttle valves type WV and WVC

Shuttle valves are stop valves with two inlets and one outlet. There is a ball in the inside of the valve, which can travel from one inlet to the other. It will automatically block the one inlet with the lower pressure. This way the higher inlet pressure is automatically led to the outlet port. The version type WV, which is for pipe connection, is integrated in a T-shaped standard pipe fitting. The version type WVC is designed as a screw-in valve.

Nomenclature:	Shuttle valve		
Design:	Individual valve for pipe mounting Screw-in valve		
p <sub>max</sub> :	315 bar		
Q <sub>max</sub> :	6 150 lpm		



#### Basic types and general parameters

Basic type and size	Flow Q <sub>max</sub> (Ipm)	Oper. pressure p <sub>max</sub> (bar)	External pipe Ø		Symbol	
WV 6 - S	6	T	6	T		
WV 8 - S	15		8			
WV 10 - S	25	315	10	Inlet	+ + + + + + + + + + + + + + + + + + +	Inlet
WV 12 - S	40		12			
WV 14 - S	60		14		Outlet	
WV 16 - S	100		16			
WV 18 - L	150		18	_		
WVC 1	6	315	(M 10 x 1.5)			

### **Additional versions**

• Screw-in shuttle valve type WVC 11

with thread seal

#### Order example

### WV 10 - S

Shuttle valve suited for pipe diameter 10 mm, heavy duty version (coding S)

#### Dimensions

Type WV ..

Type WVC 1





WV 6 - S         62         31         a/f 17         120           WV 8 - S         64         32         a/f 19         170           WV 10 - S         68         34         a/f 22         225           WV 12 - S         76         38         a/f 14         290           WV 14 - S         80         40         a/f 17         320           WV 16 - S         86         43         a/f 30         390           WV 18 - L         80         40         a/f 32         340	Basic type	L .	н	SW	m (g)
WV 8 - S         64         32         a/f 19         170           WV 10 - S         68         34         a/f 22         225           WV 12 - S         76         38         a/f 14         290           WV 14 - S         80         40         a/f 17         320           WV 16 - S         86         43         a/f 30         390           WV 18 - L         80         40         a/f 32         340	WV 6 - S	62	31	a/f 17	120
WV 10 - S         68         34         a/f 22         225           WV 12 - S         76         38         a/f 14         290           WV 14 - S         80         40         a/f 17         320           WV 16 - S         86         43         a/f 30         390           WV 18 - L         80         40         a/f 32         340	WV 8 - S	64	32	a/f 19	170
WV 12 - S         76         38         a/f 14         290           WV 14 - S         80         40         a/f 17         320           WV 16 - S         86         43         a/f 30         390           WV 18 - L         80         40         a/f 32         340	WV 10 - S	68	34	a/f 22	225
WV 14 - S         80         40         a/f 17         320           WV 16 - S         86         43         a/f 30         390           WV 18 - L         80         40         a/f 32         340	WV 12 - S	76	38	a/f 14	290
WV 16 - S         86         43         a/f 30         390           WV 18 - L         80         40         a/f 32         340	WV 14 - S	80	40	a/f 17	320
WV 18 - L         80         40         a/f 32         340	WV 16 - S	86	43	a/f 30	390
	WV 18 - L	80	40	a/f 32	340
<b>WVC 1</b> 16 a/f 5 7	WVC 1		16	a/f 5	7

All dimensions in mm, subject to change without notice!

#### **Further information**

• Shuttle valves type WV and WVC

D 7016

Z

• See also section "Devices for special applications" (Screw-in valves and installation kits)

For page and section of the devices additionally listed, see type index



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# **3. Hydraulic cylinders**

• Hydraulic clamps type HSE and HSA

**3-**4

100

3

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# Hydraulic clamps type HSE and HSA

Hydraulic clamps type HSE and HSA are single-acting power elements equipped with return springs, which are used in hydraulic fixtures where only a very restricted space is available for the generation of high forces with limited piston movement. The type HSE is designed as a screw-in cylinder whereas type HSA is manifold mounting. These clamps are available, depending on application with piston diameters between 12 and 40 mm and strokes between 2 and 25 mm. They are mainly used for clamping work pieces, slides and guides, indexing round tables and for bending punching and cutting purposes.

Nomenclature:	Hydraulic clamps		
Design:	Screw-in version Manifold mounting		
p <sub>max</sub> :	500 bar		
F <sub>max</sub> :	200 60000 N		



#### Basic types and general parameters

Basic type and size	Stroke (mm)	F <sub>max</sub> (N) with 500 bar	Oper. pressure p <sub>max</sub> (bar)	Mounting thread	Symbol
HSE 12	2 8	5500		M 20 x 1.5	T
HSE 16	3 12	10000		M 24 x 1.5	
HSE 20	4 20	15000	500	M 30 x 1.5	
HSE 24	5 20	23000		M 36 x 1.5	
HSA 32	20	40000			
HSA 40	25	60000			I

#### **Order examples**

### HSE 24 - 15

Hydraulic	SC
niston dia	mo

3

rew-in clamps type HSE, piston diameter 24 mm, stroke 15 mm

#### HSA 32 - 20

Manifold mounting hydraulic clamps type HSA, piston diameter 32 mm, stroke 20 mm

#### Dimensions

Type HSE ..



Type HSA ..



All dimensions in mm, subject to change without notice!

Basic type	H <sup>1</sup> )	G	SW	m (kg)	Basic type	H1 <sup>1</sup> )	Α	m (kg)
HSE 12	20.5 32.5	M 20 x 1.5	a/f 24	0.05 0.08	HSA 32	71	60	1.6
HSE 16	26.5 41.5	M 24 x 1.5	a/f 24	0.08 0.12	HSA 40	85	70	2.5
HSE 20	28.5 56	M 30 x 1.5	a/f 30	0.14 0.3				
HSE 24	34 65	M 36 x 1.5	a/f 36	0.25 0.5	<sup>1</sup> ) Plus stroke			

D 4711

#### **Further information**

• Hydraulic clamps type HSE and HSA

• See also section "Devices for special applications" (Hydraulics for clamping)

For page and section of the devices additionally listed, see type index



# 4. Hydraulic accessories

Pressure switches type DG	<b>4</b> -4
Hydraulic miniature accumulators type AC	4-6
Hydraulic accessories	4-8



# **Pressure switches type DG**

Electro-hydraulic pressure switches are devices, which, when set under pressure close or open electrical contacts. They are widely used in applications in which it is intended that, once a pre-set pressure is achieved and exceeded, an electrical switching command or signal should be triggered for further working cycles.

Many different versions (with pressure setting on a dial, with main and secondary switch, screw-on pressure switches) enable their use in many applications.

There is a design related difference of 8 ... 20 % between the upper switching point and the lower switching point. Only the electronic



pressure switch type DG 5 E gives provision to select two independant switch points. Type DT is an analogous pressure sensor.

Nomenclature:	Spring loaded pressure switch (piston type)
Design:	Manifold mounting version Screw-in version Version for pipe connection
p <sub>max</sub> :	4 700 bar

#### Basic types and general parameters

Basic type and size	Brief description	Adjustable pressure p <sub>max</sub> (bar) <sup>1</sup> )	Connection thread (BSPP)	Symbol
DG 1R	Adjustment via turn-knob at the dial	20 600	G 1/2 or G 1/4 A	
	Version with two pressure switches			>< 
DG 8	Main switch: Adjustment via turn-	20 600	G 1/2 or	~ ~
	knob at the dial	and	G 1/4 A	
	Secondary switch: Adjustment via	20 180		$7^{1}_{2}$
	set screw			
DG 33		200 700		
DG 34	Compact design for manifold	100 400	G 1/4 or	~
DG 35	mounting	20 250	G 1/4 A <sup>2</sup> )	۲ ۲ ۲
DG 365	Adjustment via set screw	12 170		
DG 36		4 12		
DG 5 E	Electronic pressure switch with two	0 250	G 1/4	
	switch points	0 400		<ol> <li>The max. operation pressure of 700 bar is not influenced by the max. se pressure</li> </ol>
DT1	Analogous pressure sensor	0 1000	G 1/4 A	<sup>2</sup> ) For versions with adapter only

#### **Additional versions**

- Pressure switches with bezel for switch board installation (DG 1)
- Pressure switches with various connection threads or connection pipe (DG 3.)
- Lockable adjustment knob (see also section "Further information")

#### **Order examples**

### DG 1 R

Pressure switch type DG 1, pressure range 40...160 bar

#### Dimensions

#### Type DG 1 R and DG

(see order examples)



Type DG 3 .. (see order examples)



Type DG 5E

D 5440

D 7065

D 7077

D 5440 E

D 5440 T

77

<u>∠</u>6¢

G1

approx. 35

35





Type DT1

G1/2A



# Basic type m (kg) DG 1 1.3 DG 8 1.35 DG 3.. 0.3 DG 5 E 0.25 DT 1 0.15

All dimensions in mm, subject to change without notice!

#### **Further information**

- Pressure switches type DG
- Fittings type X
- Fittings type X84
- Electronic pressure switch type DG 5E
- Analogous pressure sensor type DT 1

 See also section "Devices for special applications" (Hydraulics for clamping purposes, Press controls, Devices for up to 700 bar)

For page and section of the devices additionally listed, see type index

- Supply voltage 12V DC, 24V DC, 230V AC 50/60 Hz
- Combination with various fittings (see also section "Further information")

#### DG 35

80

Pressure switch type DG 3 including plug, pressure range 20...210 bar

40



The hydraulic miniature accumulators type AC are available in two different sizes. They are used for compensating temperature dependent volume variations, possible losses due to leakage, as source of pressurized oil for emergency actuations, or to dampen oscillations in circuits with pressure difference controlled devices.

It is possible to use a version with shut-off valve for applications with a system pressure above  $4 \times p_0$  (gas filling pressure)

These accumulators may be integrated in differing hydraulic systems e.g. hydraulic clamping systems, in various installation positions by means of a wide range of fittings.

Nomenclature:	Miniature diaphragm accumulator
Design:	Screw-in version
p <sub>max</sub> :	400500 bar
V <sub>o</sub> :	13 or 40 cm <sup>3</sup>



#### Basic types and general parameters



#### Additional versions

- Prolongations to increase the distance
- Fittings (see also "Further information")

### Order examples

#### ACS 13 - 1/4 - 50/110

Hydraulic miniature accumulator type ACS, with shut-off valve, size 13, connection thread G 1/4A, gas filling pressure 50 bar, set pressure for the shut-off valve 110 bar

#### AC 40 - 1/4 - 150

Hydraulic miniature accumulator type AC, size 40, connection thread G 1/4A, gas filling pressure 150 bar

#### **Dimensions**

### Type AC(S) 13 - 1/4

#### Type AC 40 - 1/4



#### **Further information**

• Hydraulic miniature accumulators type AC

- Fittings type X84
- Pressure gauges

D 7571 D 7077 D 7077

• See also section "Devices for special applications" (Hydraulic clamping systems)

For page and section of the devices additionally listed, see type index



# **Hydraulic accessories**

Many devices like e.g. pressure gauges, pressure switches, accumulators etc. are integrated in hydraulic circuits by means of fittings. A wide range of fittings enables mounting of these devices in all kind of installation positions to hydraulic power packs and valves from HAWE. Reducers help to combine them with other devices.

There are two types of filters, which serve to protect hydraulic devices, preferably directional valves from coarse so-called vagabond, contamination which occur sometimes. The screen filters are to restrain coarse particles whereas wire mesh filters should be used for hydraulic circuits with rather low flow only.







### **Fitting combinations Drawings and symbols** Consisting of: Miniature accumulator Pressure gauge Connector Type AC • Straight male stud fitting Connector Banjo fitting Barrel tee fitting Elbow fitting Barrel tee • Shut-off valve AVM 8 1) fitting Plug Straight male <sup>1</sup>) See also "Further information" stud fitting Shut-off valve Type AVM 8 X 84U - AC 40/100-9/400 Examples: X 84T Strainers and wire mesh filters Drawing and symbol BSPP thread Metric thread Screw-in strainer type HFC (hole-Ø 0.63) • Screw-in wire mesh filter disc type HFC.. F (filter fineness approx. 100 µm) Version with housing • Also available with housing Screw-in strainer or wire mesh filter disc **Order examples** HFC 1/4 F HFE 3/8 Screw-in wire mesh filter for ports G 1/4, Strainer with housing, hole- $\emptyset$ approx. 0.5 mm, filter fineness approx. 100 µm with connection thread G 3/8 (male and female) **Further information** • Reducers D 7235 D 845 • Strainers and wire mesh filters D 7690 • Fittings type X D 7065 • Shut-off valves type AVM 8 • Fitting combination type X84 D 7077 • See also section "Devices for special applications" (Hydraulics for clamping) For page and section of the devices additionally listed, see type index



# **5. Electronics**

- Electronic accessory components 5-4
- Programmable logical valve control type PLVC 5-6

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5



# **Electronic accessory components**

There is a wide range of electronic components for the control common on/off and proportional solenoids available. The range of e.g. electronic amplifiers as modules, cards, versions integra plug for single or twin solenoids or for pressure switches. A power supply for 230V DC / 24V DC solenoid valves is also av All these components are designed for HAWE solenoid valves.	Nomenclature:	Plugs     No special feature     (standard)     With rectifier circuit     With clamp diode     With LED     With economy circuit	
			<ul> <li>Amplifiers for proportional solenoids</li> </ul>
			<ul> <li>Power supplies</li> </ul>
		Design:	Plugs Modules with terminals Cards with terminals
	00		
Versions Pluge for solonoid valves (single and twin solonoids)			
Brief description	Application		
No special feature (standard)	For all application	ons with no special requ	uirements
Version with LED	Optical operatio	on control and EMC pro	tection
	(note prolonged	cut-off times)	
Version with clamp diode	For optimum EN	AC protection	
	(note prolonged	cut-off times)	
Version with economy circuit	Increased functi	ional security and prolo	nged service life of the solenoids
	by reducing the	voltage (pulse width m	odulation) after a defined period.
	Recommended	for use in areas with hi	gh ambient temperatures and/or
	for application v safety circuits)	vhere the solenoids are	permanently energized (e.g.
Version with rectifier circuit	Enabling use of	DC solenoids when a po	ower supply of 110V AC / 230V AC
	50/60 Hz is only	v available	

Plugs with no special feature (for DC mains) or versions with built-in rectifier for mains 110V AC / 230V AC 50/60 Hz are standard parts of delivery with any solenoid valve.

#### **Proportional amplifiers**

## Characteristic

• Maintains a constant current, largely independent of the supply voltage and temperature relate alternations of the coil resistance.

type EV 1 M 2-12/24(24/48)

type EV 1 G 1-12/24

- Improved EMC protection
- Enables use over a wide temperature range

#### Adjustable parameter

- $\bullet \ I_{max}$  and  $\ I_{min}$  setting
- Ramp time (up to 10 sec)
- Reference voltage for set point generator
- Dither amplitude and -frequency

Тур е	Brief description	Application
EV 1 SA	Built-in plug version	Simple design with low spatial requirements for all connectors with connection pattern conforming DIN 43650 Form A
EV 1 M EV 1 G	Module version (board only or built-in housing)	For installation in switch cabinets via terminals
EV 22 K	Card version	This card is able to control two proportional solenoids. May be individually installed in a card retainer or up to 3 in a module carrier

#### Mains supply for solenoid valves

Туре	Brief description		Application	
MNG	Mains supply for inlet 230V 50/60Hz and		Power supply for solenoid actuated hydraulic valves o	r electr. amplifiers
Further info	rmation	2		
• Plugs (con	nectors); Type overview	D 7163	• Electronic amplifiers type EV 22 K 1-12(24)	D 7817
• Economy of	circuits for actuation solenoids WG 230	D 7813	type EV 22 K 2-12/24	D 7817/1
• Economy of	circuit type MSE 28026	D 7832	<ul> <li>Progammable logical valve control type PLVC</li> </ul>	D 7845
<ul> <li>Plugs with</li> </ul>	economy circuit for 24V DC	D 7833	Mains supply 24V DC type MNG	D 7835
type MSD	4 P55		<ul> <li>Listing for combination possibilities</li> </ul>	P 7163-1
Electronic	amplifiers type EV 1 SA 1-24	D 7818	of valves and electronic accessories	

D 7831/1

D 7837

- Joystick type EJ D 7844
- See also section "Devices for special applications" (Proportional valves)



# Programmable logical valve control type PLVC

The programmable valve control type PLVC 16 is intended for the control of complex hydraulic circuits. Any kind of movement cycle with various pressure, speed, acceleration profiles (within predefined limits) can be controlled.

Analogous, digital and via CAN-Bus connected components (e.g. pressure sensors, joy-sticks, etc.) connected via cable or wireless can be utilized for control or closed loop tasks. This high degree of flexibility is achieved by:

- Modular concept with various extensions and add-on's (basic and extension module, diagnosis display, CAN-Bus-power relays)
- Flexible programming
- Various interfaces (RS 232, CAN-Bus)
- · Free parameter setting of all in- and outputs



Basic type and main parameter

Basic type

- · Remote diagnosis by means of modem and mobile telephone
- Software function blocks (PLC programs)
- Remote control module Main field of application is with machines for construction, lifting, logging, and machine tools, presses.

	-
Nomenclature:	Programmable valve control
Version:	Modular concept with • Basic module • Extension module • CAN-Bus power relays • Display • Software

PLVC 16	Hardware (Basic and extension module)
	- max. 24 digital inputs (for ending switches, pressure switch, keyboard etc.) and max. 32 outputs for prop. or on/off valves
	- max. 24 analogous inputs (for joy-sticks, potentiometers, sensors e.g. analogous pressure transducers) and 2 analogous outputs (010VDC)

- Power supply 10 ... 30V DC, max. 16 A
- Emergency stop signal for input and output plus stop function for external consumers (max. 10 A)
- 2 programmable ancillary voltage outputs (5, 8, 10, 12V DC, max. 500 mA, e.g. supply for potentiometers)
- 3 relay outputs

Main parameter

- Interface for CAN-Bus, RS 232 as well as diagnosis display
- 4 frequency inputs (for rotation sensor, rev. counter, etc.)
- Integrated radio control module (receiver) incl. emergency stop
- 1-digit display at the basic module, indicating malfunctions
- Software function packs (examples)
- Position indication
- CAN-Bus communication
- Position and flow control
- Malfunction indication
- Controller communication

It is additionally possible to adopt the control quickly to customer requirements via the PLC instruction list (IL), function block diagram (FBD) or ladder diagram (LD).

#### **Additional versions**

- CAN-Bus power relays (relays for high power consumers)
- CAN-Bus knot (to integrate non CAN-Bus capable components)
- Display (diagnosis)

#### Dimensions

#### Basic and extension module type PLVC 16



#### Additional information

- Programmable logical valve control type PLVC D 7845
- Prop. directional spool valves type PSL/PSV size 3
   D 7700-3
  - type PSL/PSV size 5 D 7700-5

type PSLF/PSVF size 3/5 D 7700-F

• See also chapter "Equipment for special applications" (Industrial trucks, Mobile hydraulics, Proportional valves)



# Appendix

Pressure fluids - notes for selection     (Eluid recommendations)	<b>A-</b> 4	
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**A-**4

# **Pressure fluids - notes for selection**

The operation behavior of a hydraulic application mainly depends on the quality of the utilized pressure fluid. The selection of the pressure fluid is determined by the operating conditions of the system such as:

- Temperature (see viscosity classification)
- Nomenclature (some pressure fluids may be unacceptable because of undesired reactions with metals, seals etc.)
- Kind of application (e.g. ecologically compatible pressure fluids)
- Associated field (use of already available pressure fluids)

# The following viscosity ranges and temperature ranges apply to HAWE equipment

Temperature range: Ambient: approx. -40...+80°C

(Attention: Air driven pumps type LP +5...+80°C)
Pressure fluid: -25...+80°C,
Taking into account viscosity range or additional restrictions.
Permissible temperature during start: -40°C (observe start-viscosity!), as long as the service temperature is at least 20K higher for the following operation
Biological degradable or fire inhibiting pressure fluids generally not over +60 ..+70°C.
min. approx. 4mm<sup>2</sup>/s,

max. approx. 1500mm<sup>2</sup>/s optimum service approx. 10...500mm<sup>2</sup>/s

# Pressure fluid

#### Mineral oils

- Pressure fluids HLP (DIN 51524 part 2)
- Pressure fluids HL (DIN 51524 part 1)

• Pressure fluids HVLP (DIN 51524 part 3)

#### • Undoped oil H

- e.g. Lubricating oils (DIN 51517 Part 1) - white oil (e.g. USDA H1)
- Special fluids for aviation (MIL H-5606) for off-shore applications (NATO H 540)
- Other mineral oils
   Engine oils type HD (e.g. DIN 51511)
   Automatic transmission fluid type ATF (AQA Suffix A)
   Oils for manual transmissions of vehicles (e.g. DIN 51512)

Test oil for diesel injection pumps

### Characteristics

Mineral oil with additives improving corrosion, oxidation and wear protection Mineral oil without wear protecting additives

Mineral oil with same additives as HLP, but with increased viscosity index for use in higher temperature ranges

Mineral oil without additives

Mineral oils are based as a rule on naphtenic based oil with wide temperature range

Mineral oils which basically were developed for other application purposes.

#### Unusual features / restrictions

#### Common hydraulic oil

Viscosity range:

No wear protection additives therefore not suitable for gear pumps.

HAWE-pumps type: Z, RZ, MP..-Z, HK..Z

Observe manufacturer's specifications for other devices!

Additives improving the viscosity index show drawbacks concerning e.g. shear strength (viscosity drop during load by 30%), fall out of water and air.

Use only, if temperature range requires this.

Observe fluid manufacturer's specification !

Only for systems for intermittent service (S2 or S3 operation), due to the missing additives (low lubricating characteristic). White oil is mainly used in systems for food processing.

Seals made of flour rubber FPM (e.g. Viton) might be required, depending on pressure fluid. Observe fluid manufacturer's specification !

More or less well suited pressure fluids. Observe whether it contains additives preventing corrosion and oxidation as well as material compatibility (especially with seals). Observe fluid manufacturer's specification !



# Ecologically compatible pressure fluids VDMA 24568 and 24569

Seed oil type HETG

 Polyethyleneglycol HEPG
 PEG-Polyethylene (may be solved in water)
 PPG-Polypropylene
 (can't be solved in water) Fluids based on seed oils e.g. rape or sunflower with additives show only low temperature strength (< 60...70°C)

Fluids based on Polyethyleneglycol (PAG) Similar qualities i.e. service life, lubricating characteristics and pressure resistance, like mineral oil Not suited for oil immersed hydraulic power packs type HC, MP, FP, HK, all valves with wet armature solenoids as well as control systems utilizing many throttles. Fluids type HETG show a tendency to gum, aging, and sticking at higher temperature (> 60...70°C). Their use should be avoided ! No restrictions with regard to the operation behavior, but it

- is harmful to standard enamel
- (does not apply to two-pot enamel)
- will clog cellulose filters
   (use only glass fiber or metallic filters)!
- shows bad lubrication characteristic with material pairings steel / light alloy or brass
- is not suitable for pumps type HC, MP, FP, HK, RZ, Z and connection blocks with filter type A.F., AF, BF, EF, FF

No restrictions with regard to the operation behavior, but PVC will be softened, i.e. the fluid type HEES is not suitable in conjunction with PVC.

• Synthetical ester HEES (carbon acid ester, diester, polyester) Similar qualities i.e. service life, lubricating characteristics and pressure resistance, like mineral oil

#### Fire inhibiting pressure fluids conforming DIN 51502

HFA
 (pressurized water, emulsions)

Emulsion, oil solved in water (water content > 80%) max. temp. range approx. 60°C

• HFB

• HFC

• HFD

HFDR phosphoric ester

HFDU other composition

HFDS chlorinated hydrocarbon

HFDT blend of HFDR and HFDS

Emulsion, water solved in oil (water content > 40%) max. temp. range approx. 60°C Glycol / water solution (water content < 35%) max. temp. range approx. 60°C

Fluids without water content, similar

qualities like mineral oil

There is the danger of corrosion and cavitation due to the high water content, therefore only devices intended for it, should be used (some pump versions of type R, directional seated valves acc. to D 7300).
Max. oper. pressure of the pump 50...60% - danger of cavitation.
No use of oil immersed hydraulic power packs - danger of short-cuts - applies to pumps type HC, MP, FP, HK

No cellulose filters - danger of clogging -

See pressure fluid type HFA

As a rule only used in Great Britain

No restrictions with regard to the operation behavior, but it

- is harmful to standard enamel (does not apply to two-pot enamel)
- will clog cellulose filters (use only glass fiber or metallic filters)!
- shows bad lubrication characteristic with material pairings steel
   / light alloy or brass
- is not suitable for pumps type HC, MP, FP, HK, RZ, Z and connection blocks with filter type A.F., AF, BF, EF, FF

No restrictions with regard to the operation behavior, but it

- requires seals out of FPM (FKM) (see also section "Seals")
- Attention: Devices must be equipped with EPDM-seals when operated with SKYDROL

#### Special fluids

AT-Brake fluid

Brake fluid based on glycol (DOT 4)

No restrictions with regard to the operation behavior, but devices must be equipped with EPDM or SBR-seals when operated with brake fluid. (see also section "Seals")

#### Selection of the viscosity

The industrial standard "ISO Viscosity classification for liquid lubricants" (ISO 3448, DIN 51519) lists 18 viscosity classes, but only the viscosity classes ISO VG10 to ISO VG 68 are of common interest for hydraulic systems. The index No. behind ISO VG informs about the nom. viscosity at 40°C. The temperature behavior illustrated in the curve applies to mineral oil only. The behavior of HVLP and environmentally friendly fluids is less temperature dependent i.e. the curve is less steep.

The following points should be checked in the manufacturer's specification before selecting a fluid.:

- 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



#### 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)

- 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
- (temperature during start not lower than 20°C)

#### Filtration

Major malfunctions of a hydraulic system can be caused by contamination like fine wear particles and dust or bigger particles e.g. swarf, rubber from tubing or seals. Therefore the following filtration is recommended (after a thorough initial flushing):

Permissible contamination of the pressure fluid		Recommended	Devices		
ISO 4406	NAS 1638	SAE T 490	Filter separation		
			1	Radial piston and gear pumps,	
20/1718/15	12 8	≧6	β <sub>1625</sub> ≧ 75	valves, cylinders	
				(use in generally mechanical	
				engineering)	
17/1415/12	8 6	5 3	β <sub>616</sub> ≧ 75	Prop. pressure and flow control	
				valves	

The purity degree of the pressure fluid is especially important for the repeatability accuracy with proportional valves.

It is important to be aware that fresh fluid from the barrel does not always fulfill the highest standards of cleanliness.

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#### Service life

The aging of pressure 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.

The following points should be observed:

 Service temperature in the tank < 80°C (mineral oils, pressure fluids with low water content) Avoid higher temperatures - Service life reduction -(+10K △ half service life)

#### Change of the pressure fluid

Mixing different kinds of pressure fluid sometimes can cause unintended chemical reactions such as sludging, gumming etc.

The respective manufacturers should therefore always be consulted when

#### Seals

Any question about the compatibility with seal material should be settled with the fluid manufacturer always before using a certain pressure 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:

#### Storage of hydraulics components

The storing conditions for hydraulic components mainly depend on the used seal material and the test rig fluid which is on all internal parts. The storability of rubber materials is generally influenced by the following factors: - Warmth, light, humidity, oxygen, ozone. Any storage additionally should be, when possible, without any stress and deformation on the seal material. A storing temperature in the range of 15 to 20°C has proved as optimal. The relative atmospheric humidity should be kept at approx. 65% (+-10%). Any direct sunlight or another light source with strong UV quota has to be avoided. Ozone producing facilities (electric motors, high tension facilities) mustn't be apparent in the storeroom. If seals are packed in plastic bags, these should not contain any softeners and be impermeable for UV light if necessary. Details on the storage of sealing components can be found also in the following standards: DIN 7716/BS3F68:1977, MIL-HDBK-695C, MIL-STD-1523A, DIN 9088.

Hydraulic fluids can be stored usually in containers sealed by the manu-

- Circulation ratio of the pressure fluid  $\frac{Q_{pump} \left[ lpm \right]}{V_{circuit} \left[ l \right]}$  (guideline)
- approx. 0.2...0.4/min for conventional hydraulic power packs
- approx. ...1/min for mobile hydraulics
- approx. ...4/min for hydraulic power packs operated on/off or with idle circulation
- Control of the pressure fluid on a regular base (fluid level, contamination, coloring index, neutralization value etc.)
- Change of the pressure fluid on a regular base (depending on fluid type and application conditions)
- Guideline: approx. 4000 ... 8000 h (mineral oil)
  - approx. 2000 h (other pressure fluids)
  - or at least annually
- Take into account notes of the fluid manufacturer !

changing from one to another pressure fluid. The complete hydraulic system should be thoroughly flushed anyway.

- FPM (also FKM, fluor rubber, e.g. Viton) e.g. for fluids type HFD
- The coding ...-PYD should be added to the coding for HAWE devices, e.g. WN1H-G24-PYD
- EPDM (ethylen propylen rubber)
- e.g. for SKYDROL or brake fluid or

SBR (styrene-butadiene rubber)

- e.g. for brake fluid (not suitable for SKYDROL!)
- The coding ...-AT should be added to the coding for HAWE devices, e.g. WN1H-G24-AT

facturer for prolonged periods. In connection with oxygen from the air, dust and humidity more or less fast oxidation and gumming can occur depending on fluid brand and utilized additives.

It is recommended to store hydraulic components in a dark room where the suggested temperature and atmospheric humidity are roughly constant. The parts should be kept in plastic bags to protect them from dust and permanent air exchange. It is recommended to make a function test once per year to ensure proper function for the case that the part is required.

A half-yearly function test on-site as well as a routine inspection with seal replacement every two year should be undertaken at our facilities for all safety relevant components. The danger of corrosion can be neglected when the components are properly stored (see above). Extra protection is ensured by the galvanized/nitrided surface and the residuals of the test fluid.



# **Devices for special applications**

The complexity of the selection of the proper pump, valves and other components is increasing as the number of products available is rising and as the devices are getting more specialized. We have listed the devices on the following pages according to their function or their intended purpose. This selection should be used only as a rough guide for general applications and do not include all HAWE products available.

A brief description for most of these products may be found in the main sections of this product catalogue. More detailed information is contained in the corresponding supplemental pamphlets listed, which may be ordered from via our sales offices, representatives or directly from HAWE in Germany. Devices intended for the following applications:

- Hydraulics for clamping
- Press controls
- Industrial trucks
- Hydraulics for mobile applications
- Potentially explosive systems
- Use of HFA, emulsions or pressurized water

Devices with the following characteristics:

- Proportional valves
- Devices for system pressure from 500 to 700 bar
- Cartridge and screw-in valves
- Devices with unit approval or special listing (TÜV, GL, automotive industry)

#### Devices for clamping at machine tolls, jigs etc.

Nomenclature	_Q <sub>max</sub> (lpm)	_ p <sub>max</sub> (bar)	Pamphlet	Sect.	Page
Miniature hydraulic power packs type FP and FPX	2,1	700	D 7310	1.1	6
Compact hydraulic power packs type HC, HCW, and HCG	12,9	700	D 7900, D 7900G	1.1	8
Pumps complete with motor and hydraulic power packs	14,8/108	700/150	D 7200, D 7200H	1.1	10
type MP and MPW					
Compact hydraulic power packs type HK, HKF, and HKL	12,9/16	700/150	D 7600-4, D 7600-3,	1.1	14
			D 7600-3L,		
			D 7600-2		
Connection blocks some with reflow or pressurized filter type A, B	18	700	D 6905A,	1.1	18
and C, (for hydraulic power packs type HC, MP, FP and HK(F))			D 6905B, D 6905C,		
			D 6905TÜV,		
Two stage connection block type NA		700/120	D 6905A	1.1	18
Solenoid actuated directional spool valve type SW, SWR, SWS, SWP,	25	315	D 7450, D 7451, D 7451N,	2.1	12
and NSWP			D 7951		
Directional seated valves with different actuations type G, WG, H, P, K,	120	700	D 7300, D 7300Ex	2.2	4
T, F, and D					
Directional seated valves with different actuations type of NG, NWG,	12	500	D 7300N	2.2	4
NH, NP, NK, NT, NF, and ND (connection hole pattern NG 6)					
Directional seated valve banks type VB	120	700	D 7302	2.2	6
Directional seated valves type WH and WN	60	450	D 7470A/1	2.2	10

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Nomenclature	Q <sub>max</sub> (lpm)	p <sub>max</sub> (bar)	Pamphlet	Sect.	Page
Valve banks type BWH and BWN	60	450	D 7470B/1	2.2	12
Directional seated valves type VZP	15	450	D 7785A	2.2	16
Valve banks type BVZP	15	50	D 7785B	2.2	18
Valve banks type BA, BV	20	400	D 7788	1.1	22
2/2-, 3/2- a. 4/3-way directional seated valves type BVG, BVP, NBVP	50	400	D 7400, D 7765, D 7765N	2.2	24
Directional seated valves type VP	20	400	D 7915	2.2	24
4/3- a. 3/3-way directional seated valves type VH, VHR, and VHP	25	700	D 7647	2.2	34
Directly controlled pressure valves type MV, MVS, MVE, MVP, SV, SVC,	160	700	D 7000/1, D 7000E/1	2.3	4
MVCS, DMV, and DMVN assembly kits type MVF, MVH etc.					
Pressure limiting valve type CMV and CSV, for mounting in simple	60	500	D 7710MV	2.3	6
tapped holes					
Pressure limiting valves with unit approval type CMVX, for mounting in	28	500	D 7710TÜV	2.3	6
simple, tapped holes					
Pressure reducing valves type CDK, for mounting in simple, tapped	15	500	D 7745	2.3	18
holes					
Pressure reducing valve with tracked pressure switch type DK	15	400	D 7941	2.3	18
Idle circulation valves type CNE, for mounting in simple, tapped holes	30	75	D 7710NE	2.3	24
Switch-off valves type LV	25	350	D 7529	2.3	28
Fine throttle type FG	< 1	300	D 7275	2.4	14
Slot type throttle type Q, QR, and QV	80	400	D 7730	2.4	14
Prop. throttle type PB	20	300	D 7557/1	2.4	-
Hydraulic clamps type HSE and HSA		500	D 4711	3	4
Electro-hydraulic pressure switches type DG and DG 5E	(	800	D 5440, D 5440E	4	4
Pressure sensor type DT		1000	D 5440T	4	4
Hydraulic miniature accumulator type AC		500	D 7571	4	6
Fittings type X 84			D 7077	4	8
Device connectors with LED and clamp diode etc. type MSD, SVS,			D 7163	5	4
MSE, MSUD					
Economy circuit type MSD4 P53 and MSD4 P63 for solenoid valves			D 7813	5	4
with actuation solenoids type WG 230/115, 50/60 Hz					
Economy circuit type MSE 28026			D 7832	5	4
Economy circuit type MSD 4 P55 for solenoid valves with actuation so-			D 7833	5	4
lenoids type G24					
Mains supply type MNG			D 7835	5	4

#### Hydraulics for clamping especially for chucks of lathes or other consumers with design related leakage

Nomenclature	Q <sub>max</sub> (lpm)	p <sub>max</sub> (bar)	Pamphlet	Sect.	Page
Valve banks type BA	25	500	D 7788	1.1	22
Compact hydraulic power packs type HK, HKF, and HKL	12,9/16	700/150	D 7600-4, D 7600-3,	1.1	14
			D 7600-3L,		
			D 7600-2		
Connection blocks some with reflow or pressurized filter		700	D 6905A	1.1	18
type A	<b>_</b>				
Solenoid actuated directional spool valve type SWP and NSWP	25	315	D 7450, D 7451, D 7451N	2.1	12
Clamping modules type NSMD	25	100	D 7787	2.1	28
2/2- , 3/2- and 4/3-way directional seated valves type NBVP	20	400	D 7765	2.2	24

Appendix

# Press controls (top or bottom acting ram presses, or presses for laboratories, injection molds)

Nomenclature	Q <sub>max</sub> (lpm)	_ p <sub>max</sub> (bar)	Pamphlet	Sect.	Page
Two stage connection block type NA	T	700/120	D 6905A	1.1	18
Pumps complete with motor and hydraulic power packs	14,8/108	700/150	D 7200, D 7200H	1.1	10
type MP and MPW					
Hydraulic pumps type R and RG	91,2	700	D 6010, D 6010H,	1.2	4
			D 6010D, D 6010DB,		
			D 6010S		
InLine variable displacement axial piston pump type V30D	365	350 (420)	D 7960	1.2	8
Dual stage pumps type RZ	91,2/135	700/150	D 6910, D 6910H	1.3	4
Airdriven hydraulic pumps type LP	12	1500	D 7280, D 7280H	1.4	4
Hand pumps type H, HD, HE and DH		600	D 7147/1	1.5	4
Directional seated valves with different actuations type G, WG, H, P, K,	120	700	D 7300, D 7300Ex,	2.2	4
T, F, and D			D 7300H		
Directional seated valves with different actuations type of NG, NWG,	12	500	D 7300N	2.2	4
NH, NP, NK, NT, NF, and ND (connection hole pattern NG 6)					
Valve banks type VB	120	700	D 7302	2.2	6
Lift monitored seated valves	120	400	D 7300H	2.2	4
Switch units type CR	20/160	500/60	D 7150	2.2	28
Directly controlled pressure valves type MV, MVS, MVE, MVP, SV, SVC,	160	700	D 7000/1, D 7000 E/1	2.3	4
MVCS, DMV, and DMVN assembly kits type MVF, MVH etc., multiple			D 7000M, D 7000TÜV		
pressure limiting valves					
Piloted pressure valve type DV, DVE and DF	120	420	D 4350	2.3	8
Piloted pressure valve with check valve type AL, AE a. AS	120	350	D 6179	2.3	28
Prop. pressure limiting valve type PMV	120	700	D 7485/1	2.3	12
Prop. pressure valves type PDV	120	350	D 7486	2.3	12
Shut-off valve type LV	25	350	D 7529	2.3	28
Idle circulation valves type CNE, for mounting in simple, tapped holes	30	75	D 7710	2.3	24
Two stage valves type NE	25/180	700/60	D 7161	2.3	26
Blocking valves with pre-release type RHV	200	500	D 3056	2.5	-
Suction and reflow control valves type N and B	400	500	D 4416	2.5	-
Check valves and pre-fill valves type F	4000	400	D 6960	2.5	16
Electro-hydraulic pressure switches type DG, DG5E		800	D 5440, D 5440E	4	4

### Devices for industrial trucks and lifting equipment (e.g. stackers, lifting platforms etc.)

Nomenclature	Q <sub>max</sub> (lpm)	p <sub>max</sub> (bar)	Pamphlet	Sect.	Page
Solenoid actuated directional spool valve type SW, SWR, SWP, and	25	315	D 7450, D 7451,	2.1	12
SWS			D 7951		
Directional spool valves type WSR	25 / 40	315	D 6560WSR	2.1	-
Directional spool valves type DL and DLS	90	315	D 7260/1	2.1	20
Directional spool valves type DLSR	80	250	D 7260SR	2.1	20
Directional seated valves type EM and EMP	160	450	D 7490/1	2.2	22
Lifting/lowering valves type HSV, HZV	120	315	D 7032	2.2	26
Lifting modules type HMT and HMC	90	315	D 7650, Sk 7650B2,	2.2	30
			Sk 7650B33		
Lifting modules type HMB, HSN, HST, HMS, HMF, and HMR	90/100	315	Sk 7758HMT etc.	2.2	30

Nomenclature	_Q <sub>max</sub> (Ipm)	_ p <sub>max</sub> (bar)	Pamphlet	Sect.	Page
Directly controlled pressure valves type MV, MVS, SV, SVC, MVCS,	160	700	D 7000/1, D 7000E/1,	2.3	4
DMV, and DMVN assembly kits type MVF, MVH etc., multiple pressure			D 7000M		
limiting valves					
Pressure limiting valve type BMVD and BMVE	20	240	D 7184	2.3	-
Pre-loaded check valves type VR	120	300/15	D 7340	2.3	10
Load-holding valves type LHK and LHT	250	400	D 7100, D 7918	2.3	32
2-way flow control valves (drop-rate braking valves) type SB	400	315	D 6920	2.4	6
2-way flow control valves type DSJ	25	315	D 7825	2.4	6
2-way flow control valves type CSJ	10	315	D 7736	2.4	6
Flow divider with priority division type TV	60	300	D 7394	2.4	10
Emergency drain valve type BR		400	D 7854	2.4	-
Line rupture safety valves type LB	160	500	D 6990	2.5	18
Prop. amplifiers type EV22K			D 7817, D 7817/1	5	4
Prop. amplifiers type EV1M			D 7831/1	5	4
Prop. amplifiers type EV1G			D 7837	5	4
Programmable valve control type PLVC			D 7845	5	6
Devices for mobile applications (e.g. crane controls, ship building)					
Nomonolaturo	0 (lpm)	n (har)	Domoblet	Soot	Dago

## Devices for mobile applications (e.g. crane controls, ship building)

Nomenclature	Q <sub>max</sub> (lpm)	p <sub>max</sub> (bar)	Pamphlet	Sect.	Page
InLine variable displacement axial piston pump type V30D, V60N	365	350/420	D 7960, D 7960N	1.2	8
Air driven hydraulic pumps type LP	12	1500	D 7280, D 7280H	1.4	4
Hand pumps type H, HD, HE and DH		600	D 7147/1	1.5	4
Individual directional spool valves type SG and SP	100	400	D 5650/1	2.1	4
Actuations for directional spool valves type S (type RE, RD, BE, BD,			D 5870, D 6250,	2.1	4
NE., NU., ND., NM, KD., KM., A., C.,D., P., K., R., A., C.,Y., V., S., U.,			D 6511/1, D 7055		
W., X., P., BX., ZX, OX, TX., ME, MD, MU)					
Directional spool valves type SKP and SKH	100	400	D 7230	2.1	8
Directional spool valves type DL and DLS	90	315	D 7260/1	2.1	20
Prop. directional spool valves type SKS, SKV, SKG	120	315	D 5700, D 5700AM,	2.1	-
			D 5700H, D 5700K		
Prop. directional spool valves type PSL, PSV, PSLF, PSVF	160/210	420	D 7700-3, D 7700-5,	2.1	24
			D 7700-F		
Directly controlled pressure valves type MV, MVS, MVE, MVP, SV, SVC,	160	700	D 7000/1, D 7000E/1,	2.3	4
MVCS, DMV, and DMVN, assembly kits type MVF, MVH etc., multiple			D 7000M		
pressure limiting valves					
Pre-loaded check valves type VR	120	300/15	D 7340	2.3	10
Load-holding valves type LHK	100	400	D 7100	2.3	32
Load-holding valves type LHT	250	400	D 7918	2.3	32
Load-holding valves type LHDV	80	420	D 7770	2.3	32
Flow control valves type SD, SF, SK, SKR, and SU	130	300	D 6233	2.4	4
2-way flow control valves (drop-rate braking valves) type SB and SQ	400	315	D 6920	2.4	6
2-way flow control valves type SJ	15	315	D 7395	2.4	6
Flow divider type TQ	200	350	D 7381	2.4	10
Flow divider with priority division type TV	60	300	D 7394	2.4	10
Pressure sensor type DT		1000	D 5440T	4	4
Prop. amplifiers type EV22K			D 7817, D 7817/1	5	4
Prop. amplifiers type EV1M			D 7831/1	5	4
Prop. amplifiers type EV1G			D 7837	5	4
Plugs type MSD, SVS, MSE, MSUD with LED and clamp diode etc.			D 7163	5	4
Programmable valve control type PLVC			D 7845	5	6

### Devices for explosion hazardous areas

Nomenclature	Q <sub>max</sub> (lpm)	_ p <sub>max</sub> (bar)	Pamphlet	Sect.	Page
Hydraulic pumps type R and RG	91,2	700	D 6010, D 6010H,	1.2	4
			D 6010D, D 6010DB,		
			D 6010S		
Hydraulic power packs type Z	135	150	D 6820	1.2	4
Dual stage pumps type RZ	91,2/135	700/150	D 6910, D 6910H	1.3	4
Airdriven hydraulic pumps type LP	12	1500	D 7280, D 7280H	1.4	4
Solenoid actuated directional spool valve type SW, SWR, SWS, SWP,	25	315	D 7450, D 7451, D 7451N	2.1	12
and NSWP			D 7951		
Directional spool valve type HSRL 3	80	400	Sk 7493RL	2.1	16
Prop. directional spool valves type PSL, PSV, PSLF, and PSVF	210	420	D 7700-3, D 7700-5,	2.1	24
			D 7700-F		
Directional seated valves with pneumatic actuation type P	65	700	D 7300, D 7300N	2.2	4
Directional seated valves with explosion-proof design (Ex) sG4	65	700	D 7300Ex	2.2	4
Valve banks type VB, pneumatically actuated	65	700	D 7302	2.2	6
2/2- a. 3/2-way directional seated valves type BVG, BVP, and NBVP	20	400	D 7400, D 7765, D 7765N	2.2	24
2/2-, 3/2-, 4/2-way directional seated valves type VP	20	400	D 7915	2.2	24
Lifting/lowering valves type HSV	30	315	D 7032	2.2	26

#### **Proportional valves**

Nomenclature	Q <sub>max</sub> (lpm)	p <sub>max</sub> (bar)	Pamphlet	Sect.	Page
Connection blocks type AP		700	D 6905A	1.1	18
Directional spool valve banks type SKS, SKV, and SKG	120	315	D 5700, D 5700AM,	2.1	-
			D 5700H, D 5700K		
Solenoid actuated directional spool valve type SWS	25	315	D 7951	2.1	12
Prop. directional spool valves type PSL, PSV, PSLF, PSVF	160/210	420	D 7700-3, D 7700-5,	2.1	24
			D 7700-F		
Valve banks type BVZP1FEH	15	450	D 7785B	2.2	18
2/2-way directional seated valve with prop. throttle function type EMP	60	400	D 7490/1	2.2	22
Prop. pressure limiting valve type PMV	120	700	D 7485/1	2.3	12
Prop. pressure valves type PDV	120	350	D 7486	2.3	12
Prop. pressure reducing valves type PDM	120	400/350	D 7486, D 7584/1	2.3	22
Prop. pressure valves type PDVE	120	350	D 7486	2.3	12
Prop. pressure reducing valves type PM and PMZ	< 2	40/19	D 7625	2.3	20
Prop. flow control valves type SE and SEH	90	300	D 7557/1	2.4	8
Prop. throttle type PB	20	300	D 7557/1	2.4	-
Pressure sensor type DT		1000	D 5440T	4	4
Prop. amplifiers type EV22K			D 7817, D 7817/1	5	4
Prop. amplifiers type EV1SA			D 7818	5	4
Prop. amplifiers type EV1M			D 7831/1	5	4
Prop. amplifiers type EV1G			D 7837	5	4
Programmable valve control type PLVC			D 7845	5	6

# Devices for HFA, emulsions and pressurized water

Nomenclature	Q <sub>max</sub> (lpm)	p <sub>max</sub> (bar)	Pamphlet	Sect.	Page
Hydraulic pumps type RHFA, RGHFA	91,2	700	D 6010 ++.	1.2	4
Directional seated valves with different actuations type G, WG, H,	120	500	D 7300, D 7300Ex,	2.2	4
P, K, T, F, and D (version for HFA)			D 7300N		
Valve banks type VB (version for HFA)	120	500	D 7302	2.2	6

### Devices for operating pressure of 500...700 bar

Nomenclature	Q <sub>max</sub> (lpm)	p <sub>max</sub> (bar)	Pamphlet	Sect.	Page
Miniature hydraulic power packs type FP and FPX	2,1	700	D 7310	1.1	6
Compact hydraulic power packs type HC and HCW	12,9	700	D 7900, D 7900G	1.1	8
Pumps complete with motor and hydraulic power packs type MP and MPW	14,8/108	700/150	D 7200, D 7200H	1.1	10
Compact hydraulic power packs type HK, HKF, and HKL	12,9/16	700/150	D 7600-4, D 7600-3,	1.1	14
			D 7600-3L, D 7600-2		
Connection blocks some with reflow or pressurized filter type A, B, C			D 6905A,	1.1	18
(for hydraulic power packs type HC, MP, FP, and HK)	_		D 6905B, D 6905C		
Two stage connection block type NA	_	700/120	D 6905A	1.1	18
Hydraulic pumps type R and RG	91,2	700	D 6010, D 6010H, D 6010D,	1.2	4
			D 6010DB, D 6010S		
Hydraulic power packs type R with DC-motor	ca. 19	700	D 6010G	1.2	4
Dual stage pumps type RZ	91,2/135	700/150	D 6910, D 6910H	1.3	4
Dual stage pumps type RF (with 2-hole SAE flange suited for direct	30,4/	700/	D 7410	1.3	4
mounting of an additional pump)	_				
Airdriven hydraulic pumps type LP	12	1500	D 7280, D 7280H	1.4	4
Hand pumps type HE	_	600	D 7147/1	1.5	4
Directional seated valves with different actuations type G, WG, H, P, K,	25	700	D 7300, D 7300Ex	2.2	4
T, F, and D	-				
Directional seated valves with different actuations type NG, NWG, NH,	12	500	D 7300N	2.2	4
NP, NK, NT, NF, and LP (connection hole pattern NG 6)	_				
Directional seated valve banks type VB	25	700	D 7302	2.2	6
Switch units type CR	20/160	500/60	D 7150	2.2	28
4/3- and 3/3-way directional seated valves type VH, VHR, VHP	25	700	D 7647	2.2	34
Single and double acting shut-off valves type DA	150	500	D 1741	2.2	36
Miniature pressure limiting and sequence valves type MVG, MVE, MVP	8	700	D 3726	2.3	4
Directly controlled pressure valves type MV, MVS, MVE, MVP, SV, SVC,	70	700	D 7000/1, D 7000E/1	2.3	4
MVCS, DMV, and DMVN, assembly kits type MVF, MVH etc.					
Pressure limiting valve for manifold mounting type SVP	80	700	D 7722	2.3	-
Pressure limiting valve type CMV and CSV, for mounting in simple,	60	500	D 7710MV	2.3	6
tapped holes					
Pressure limiting valve with unit approval type CMVX, for mounting in	28	500	D 7710TÜV	2.3	6
simple, tapped holes					
Prop. pressure limiting valve type PMV	120	700	D 7485/1	2.3	12
Pressure reducing valve type CDK, for mounting in simple, tapped	15	500	D 7745	2.3	18
holes					
Dual stage valve type NE	25/180	700/60	D 7161	2.3	26
Idle circulation valves type CNE, for mounting in simple, tapped holes	30	500/75	D 7710NE	2.3	24
Pressure dependent shut-off valves type DSV	60	600	D 3990	2.3	30
Pressure dependent shut-off valves type CDSV, for mounting in	10	600	D 7876	2.3	30
simple, tapped holes					
By-pass check valves type BC	60	700	D 6969B	2.4	12
Restrictor check valves and check valves type BE	120	500	D 7555B	2.4	12
Throttle and shut-off valves type AV	100	500	D 4583	2.4	18
Shut-off valves type AVT and AVM	80	630	D 7690	2.4	18
Throttle and shut-off valves type CAV, for mounting in simple, tapped	50	500	D 7711	2.4	18

holes

Nomenclature	Q <sub>max</sub> (lpm)	_ p <sub>max</sub> (bar)	Pamphlet	Sect.	Page
Suction and reflow control valves type N	400	500	D 4416	2.5	T _
Check valves type RC	60	700	D 6969R	2.5	4
Check valves inserts type ER and EK	120	500	D 7325	2.5	4
Check valves inserts type RK and RB	120	700	D 7445	2.5	4
Check valves inserts type RE	120	500	D 7555R	2.5	4
Blocking valves type CRK, CRB, for mounting in simple, tapped holes	80	500	D 7712	2.5	6
Check valves with pre-release type RHV	200	500	D 3056	2.5	-
Check valves type B	160	500	D 1191	2.5	8
Check valve inserts with hydraulic release type RHC and RHCE	200	500	D 7165	2.5	10
Check valves type CRH, for mounting in simple, tapped holes	55	500	D 7712	2.5	10
Check valves with hydraulic release type HRP	140	700	D 5116	2.5	12
Check valves with hydraulic release type RH	160	700	D 6105	2.5	14
Twin check valves with release type DRH	140	500	D 6110	2.5	14
Suction and reflow control valves type N	400	500	D 4416	2.5	-
Line rupture safety valves type LB	160	500	D 6990	2.5	18
Hydraulic clamps type HSE and HSA		500	D 4711	3	4
Electro-hydraulic pressure switches type DG, DG5E		800	D 5440, D 5440E	4	4
Pressure sensor type DT		1000	D 5440T	4	4
Hydraulic miniature accumulator type AC		500	D 7571	4	6

# Screw-in valves and installation kits

				-	0
Screw-in valves and installation kits					
Nomenclature	Q <sub>max</sub> (lpm)	p <sub>max</sub> (bar)	Pamphlet	Sect.	Page
Solenoid actuated 2/2-way directional seated cartridge valves type EM and EMP	160	450	D 7490/1	2.2	22
Solenoid actuated 2/2-, 3/2-way directional seated valve type BVE	60	400	D 7921	2.2	24
Miniature pressure limiting and sequence valves type MVE	8	700	D 3726	2.3	4
Directly controlled pressure valves type MVE, assembly kits type MV.	160	700	D 7000/1,	2.3	4
Pressure limiting value type CMV and CSV for mounting in simple	60	500	D 7000E/1	03	6
tapped holes	00	300		2.0	0
Pressure limiting valves type CMVX with unit approval, for mounting in simple, tapped holes	28	500	D 7710TÜV	2.3	6
Miniature pressure reducing valves type ADC, AM , ADM, and ADME	8	300/70	D 7458	2.3	14
Pressure reducing valves type CDK, for mounting in simple, tapped holes	15	500	D 7745	2.3	18
Prop. pressure reducing valves type PM	< 2	40/19	D 7625	2.3	20
Idle circulation valves type CNE, for mounting in simple, tapped holes	30	500/75	D 7710NE	2.3	24
Pressure dependent shut-off valves type CDSV, for mounting in	10	600	D 7876	2.3	30
simple, tapped holes	····-				
Load-holding valves type LHKE and LHTE	120	420	D 7100, D 7918	2.3	32
2-way flow control valves (drop-rate braking valves) type SB and SQ	400	315	D 6920	2.4	6
2-way flow control valves type SJ	15	315	D 7395	2.4	6
2-way flow control valves type DSJ	25	315	D 7825	2.4	6
2-way flow control valves type CSJ	10	315	D 7736	2.4	6

Nomenclature	Q <sub>max</sub> (lpm)	p <sub>max</sub> (bar)	Pamphlet	Sect.	Page
Orifice inserts type EB	120	500	D 6465	2.4	12
By-pass check valves type BC	60	700	D 6969B	2.4	12
By-pass check valves type BE	120	500	D 7555B	2.4	12
Throttle type FG	< 1	300	D 7275	2.4	14
Slot type throttle type Q, QR, and QV	80	400	D 7730	2.4	14
Throttle and shut-off valves type AV.E	100	500	D 4583	2.4	18
Throttle and shut-off valves type CAV, for mounting in simple, tapped	50	500	D 7711	2.4	18
holes					
Check valves type RC	60	700	D 6969R	2.5	4
Check valves inserts type ER and EK	120	500	D 7325	2.5	4
Check valves inserts type RK and RB	120	700	D 7445	2.5	4
Check valves inserts type RE	120	500	D 7555R	2.5	4
Check valves type CRK, CRB, for mounting in simple, tapped holes	80	500	D 7712	2.5	6
Screw-in check valves with hydraulic release type RHC and RHCE	200	500	D 7165	2.5	10
Check valves with hydraulic release type CRH, for mounting in simple,	55	500	D 7712	2.5	10
tapped holes					
Line rupture safety valves type LB	160	500	D 6990	2.5	18
Shuttle valves Typ WVC	6	315	D 7016	2.5	20
Hydraulic clamps type HSE		500	D 4711	3	4
Electro-hydraulic pressure switches type DG, DG5E		800	D 5440, D 5440E	4	4
Pressure sennsor type DT		1000	D 5440T	4	4
Hydraulic miniature accumulator type AC		500	D 7571	4	6
Pressure resistant screen filters type HF	100		D 7235	4	8

# Devices with unit approval (TÜV), specimen approval (German Lloyd), or for automotive industry

Nomenclature	Q <sub>max</sub> (lpm)	p <sub>max</sub> (bar)	Pamphlet	Sect.	Page
Unit approval by TÜV (German test organization)		T	T	T	
Pressure limiting valve with unit approval in connection blocks type A	x		D 6905TÜV	1.1	18
(for hydraulic power packs type HC, MP, FP, and HK)					
Pressure limiting valves with unit approval type MV.X	80	450	D 7000TÜV	2.3	4
Pressure limiting valves with unit approval type CMVX, for mounting	28	500	D 7710TÜV	2.3	6
in simple, tapped holes					

### Specimen approval by German Lloyd

Individual directional spool valves type SG and SP	100	400	D 5650	2.1	4
Directly controlled pressure valves type MV, MVS, MVE, MVP, SV, SVC,	70	700	D 7000/1, D 7000E/1	2.3	4
MVCS, DMV, and DMVN, assembly kits type MVF, MVH etc.			D 7000M		
Piloted pressure reducing valves type VDM	120	400	D 5579	2.3	16
Pressure reducing valves type ADM	60	300/250	D 7120	2.3	16
Load-holding valves type LHK	100	400	D 7100	2.3	32
Flow control valves type SD, SF, SK, SKR	130	300	D 6233	2.4	4
2-way flow control valves (drop-rate braking valve) type SB and SQ	400	315	D 6920	2.4	6
Throttles and by-pass check valves type ED, RD, and RDF	150	500	D 7540	2.4	16
Check valves type B	160	500	D 1191	2.5	8
Check valves with hydraulic release type RH	160	700	D 6105	2.5	14
Line rupture safety valves type LB	160	500	D 6990	2.5	18

#### Devices utilized by the automotive industry

Radial piston pumps         Seated valves         Hydraulic power packs for high pressure         Seated valves (NG 6)         Check valves with release (type RH, DRH)         Clamps (type HSA, HSE)         Hydraulic power packs < 63 I-tank         (type HC, MP, HK)	1.2, 1.3         2.2         1.1, 1.2, 1.3, 1.4, 1.5         2.2         2.5         3         1.1, 1.2
Seated valves Hydraulic power packs for high pressure Seated valves (NG 6) Check valves with release (type RH, DRH) Clamps (type HSA, HSE) Hydraulic power packs < 63 I-tank (type HC, MP, HK)	2.2 1.1, 1.2, 1.3, 1.4, 1.5 2.2 2.5 3 1.1, 1.2
Hydraulic power packs for high pressure Seated valves (NG 6) Check valves with release (type RH, DRH) Clamps (type HSA, HSE) Hydraulic power packs < 63 I-tank (type HC, MP, HK)	1.1, 1.2, 1.3, 1.4, 1.5         2.2         2.5         3         1.1, 1.2
Seated valves (NG 6) Check valves with release (type RH, DRH) Clamps (type HSA, HSE) Hydraulic power packs < 63 I-tank (type HC, MP, HK)	2.2 2.5 3 1.1, 1.2
Check valves with release (type RH, DRH) Clamps (type HSA, HSE) Hydraulic power packs < 63 I-tank (type HC, MP, HK)	2.5 3 1.1, 1.2
Clamps (type HSA, HSE) Hydraulic power packs < 63 I-tank (type HC, MP, HK)	3 1.1, 1.2
Hydraulic power packs < 63 I-tank (type HC, MP, HK)	1.1, 1.2
(type HC, MP, HK)	
Airdriven hydraulic numps (type I P)	
And went hydraulic pumps (type Li )	1.4
Seated valves (NG 6)	2.2
Hydraulic power packs	1.1, 1.2, 1.3
Valves	2.1, 2.2, 2.3, 2.4, 2.5
Hydraulic power packs	1.1, 1.2, 1.3, 1.4
Radial piston pumps	1.2, 1.3
Valves for pipe connection	2.1, 2.2, 2.3, 2.4, 2.5
Hydraulic power packs	1.1, 1.2, 1.3, 1.4
Radial piston pumps	1.2, 1.3
Valves	2.1, 2.2, 2.3, 2.4, 2.5
Hydraulic power packs	1.1, 1.2, 1.3, 1.4
Radial piston pumps	1.2, 1.3
Seated valves	2.2
	Seated valves (NG 6) Hydraulic power packs Valves Hydraulic power packs Radial piston pumps Valves for pipe connection Hydraulic power packs Radial piston pumps Valves Hydraulic power packs Radial piston pumps Seated valves

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# **Formulas and units**

Hydraulic system and circuit design is limited only by the creativity of the application engineer. All basic circuit design begins with the ultimate actuator functions in mind however. The most critical parameters are the required rates of travel, feeds, speeds, acceleration, deceleration requirements as well as ambient conditions and duty cycles. Additional consideration must be given to load induced as well as external forces. Thermal efficiencies and noise abatement considerations are another major factor in today's fluid power system design.

The following formulas and tables are intended to serve as guideline only and should help with the planning of your hydraulic system.

Equipment	Formulas and descri	ption		Symbol
General information	Basic equations (stati	c, with	out any loss)	
	$Q = \frac{V}{V}$	F:	force	
	t	p:	pressure	
	$V = A \cdot S$	A:	area	
	F = p·A	Q:	flow	
	$p = \frac{1}{A}$	v:	speed	
	$Q = A \cdot v$	V:	volume	
	$M = \frac{V \cdot p}{r}$	t:	time	
	2'π	s:	travel (stroke)	
	$v = \frac{s}{t}$	M:	torque	

## Hydraulic cylinders

Single acting

A [mm<sup>2</sup>] = 
$$\frac{\pi}{4}$$
 d<sup>2</sup> [mm]

$$r\left[\frac{m}{s}\right] = \frac{s \text{ [mm]}}{1000 \text{ t [s]}}$$

$$F_{s}[N] = -0.1 \cdot p_{B} [bar] \cdot A [mm^{2}]$$
$$p_{B} [bar] = \frac{-10 F_{s}[N]}{-10 F_{s}[N]}$$

 $Q_{in} [lpm] = 0.06 \cdot A [mm^2] \cdot v \left[\frac{m}{s}\right]$ 

- $\begin{array}{lll} \text{d:} & \text{piston diameter (mm)} \\ \text{A:} & \text{piston area (mm^2)} \\ \text{F}_{s} & \text{force (N)} \\ \text{p}_{B} & \text{operating pressure (bar)} \\ \text{v:} & \text{piston speed} & \left(\frac{m}{s}\right) \\ \text{Q}_{in} & \text{inflow (lpm)} \\ \text{s:} & \text{stroke (mm)} \end{array}$
- t: time (S)



#### Equipment

#### Formulas and description

Symbol

#### Double acting Extending Basic equations (balance of forces): Simplified: $A_1 = \frac{\pi}{4} d_1^2 \approx 0.78 d_1^2$ $p_1 [bar] = \frac{p_3 [bar] \cdot A_3 [mm^2] - 10F [N]}{A_1 [mm^2]}$ $A_3 = \frac{\pi}{4} \left( d_1^2 - d_2^2 \right)$ $p_1 \cdot A_1 = p_3 \cdot A_3 - F$ $F[N] = \frac{-p_1 [bar] \cdot A_1 [mm^2] + p_3 [bar] \cdot A_3 [mm^2]}{10}$ Qzu Qah $p_1 = \frac{1}{A_1} \left( p_3 \cdot A_3 - F \right)$ p<sub>3</sub> is the result of back pressure from pipes and valves for Q<sub>out</sub> $Q_{in} = A_1 \cdot v$ Attention: Pressure intensification could occur! $Q_{out} = A_3 \cdot v$ Retracting Basic equations (balance of forces): $p_1 \cdot A_1 = p_3 \cdot A_3 + F$ Simplified: $p_3 = \frac{1}{A_3} (p_1 \cdot A_1 - F)$ $p_{1} [bar] = \frac{p_{1} [bar] \cdot A_{1} [mm^{2}] - 10F [N]}{A_{3} [mm^{2}]}$ Qab Q<sub>zı</sub> $Q_{in} = A_3 \cdot v$ $F[N] = \frac{p_1[bar] \cdot A_1[mm^2] - p_3[bar] \cdot A_3[mm^2]}{mm^2}$ $Q_{out} = A_1 \cdot v$ p1 result of back pressure from pipes and valves for Qout piston area (mm<sup>2</sup>) Q<sub>in</sub>: inflow (lpm) A<sub>1</sub>: rod side area (mm<sup>2</sup>) O<sub>out</sub>: outflow (lpm) A<sub>3</sub>: piston Ø (mm) p1: pressure, piston side (bar) d<sub>1</sub>: d<sub>2</sub>: rod Ø (mm) pressure, rod side (bar) $p_2$ : F: force (N) s: stroke, travel (mm) Hydraulic pumps / Basic equations: 1) Simplified: Hydraulic pump $\Delta p = p_1 - p_0$ hydraulic motors Geometric volume per $V[cm^3] \approx \frac{A[mm^2] \cdot h[mm]}{318}$ revolution (piston pumps): $V = A \cdot h \cdot \pi$ V [m<sup>3</sup>] · n [min<sup>-1</sup>] Q [lpm] ≈ Flow: Q=V ⋅ n 1000 V [cm³] · ∆p [bar] M [Nm] ≈ $\mathsf{M} = \frac{\mathsf{V} \cdot \Delta \mathsf{p}}{2\pi}$ Middle torque: 62 $P_{hyd}$ [kW] $\approx \frac{\Delta p \text{ [bar]}}{-} Q \text{ [lpm]}$ Power: $P_{hvdr} = \Delta p \cdot Q$ 612 Hydraulic motor $\Delta p [bar] \cdot Q [lpm]$ $P_{mech} = \frac{\Delta p \cdot Q}{\eta_T} = \frac{M \cdot 2 \pi n}{\eta_T - 2}$ P<sub>drive</sub> [kW] ≈ Power consumption (pump): 500 $\Delta p [bar] \cdot Q [lpm]$ $P_{mech} = \Delta p \cdot Q \cdot \eta_T = M \cdot 2 \pi n \cdot \eta_T ^2$ Power rating (motor): P<sub>out</sub> [kW] ≈ 740 M [Nm] · n [min-1] V: displacement (cm<sup>3</sup>) A: effective piston area (mm<sup>2</sup>) 12000 ۵ h: double stroke (mm) rev. rating (rpm) P<sub>drive</sub>: drive performance (kW) n: M: middle torque (Nm) output hydraulic motor (kW) Pout: pressure (bar) p: 1) po result of back pressure from pipes and valves Δp: effective pressure (bar) <sup>2</sup>) incl. degree of efficiency $\eta_T \approx 0.82$ Q: flow (lpm) hydraulic performance (kW) Guideline: A power rating of 1 kW for the drive is neces-

 $\eta_{T}$  : total efficiency (including volumetric and mechanical losses)

sary to achieve a delivery flow of Q = 1 lpm

with operating pressure p = 500 bar!

Equipment	Formulas and description	Symbol
Valves	Losses of pressure by streaming fluid	Examples:
Directional valves	The loss of pressure in hydraulic systems is caused by:	
Pressure valves	Back pressure of valves	Directional valve
Flow valves	Back pressure of pipes	B
Check valves	Back pressure due to geometric shape (elbows etc.)	
	The back pressure $\Delta p$ of valves caused by streaming fluid, may be	
	found in the $\Delta p$ - Q curves of the corresponding pamphlets. They will	Pressure limiting valve
	be approx. 30% as a rough estimation when calculating the	
	performance loss of a complete circuit	
		Flow control valve
		check valve

## Orifices

(ideally, sharp edged) e.g. orifice inserts type EB; by-pass check valves type BC, BE

## Basic equation:

$$Q \approx \alpha \cdot \frac{\pi}{4} d^2 \cdot \sqrt{\frac{2\Delta p}{\rho}}$$

Q: flow (lpm)

- $\Delta p$ : back pressure between A and B (bar)
- d: orifice diameter (mm)
- $\rho$ : density (approx. 0.9 g/cm<sup>3</sup>)
- a: flow coefficient (approx. 0.78)

Pipes /

hoses

The diameter of pipes and/or hoses should be selected in such a way that back pressure is minimized.

Basic equations:

$$Re = \frac{v \cdot d}{v} \qquad \lambda_R = \frac{64}{Re}$$

$$\Delta p = \lambda_{\mathsf{R}} \cdot \frac{\mathsf{I}}{\mathsf{d}} \cdot \frac{\rho}{2} \mathsf{v}^2$$

Simplified:

Q ≈ 0.55d² [mm]· √∆p [bar]

 $d \approx 1.37 \cdot \frac{Q \text{ [lpm]}}{\sqrt{\Delta p \text{ [bar]}}}$ 

 $\Delta p \approx \left(\frac{1.81 \cdot Q \text{ [lpm]}}{d^2 \text{ [mm]}}\right)^2$ 

 $\lambda_R$ : pipe back pressure coefficient

- $\Delta p$ : back pressure (bar)
- I: pipe length (m)
- d: pipe diameter (mm)
- n: cinematic viscosity (mm<sup>2</sup>/s)
- Q: flow (lpm)
- Re: Reynolds No. (< 2300)
- ρ: density (approx. 0.9 g/cm<sup>3</sup>)
- v: flow velocity  $\left(\frac{m}{s}\right)$

Simplified:  
Q [lpm] 
$$\leq 0.108 \cdot d \text{ [mm]} \cdot v \quad \left[\frac{\text{mm}^2}{\text{s}}\right]$$
  
d [mm]  $\geq \frac{9.2 \text{ Q [lpm]}}{v\left[\frac{\text{mm}^2}{\text{s}}\right]}$   
 $\frac{\Delta p}{l} \left[\frac{\text{bar}}{\text{m}}\right] \approx \frac{6.1 \cdot v \left[\frac{\text{mm}^2}{\text{s}}\right] \cdot \text{Q} \left[\frac{l}{\text{lpm}}\right]}{d^4 \text{ [mm]}}$ 

\_\_\_\_Z



Equipment	Formulas and description	Symbol
T Back pressure due to geometric shape	Basic equations: $\Delta p = \zeta \cdot \frac{\rho}{2} v^2$ $v = \frac{Q}{A} = \frac{4Q}{\pi d^2}$	
(elbows etc.)	90° elbow ζ = 0.15	
	straight pipe fitting $\zeta = 0.5$ Simplified:	
	elbow fitting $\zeta = 1.0$ $\Delta p[bar] = 2.2 \cdot \zeta \cdot \frac{Q^2[l/min]}{a^4 [mm]}$	
	Δp: back pressure (bar)	
	ζ: back pressure coefficient	
	v : cinematic viscosity (mm <sup>2</sup> /s)	
	d: pipe diameter (mm)	
	ρ: density (approx. 0.9 g/cm <sup>3</sup> )	
Leakage losses (by concentric (e = 0)	Basic equation: $Q_{L} = \frac{\pi \cdot d \cdot \Delta r^{3}}{12 \cdot v \cdot p} \cdot \frac{\Delta p}{l} \left(1 + 1.5 \cdot \epsilon^{2}\right)$	e    → ↓
and eccentric gaps)	e: eccentricity (mm) Simplified:	
	$\Delta r:$ gap (mm) $Q_L = 1848 \frac{d \cdot \Delta r^3}{d \cdot d \cdot$	The second se
	$\Delta p$ : back pressure (bar)	
	d: diameter (mm)	
	v: cinematic viscosity (mm <sup>2</sup> /s)	
	I: gap length (mm)	
	ρ: density (approx. 0.9 g/cm <sup>3</sup> )	
	Q <sub>L</sub> : leakage losses	
Volumetric losses (due to pressure increase)	Basic equation: $\Delta V = \beta_P \cdot V_o \cdot \Delta p$ with $\Delta p = p_2 - p_1$	
	p <sub>1</sub> : pressure, start (bar) Simplified:	
	p <sub>2</sub> : pressure, end (bar) $\Delta V = 0.7 \cdot 10^{-4} \cdot V_0 \cdot \Delta p$	
	$V_{o}$ : initial volume (I) $\left( with \theta = 0.7 \pm 10^4 \right)$	$F = \Delta p \cdot A$
	$\Delta \vartheta$ : volume alternation (I) $\left( \begin{array}{c} \text{with } p_{p} \approx 0.7 \cdot 10 & \frac{1}{\text{bar}} \end{array} \right)$	Ļ
	$\beta_{P}$ : compressibility	
Volumetric losses (due to temperature rise)	Basic equation: $\begin{array}{l} \Delta V \cdot \beta_T \cdot V_o \cdot \Delta \vartheta \\ \text{with}  \Delta \vartheta = \vartheta_2 - \vartheta_1 \end{array}$	
	$\vartheta_1$ : temperature, start (°C) Simplified:	
	$\vartheta_2$ : temperature, end (°C) $\Delta V = 0.7 \cdot 10^{-3} \cdot V_a \cdot \Delta \vartheta$	
	$\Delta \vartheta$ : temperature, difference (K) ( 2 07 10 1 )	
	$V_{o:}$ initial volume (I) $\left( \begin{array}{c} \text{with } \beta_T \approx 0.7 \cdot 10 \\ \text{K} \end{array} \right)$	
	$\Delta V:$ volume alternation (I)	
	$\beta_{T}$ : expansion coefficient	
	$\Delta V = 0.7 \cdot 10^{-4} \cdot \Delta p = 0.7 \cdot 10^{-3} \cdot \Delta \vartheta$	
Pressure increase caused	i.e. $\Delta \vartheta \approx 1 K \Delta p \approx 10$ bar	
by temperature rise		
(without volumetric	Attention: A temperature rise of trapped oil volume will cause a pressure increase!	
compensation)	(i.e. a pressure limiting valve will be required sometimes)	
	Guideline: The pressure will rise by approx. 10 bar for 1 K of temperature increase.	

Equipment	Formulas and descr	iption		Symbol	
Hydraulic accumulators	Hydraulic accumulato sudden demands (qui leakage losses or to c	ors are intended for the supply of pressurized ick, adiabatic pressure alternations), comper lampen oscillations (slow, isotherm pressure	I fluid during nsation of alternations).	$\bigcirc$	
Pressure alternations, isotherm (slow)	Basic equations:	$p_1 = 1.1 \cdot p_0$			
adiabatic (quick)	isotherm (slow)	$\Delta \mathbf{V} = \mathbf{V}_1 \cdot \left( 1 - \frac{\mathbf{p}_1}{\mathbf{p}_2} \right)$			
	adiabatic (quick)	$\Delta V = V_1 \cdot \left( 1 - \left( \frac{p_1}{p_2} \right)^{0.71} \right)$			
	p <sub>o</sub> : filling pressure f	or the gas (bar)			
	p1: lower operating	pressure (bar)			
	p <sub>2</sub> : upper operating	pressure (bar)			
	V <sub>1</sub> : initial volume (I)				
	$\Delta V:$ volume alternati	on (l)			
Cavitation	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, a	accompanied by sudden noise	e, during suction process	
	of pumps and cylinde	rs as well as at extreme throttle sections. In	e nydraulic components wher	re this occurs will show	
	Increased wear.				
Thermal level	The hydraulic power l	osses in a hydraulic system result in a temp	erature rise of the fluid and the	e equipment which is	
Dissipation power	partly radiated to the	surroundings via the surface of the system.	They roughly amount 20 - 30%	% of the induced perfor-	
and oil temperature	mance. The induced and the radiated heat will balance at some point after the warm-up of the system.				

Basic equations: $P_v = 0.3 \cdot F$	hydr $\vartheta_{\text{oil max}} \approx \vartheta_{\text{amb}} +$	$c \cdot \frac{P_v}{A}$	
Surface with unhindered circulation	c ≈ 75	Simplified:	
Surface with bad circulation	c ≈ 120	0.0	
with fan (v $\approx$ 2 m/s)	c ≈ 40	$\vartheta_{\text{oil max}} \approx \vartheta_{\text{amb}} + \mathbf{c} \cdot \frac{0.3}{2}$	· P <sub>hydr</sub> [KVV]
Oil/water radiator	c ≈ 5		A[m <sup>2</sup> ]
P · porformance loss transfor	mod in boat (k)M		

 P<sub>v</sub>:
 performance loss, transformed in heat (kW)

 P<sub>hydr</sub>:
 hydraulic performance (kW)

  $\vartheta_{oil\,max}$ :
 max. fluid temperature (°C)

 $\vartheta_{amb}$ : ambient temperature (°C)

A: surface of the system (tank, pipes etc.) (m<sup>2</sup>)

## **Conversion table**

Nomenclature	Codings	Unit	*	Factor	x Unit	
Pressure	p	$1\frac{N}{mm^2}$	*	10	bar	
		1 MPa	~	10	bar	
		$1 \frac{\text{kgf}}{\text{cm}^2}$	*	1	bar	
		1 psi	*	0.07	bar	
Force	F	$1\frac{\text{kg}\cdot\text{m}}{\text{s}^2}$	=	1	Ν	
		1 lbf	*	4.45	Ν	
Length, travel,	l, s, h	1 in	*	25.4	mm	
stroke		1 ft	~	304.8	mm	
Torque	М	$1 \frac{\text{kg} \cdot \text{m}^2}{\text{s}^2}$	=	1	Nm	
Performance	Р	1 PS, 1 hp	*	0.74	kW	
Area	А	1 ft <sup>2</sup>	*	92903	mm <sup>2</sup>	
		1 in <sup>2</sup>	*	645.16	mm <sup>2</sup>	2
Volume	V	1 ft <sup>3</sup>	*	28.92		
		1 in <sup>3</sup>	~	$1.64 \cdot 10^{-2}$	I	
		1 UK gal	≈	4.55	I .	
		1 US gal	≈	3.79	I	
Temperature	Τ, ϑ	5 (°F-32)/9	*	1	°C	
Mass	m	1.lb	*	0.45	kg	
Cinematic viscosity	v	1 cSt	=	1	$\frac{\text{mm}^2}{\text{s}}$	



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