

HAWE Product Overview



Content

1	Pum	ips	10
	1.1	Compact hydraulic power packs	10
	1.2	Standard pumps and power packs	44
	1.3	Dual stage pump	60
	1.4	Air driven hydraulic pumps	66
	1.5	Hand pumps	72

2	Valv	Valves				
	2.1	Directional spool valves	76			
	2.2	Directional seated valves	120			
	2.3	Pressure valves	174			
	2.4	Metering valves	216			
	2.5	Check valves	240			

3	Hydraulic cylinders	260
	Hydraulic clamps type HSE and HSA	262

4	Hydraulic accessories	264
	Pressure switches type DG	266
	Hydraulic miniature accumulators type AC	268
	Piston type accumulator type HPS	270
	Hydraulic accessories	272

5	Electronics	274
	Electronic accessory components	276
	Type PLVC programmable logic valve control	278



Compact hydraulic power packs type KA und KAW



Prop. directional spool valve type PSL und PSV



Hydraulic clamps type HSE und HSA



Pressure switches type DG



Electronic accessory components type PLVC

6 Appendix

_	_	_
- 7	Ο	n
_	~	
_	-	-

Pressure fluids – notes for selection	281
Devices for special applications	286
Formulas and units	295
Adresses of Offices and Representatives	302
Pamphlet index	310
Type index	314
Index	320

HAWE Hydraulik SE Streitfeldstr. 25 81673 Munich Postfach 80 08 04 81608 Munich Germany Tel. +49 (0)89 379 100-0 Fax +49 (0)89 379 100-1269 <u>www.hawe.de</u> info@hawe.de



Preface

HAWE Hydraulik SE was established as "Heilmeier & Weinlein, Fabrik für Oelhydraulik GmbH & Co. KG in Munich in 1949. nnovative ideas, high product quality and a lot of enthusiasm has contributed to HAWE's steady growth. We now have more than 2200 employees, a worldwide sales network with sales offices in Germany, 14 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. Secondly, all pressurized parts are made of steel. And finally, sustainable business takes top priority during manufacture and installation, meaning certification according to ISO 9001 (quality management), ISO 14001 (environmental management) and EN 16001 (energy management) is a given. Production Site Freising





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 (listed at "Additional Information"), which contain detailed technical specifications as well as further information. The technical information contained in these pamphlets is substantial and include guarantee and warrantee relevant details. These pamphlets may be ordered from your local HAWE sales representative (see addresses on page 278) or directly from HAWE in Munich (contact: info@hawe.de). It goes without saying that your sales partner (please see "Office addresses" attached for the addresses) and our "Technical Support" team in Munich would be glad to help with the selection, configuration and specification of the optimal HAWE products for you.







Headquarters Munich

OUR VERTICAL RANGE OF MANUFACTURE ENSURES SUPERIOR QUALITY!



Production Site Kirchheim



Production Site Sachsenkam



Production Site Dorfen 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.

All dimensions in mm, subject to change without notice!

Our vertical range of manufacture ensures superior quality!

Efficiency:

Example: Machine tools

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

Example: Truck mounted cranes

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

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





Flexibility:

Example: Tractors for logging and agriculture

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

Example: Food processing

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

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









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

Reliability:

Example: Wind energy plants

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

Example: Construction machines

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



Technology:

Example: Tools with hydraulic drive

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

Example: Hydraulic presses

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

SOLUTIONS FOR A WORLD UNDER PRESSURE

Efficiency in modules

Hydraulics is based on a simple principle that allows its use in a wide variety of different applications. In order to use all of these variations, we offer a modular range of products. As a direct result of our development philosophy, the individual HAWE components supplement one another to form one complete product range. They can then be combined to form solutions and systems. Unified components and the possibility to combine them individually serve to increase efficiency at an ideal price-performance ratio.

- individual components supplement one another to form one complete product range
- allows customer-specific solutions



Compact hydraulic power packs





Order examples

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

Compact hydraulic power packs

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

Connection blocks

BWH 1 - NW - 33 - G 24

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

Directly mounted valve banks

The practical modular system allows individual combinations.

Connection blocks



Pumps

1.1 Compact hydraulic power packs

Miniature hydraulic power packs type NPC	12	
Compact hydraulic power packs type HC and HCW		
Compact hydraulic power packs type KA and KAW		
Hydraulic power packs type MP and MPN		
Compact hydraulic power packs type HK, HKF, HKL		
Connection blocks type A, B, and C	32	
Valve bank type BA	34	
Valve bank type BVH		



Compact hydraulic power packs type KA and KAW



Compact hydraulic power packs type HK, HKF and HKL



Туре	Nomenclature	Design	p _{max}	Q _{max}	
NPC	 Radial piston pump With integrated electric motor Direct current supply 	Oil immersed compact hydraulic power pack for short period operation	750 bar	approx. 1.36 lpm	
HC, HCW	Radial piston or gear pump With integrated electric motor	Oil immersed compact hydraulic power pack for	Radial piston pump 700 bar	approx. 4.4 lpm	
	 3-phase or 1-phase version 	intermittent operation	Gear pump 180 bar	approx. 3.4 lpm	
KA, KAW	 Radial piston or gear pump With integrated electric motor 3-phase or 1-phase version 	Oil immersed compact hydraulic power pack for intermittent operation	Radial piston pump 700 bar	approx. 7 lpm	
			Gear pump 180 bar	approx. 24.1 lpm	
MP, MPN	Radial piston pump and/or gear pumpWith integrated motor	Oil immersed compact hydraulic power pack for	Radial piston pump 700 bar	13.1 lpm	
	 Single- or dual-circuit pump 	intermittent or load/no load operation	Gear pump 220 bar	135 lpm	
HK, HKF, HKL	Radial piston pump and/or gear pumpWith integrated motor	Oil immersed compact hydraulic power pack for	Radial piston pump 700 bar	approx. 13 lpm	
	 3-phase version 	continuous and intermittent operation	Gear pump 180 bar	16 lpm	

Connection blocks/mounted valves

Туре	Nomenclature	Design	p _{max}	Q _{max}
A, B, C	Connection blocksFor completion of hydraulic power packs	Add-on valve enabling pipe connection or mounting of valves	700 bar	approx. 20 lpm
ВА	Valve bankDirectional seated valveZero leakage	Valve bank enabling pipe connection Actuation: solenoid, pressure-actuated or manual, mechanical	400 bar	20 lpm
BVH	Valve bankDirectional seated valveZero leakage	Valve bank enabling pipe connection	400 bar	20 lpm

1.1 Miniature hydraulic power packs type NPC

The NPC compact hydraulic power pack can be universally used in short period operation for all consumers with low oil requirements. The energy is supplied by direct current. A pressure-limiting valve is integrated into the intermediate flange. The NPC can be used on construction sites and in other mobile applications. It can be developed into a compact, complete hydraulic control by connecting valves from the VB or BWN(H) ranges.

Features and benefits:

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

Intended applications:

- Rivets
- Ventilation of winch brakes
- Hydraulic jigs
- Crimping

Design and order coding example



lomen- lature:	Radial piston pump with integrated electric motor (version for 3-phase mains)
Design:	Oil immersed compact hydraulic power pack for short period operation
) _{max} :	750 bar
a _{max} :	approx. 1.36 lpm (V _g = 0.09 - 0.76 cm³/rev)

NPC 11	/ 0,87	- 1/170	- R	- G12	BWN 1 - NN - 35 - 1 - G12
					 Walve assembly BWN1, BWH1, VB01 or BVH can be mounted directly, without connection blocks according to D 7470 B/1, D 7302, D 7788 BV
				Motor volt	age 12V DC or 24V DC
			Check v	alve Wi	ith/without check valve
		Pressure lim	iting va	lve and se	tting 1 = Tool adjustable
					2 = Manually adjustable
	Delivery flo	ow [lpm]			

Basic type, size Type NPC, size 11 and 12



Function

Symbol:



NPC 11 / 0,87 - 1/170 - R - G 12 BWN 1 - NN - 35 - 1 - G 12 Compact hydraulic power pack type

NPC, pump delivery flow approx. 0.87 lpm

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



General parameters and dimensions



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

Associated technical data sheets:

<u>Compact hydraulic power pack, type NPC: D 7940</u>

Directly mountable valve banks:

- Type VB: <u>Page 130</u>
- Type BVH: Page 40
- Type BWH, BWN: Page 138
- Pressure switches type DG: Page 266
- Electronic pressure transducer type DT: D 5440 T ++

See also section "Devices for special applications"

- Hydraulics for clamping
- Devices for up to 700 bar

1.1 Compact hydraulic power packs type HC and HCW

The ready-for-connection compact hydraulic power pack can be used in applications where consumers with a low oil volume requirement have to be connected in intermittent operation (S 3), e.g. in machine tool and jig construction, or in general machine engineering. The power pack consists of the housing (tank) with integrated motor and pump. The filling gauge on HC(W) size 2, 3 and 4 types enables the fluid level to be controlled even during operation. The electrical connections are made via an integrated terminal box. Compact control systems can be created by mounting various combinations of connection blocks and valve banks. Float switches and temperature switches are optionally available for perfect monitoring.

Features and benefits:

- Wide range of application achieved with four sizes
- Direct current version for voltage supply with 12 V DC or 24 V DC
- Long service life and excellent reliability achieved by using radial piston pumps
- Low oil fill volumes make it environmentally sound thanks to the small amount of oil to be disposed of and the low costs for hydraulic fluid
- Co-ordinated range of valves and accessories from modular system
- Suitable for vertical and horizontal installation

Intended applications:

- Brake and rotor adjustment modules on wind turbines
- Tracking systems on solar panels and parabolic aerials
- Clamping systems on machine tools and jigs
- Rivets and clinching equipment

Design and order coding example

- Welding robots
- Lubrication systems



Nomen- clature:	Radial piston pump with integrated electric motor (3-phase or 1-phase version)
Destant	Oil immensed budgestie neuron neels fer
Design:	intermittent service (S3-service)
p _{max} :	Radial piston pump 700 bar Gear pump 180 bar
0	Dedited with the second second of the second
Q _{max} :	Radial piston pump approx. 4.4 lpm ($V_{\alpha} = 1.6 \text{ cm}^3/\text{rev}$)
	Gear nump approx. 3.4 lpm
	$(V_g = 1.3 \text{ cm}^3/\text{rev})$
Vusable max:	8 L

HC24	/0,6	- A1/400	- BWH1F-HH-1-1-G24	- 400V 50 Hz					
				Motor voltage	3 ~ 400V 50 Hz, 3 ~ 460V 60 Hz				
			Ontional directly mounts	d directional valu	$1 \sim 230V 50 Hz$, $1 \sim 110V 60 Hz$ (3~phase motor)				
			optional unecity mounte	u uneccional valv					
		Connection bl	ock						
	Pump ve	r sion Singl o ■ Ra	e circuit pump dial piston pump H (3-, 5-	or 6-cylinders) or	gear pump Z				
		Dual Co	circuit pump mbinations:						
		11	Radial piston pump - gea Radial piston pump - radi	r pump al piston pump					
Basic type	, size	size Type HC (3-phase motor) and type HCW (1-phase motor, power reduction of 30 50% depending on size), size 2, type HCG (direct current motor), size 1							
		HorizontalUsable voluWith/withc	version with low profile (1 Ime V _{usable} 0.5 l to 1.1 l put fluid level gauge	type HCL) or verti	ical version				

• With DC-motor (Type HCG) for short time operation



Function

Symbol:



Example circuit:				
HC 24/0.64 -	- A1/400	- BWH1F - RH1 - 1 - 1 - G 24		
Hydraulic power pack type HC, size 24, pump delivery flow approx. 0.64 lpm	Connection block type A and pressure-limiting valve (400 bar)	Directly mounted valve bank type BWH1		
BWH1F-RH-1-1-G24				

General parameters and dimensions







	Radial piston pump (3 cyl.)			Gear pump	p						
	Max. pressure	Delivery flow	Max. Delivery flow pressure		Delivery flo)W			Dimens	sions [m	ım]
	p _{max} [bar]	Q _{pu} [lpm] 50 Hz	Q _{ри} [lpm] 60 Hz	p _{max} [bar]	Qpu Qpu [lpm] [lpm] 50 Hz 60 Hz	Q _{pu} [lpm] 60 Hz	P _N [kW] ¹⁾	m [kg] ²⁾	н	В	т
HC 14	700 - 160	0,2 - 1,05	0,2 - 1,2	-	-	-	0,18	6,3	197	120	120
HC 12	600 - 120	0,4 - 2,15	0,5 - 2,5	-	-	-	0,25				
HC 24	700 - 185	0,27 - 2,27	0,3 - 2,7	150	0,4 - 1,6	0,5 - 1,9	0,55	10,1	243	148	148
HC 22	700 - 140	0,52 - 4,41	0,6 - 5,3	150	0,9 - 3,4	1,1 - 4	0,55				

1) 2) The actual power input depends on the respective operation pressure and can be up to $1.5\times P_N$ Without oil filling



Example circuit:

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



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

Associated technical data sheets:

- Compact hydraulic power packs type HC: <u>D 7900</u>
- Compact hydraulic power packs type HCG: <u>D 7900 G</u>

Connection blocks:

Types A, B and C: Page 32

Directly mountable valve banks:

- Type VB: <u>Page 130</u>
- Type BWH, BWN: Page 138

- Type BVZP: <u>Page 146</u>
- Type SWR, SWS: Page 88
- Type BA: Page 34
- Type BVH: <u>Page 40</u>

See also section "Devices for special applications"

- Hydraulics for clamping
- Devices for up to 700 bar

1.1 Compact hydraulic power packs type KA and KAW

The ready-for-connection compact hydraulic power pack consists of a housing (tank) with integrated motor and pump. The tank volume (effective volume) can be increased by extensions. A vertical and a horizontal variant are available. A filling gauge enables visual control of the fluid level even during operation. The electrical connections are made via an integrated terminal box. Compact control systems can be created by mounting various combinations of connection blocks and valve banks. Float switches and temperature switches are optionally available for perfect monitoring.

Features and benefits:

- Additional external fan for optimum load set
- Fill/effective volumes can be flexibly extended by modular tank extensions
- Long service life and high reliability achieved by using radial piston pumps
- Low oil fill volume makes it environmentally sound thanks to the small amount of oil to be disposed of and the low costs for hydraulic fluid
- Co-ordinated range of valves and accessories from modular system
- Suitable for vertical and horizontal installation
- Optimum efficiency achieved by suboil motor cooling, direct transmission of force and cleverly designed heat dissipation

Intended applications:

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



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



Design and order coding example

KA28	22	L1	KFTP	/HZ0,59/8,8		- 3x400V	- G1/2x300				
							Oil drain hose				
					Motor voltage 3 ~ 400V 50 Hz, 3 ~ 460V 60 Hz, 3 ~ 690V 50 Hz, 1 ~ 230V 50 Hz, 1 ~ 110V 60 Hz (1~phase motor)						
					Valve de	esign					
				Pump version	Single circuit pumpRadial piston pump H or gear pump Z						
					 Dual circuit pump with joint connection pedestal for pressure connections P1 and P3 Combinations: Radial piston pump - radial piston pump (HH) and radial piston pump - gear pump (HZ) 						
		Additional function Oil sight glass Filling gauge with float swit Temperature switch Silica gel filter (instead of b Additional fans Various electrical connectio						er) zype KAS)			
		Install	ation pos	ition Horizont	al versio	n with low inst	allation heights	(type KAL) or vertical version (type KAS)			
· ·	Tank si	ze [l]									
Basic type	, size	Туре	KA (3~ph	ase motor) and K	AW (1~pł	hase motor, pov	ver reduction 30	50% dep. on size), size 2 and 4			

Function

Switching symbol:



KA 231 LKP/H 0.59 - A1 D 10-B 400-3/380 - BA 2

- NBVP 16 G/R/AB 2.0 - M/0 - NBVP 16 Y/ABR 1.5/4 - M/0 - 1 - G 24



General parameters and dimensions







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

	3-cylinder i	radial pisto	on pump	6-cylinder i	radial pisto	lial piston pump		D		
	p _{max} [bar]	Q _{max} [lpm] 50 Hz	Q _{max} [lpm] 60 Hz	p _{max} [bar]	Q _{max} [lpm] 50 Hz	Q _{max} [lpm] 60 Hz	p _{max} [bar]	Q _{max} [lpm] 50 Hz	Q _{max} [lpm] 60 Hz	P _N [kW]
KA 44	700 - 220	0,84 -	1,01 -	700 - 110 1,68 - 2,04 - 200 - 130 0,84 - 9,1 1,0	1,01 -	- 1,5				
		5,98	7,25		11,97	14,53			11,1	- 2,2
										- 3,0



Example circuit:

KA 44 S/H 3.2

-A 1/250 -BVH 11 G/GM/R/2 -BVH 11 G/GM/R/2 -GM 24 3x400V Hz-1.5kW



Associated technical data sheets:

 Compact hydraulic power packs type KA: <u>D 8010</u>, <u>D 8010-4</u>

Similar products:

• Compact hydraulic power packs type HC and HCG: <u>Page 14</u>

Suitable connection blocks:

Types A, B and C: Page 32

Directly mountable valve banks:

- Type VB: <u>Page 130</u>
- Type BWH, BWN: Page 138
- Type BVZP: <u>Page 146</u>
- Type SWR, SWS: Page 88
- Type BA: Page 34
- Type BVH: Page 40

See also section "Devices for special applications"

- Clamping hydraulics
- Geräte bis 700 bar

1.1 Hydraulic power packs type MP and MPN

These compact hydraulic power packs are designed for use in stationary applications, which work in intermittent or load/no load operation. Two different pumps can be easily mounted as an option to make this type particularly suitable for dual-stage drives such as in presses or dual-circuit systems. The tank size and drive power can be easily adjusted to the system requirements using several sizes. Compact control systems can be created by directly mounting connection blocks and valve banks.

Features and benefits:

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

Intended applications:

- Brake and rotor adjustment modules on wind turbines
- Counterbalance and provision of clamping pressure for lathe chucks, tailstocks and steady rests on large machine tools and turning centres
- Presses and other shaping machines
- Handling and clamping systems on machine tools and jigs
- Lubrication systems



- Nomen-Radial piston and/or gear pump with integrated clature: motor single or dual circuit pump
- Design: Oil immersed hydraulic power pack for intermittent or load/no load operation (S2-/S3-/S6-service)
- pmax: Radial piston pump 700 bar (high pressure) Gear pump 220 bar (low pressure)
- Qmax: 13.1 lpm (high pressure) (Vg = 10.7 cm³/rev) 135 lpm (low pressure) (Vg = 60 cm³/rev)
- V_{t max}: approx. 100 lpm



Design and order coding example

MPN 44	- H 1,5	- B10.20	D	- 3 ~ 230V 50 l	Hz
				Motor voltage	3 ~ 230/400V ∆丫 50 Hz, 3 ~ 500V 丫 50 Hz, 1 ~ 230V 50 Hz, 1 ~ 110V 60 Hz (1-phase moto
			Valve n	nounting	
			Additional o	ptions = Filling = Float s = Tempe = Variou	g gauge switch erature switch us means of electrical connection
		Design 📕	For installation With tank, us	on in self-made oil 1 able volume V _{usable} 1	tanks: as individual pump or cover plate version 10 l to 75 l
	Pump ve	rsion Single Rad	-circuit pump ial piston pum ernal gear pum	p H or gear pump Z p IZ	
		Dual-c Com	ircuit pump binations:		
		■ F ■ F ■ (Radial piston p Radial piston p Gear pump - ge	ump - radial piston ump - gear pump (H ar pump (ZZ, only N	i pump (HH, only MPN) HZ) MP)
lasic type,	size Ty Ty 1:	/pe MP (3-phase /pe MPN (3-phas -phase motor, po	motor) and M e motor) and I ower reduction	PW (1-phase motor) MPNW (1-phase mot by 30 50% depe), sizes 1 and 2 tor), size 4 ending on size

Function

Single stage pump

(radial piston pump, gear pump)





Installation pump

Hydraulic power pack (incl. tank)

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

Installation

pump







General parameters and dimensions

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



Compact hydraulic power pack (tank with mounted valves)





	Radial pis	ton pump (3 c	yl.)	Gear pun	пр							
	Max. pressure	Delivery flow		Max. pressure	Delivery flow				Dimensio	Dimensions [mm		
	p _{max} [bar]	Q _{ри} [lpm] 50 Hz	Q _{ри} [lpm] 60 Hz	p _{max} [bar]	Q _{pu} [lpm] 50 Hz	Q _{pu} [lpm] 60 Hz	P _N [kW] ¹⁾	m [kg] ²⁾	H1 ²⁾	H2 _{max}	ØD	
MP 14	700 - 220	0,27 - 1,07	0,32 - 1,28	150 - 15	0,5 - 6,9	0,6 - 8,29	0,25	5,2/5,0	183/228	249	124	
MP 12	700 - 250	0,53 - 2,1	0,64 - 2,52	150 - 60	2 - 6,9	2,4 - 8,28	0,37					
MP 24	700 - 310	0,46 - 1,73	0,55 - 2,08	150 - 35	2 - 12,3	2,4 - 14,76	0,75	9,1/7,7	195/291	322,5	140	
MP 22	700 - 260	0,88 - 3,51	1,06 - 4,21	150 - 18	4 - 41,4	4,8 - 49,68	0,55					
MPN 42	700 - 250	2,39 - 7,33	2,87 - 8,8	200 - 60	8,46 - 30,02	10,2 - 36,02	2,1	12,9	251/258	431		
MPN 44	700 - 250	1,53 - 5,37	1,84 - 6,44	200 - 55	5,37 - 25,99	6,4 - 31,19	2,1					
MPN 46	700 - 250	3,16 - 11,12	3,8 - 13,34	200 - 40	12,41 - 71,73	14,89 - 86,08	3,0	18,5	274/281	454	165	
MPN 48	700 - 330	2,36 - 4,06	2,83 - 4,87	220 - 60	4,16 - 34,91	4,99 - 41,89	3,0					
MPN 404	700 - 340	3,1 - 3,49	3,7 - 4,19	220 - 45	2,7 - 68,16	2,25 - 81,79	4,2	26,4	298/313	486		

1) The actual power input is dependent on the respective operation pressure and can be up to $1.5xP_N$ 2) Values apply to radial piston pump/gear pump versions

Version with tank:

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



Example circuit:

MPN 44-Z 8.8-B 10 KT

-AS 1 F 3/160 -BA 2 -NBVP 16 G/R-GM/NZP 16 LZY 5/50-G 8 MA/GM/3-X 84 V-DG 5E-250-1/4 -NBVP 16 G-GM/NZP 16 LZY 5/50-G 8 MA/GM/3-X 84 V-DG 62 -1-G 24 -X 84 V-9/250 -3 x 400/230 V 50 Hz



Associated technical data sheets:

- Compact hydraulic power packs type MP, MPW: <u>D 7200</u>, <u>D 7200 H</u>
- Compact hydraulic power packs type MPN, MPNW: <u>D 7207</u>

Connection blocks:

Types A, B and C: Page 32

Directly mountable valve banks:

- Type VB: <u>Page 130</u>
- Type BWH, BWN: Page 138

- Type BVZP: <u>Page 146</u>
- Type SWR, SWS: <u>Page 88</u>
- Type BA: Page 34
- Type BVH: Page 40

See also section "Devices for special applications"

- Hydraulics for clamping
- Devices for up to 700 bar

1.1 Compact hydraulic power packs type HK, HKF, HKL

Because of the unique integrated fan configuration, the "ready for connection" hydraulic power packs are ideal for continuous operation. Another 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 horizontal 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.

Features and benefits:

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

Intended applications:

- Supply of clamping pressure for lathe chucks, tail stocks, steady rests at machine tools and machining centers
- Welding machines, roboter
- Endurance test benches
- Endurance test bench construction
- Torque wrench



Design: Oil immersed compact hydraulic power pack for permanent and intermittent operation (S1/S6 service) pmax: 700 bar (radial piston pump) 180 bar (gear pump) Qmax: Radial piston pump (high pressure) approx. 13 lpm (Vg = 9.15 cm³/rev) Gear pump (low pressure) 24 lpm (Vg = 17.0 cm³/rev)	Nomen- clature:	ston pump and/or gear pump with d motor for 3-phase mains)
pmax: 700 bar (radial piston pump) 180 bar (gear pump) Qmax: Radial piston pump (high pressure) approx. 13 lpm (Vg = 9.15 cm³/rev) Gear pump (low pressure) 24 lpm (Vg = 17.0 cm³/rev)	Design:	rsed compact hydraulic power permanent and intermittent n (S1/S6 service)
Q _{max} : Radial piston pump (high pressure) approx. 13 lpm ($V_g = 9.15 \text{ cm}^3/\text{rev}$) Gear pump (low pressure) 24 lpm ($V_g = 17.0 \text{ cm}^3/\text{rev}$)	p _{max} :	(radial piston pump) (gear pump)
	Q _{max} :	ston pump (high pressure) 3 lpm (Vg = 9.15 cm³/rev) np (low pressure) Vg = 17.0 cm³/rev)
Vusable max: approx. 11.1 l	Vusable max:	1.1 l



Design and order coding example

HK 34	8	LST	- H 3,6	3 x 400V 50Hz
			l Pump versio	Motor voltage 3 ~ 230/400V △丫 50 Hz, 3 ~ 265/460V △丫 60 Hz 1 ~ 230V 50 Hz, 1 ~ 115V 60 Hz (1~phase motor) n Single circuit pump ■ Radial piston pump H, gear pump Z, internal gear pump IZ
				Dual circuit pump with joint connection pedestal for pressure ports P1 and P3 Combinations:
				 Radial piston pump - radial piston pump (HH) Radial piston pump - gear pump (HZ)
				Dual circuit pump with separate connection pedestals Radial piston pump H or gear pump Z
		Additior	al function	Temperature and fluid level switchAdditional leakage port (Type HK 4.L)
1	lank s	ize T	ype HK: Usa Various fil	ble volume V _{usable} 0.85 l to15.4 l, Type HKL: Usable volume V _{usable} 1.7 l to 9.1 l ler neck designs
Basic type,	size	Туре Туре	HK, size 2 to HKL (3~phas	4, type HKF (with auxiliary blower for increased cooling), size 4 e motor) and HKLW (1~phase motor), size 3
		Addit ■ Wi	ional versio th molded m	ns: otor

Function

Single stage pump

(radial piston pump, or gear pump)



Dual stage pump

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







Separate pump pedestals

Triple circuit pump (only radial piston pump)



Separate pump pedestals

General parameters and dimensions







	Radial pistor	n pump		Gear pump								
	Max. pressure	Delivery flow		Max. pressure Delivery flow				Dimensions [mm]				
	p _{max} [bar]	Q _{pu} [lpm] 50 Hz	Q _{pu} [lpm] 60 Hz	p _{max} [bar]	Q _{pu} [lpm] 50 Hz	Q _{pu} [lpm] 60 Hz	P _N [kW] ¹⁾	H _{max}	В	т	m [kg]	
HK 24	700 - 220	0.46 - 1.77	0.55 - 2.12	-	-	-	0.55	340	196	196	13	
HK 33	560 - 100	1.25 - 6.5	1.5 - 7.8	170 - 100	2.7 - 6.9	3.24 - 8.28	0.8	405	212	212	20.5	
HK 34	700 - 170	1.25 - 6.5	1.5 - 7.8	170 - 160	2.7 - 6.9	3.24 - 8.28	1.1	405	212	212	20.5	
HK(F) 43	610 - 90	2.08 - 13.1	3.36 - 15.72	170 - 80	4.5 - 16	3.29 - 19.2	1.5	460	240	240	29	
HK(F) 44	700 - 130	700 - 130 2.08 - 13.1		170 - 110	4.5 - 24	3.29 - 28.8	2.2	460	240	240	29	
HK(F) 48							3	833	240	240	40	
HKL(W) 32	700 - 220	0 - 220 1.65 - 8.7 1.98 - 10.44 170		170 - 130	2.7 - 11.3	3.24 - 13.56	1.8	358	617	196	19.2	
HKL(W) 34												
HKL 38	700 - 220	1.65 - 8.7	1.98 - 10.44	170 - 130	2.7 - 11.3	3.24 - 13.56	2.2	358	617	196	22.2	

1) The actual power input is depends on the respective operation pressure and can be up to 1.5 x P_{N}



Example circuits:

HK34T/1-H 3.6-AS1/260-BWN1F-H H5 R-1-1-G24

Compact hydraulic power pack type HK 34 with temperature switch (coding T), radial piston pump H 3.6, connection block (type AS 1/260) with pressure-limiting valve (260 bar) and idle circulation valve as well as directly mounted valve bank type BWN 1



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

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

(400 bar and 110 bar) and idle circulation valve (connection of valve banks possible)



Example circuit:



```
- NA21FO-A700R/100/V120
- WGZ4-1R-WG110
```

 $1 \sim 110V 60 Hz$





Example circuit:



Associated technical data sheets:

- Compact hydraulic power packs type HK 4, HKF 4: D 7600-4
- Type HK 3: <u>D 7600-3</u>
- Type HK 2: <u>D 7600-2</u>
- Type HKL 3, HKLW 3: <u>D 7600-3L</u>

Connection blocks:

Type A, B and C: <u>Page 32</u>

Directly mountable valve banks:

- Type VB: Page 130
- Type BWH, BWN: <u>Page 138</u>, Type BVZP 1: <u>Page 146</u>
- Type SWR, SWS: <u>Page 88</u>
- Type BA: <u>Page 34</u>
- Type BVH: Page 40

See also section "Devices for special applications"

- Hydraulics for clamping, devices for up to 700 bar

1.1 Connection blocks type A, B, and C

Connection blocks are used to develop types HC, KA, MP, MPN, HK, HKF and HKL compact hydraulic power packs into a ready-for-connection solution. Compact control systems can be created by directly mounting valve banks to the connection blocks on type A (see "complete solutions in modular system").

Features and benefits:

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

Intended applications:

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



Nomen- clature:	Connection blocks to the completion of hydraulic power packs
Design:	Add-on valve enabling pipe connection or direct mounting of valve banks
p _{max} :	700 bar
Q _{max} :	approx. 20 lpm

Design and order coding example

AS3F2 /420 - G24 Solenoid voltage 12V DC, 24V DC, 230V AC Pressure setting (bar)

Basic type Type A, B, C see table

Options, type A, B, C

Type A with pressure-limiting valve (pre-set or manually adjustable, also with unit approval) **Type B** with pressure-limiting valve to actuate single- and double-acting cylinders

 For direct pipe connection 	 For direct pipe connection Options: 					
To attach valve banks						
 Options: Check valve in P gallery Prop. pressure-limiting valve Return filter, Pressure filter Idle circulation valve (solenoid-actuated) Shut-off valve, accumulator charging valve 	 Check valve in P gallery Throttle for regulating the drain speed Idle circulation valve open or closed in neutral position Pressure switch in P gallery Automatic clamping and releasing via the pressure switch (type BDW) 					
Type C without additional elements	Additional versions					
 For direct pipe connection 	 Connection blocks for dual-stage pumps 					
 Options: For pipe connection (pump side) of all type A, B connection blocks (Type C15, C16 - connection block with hole pattern of the pump, 	 Intermediate blocks for dual-stage pumps type S, V, C30 Spacer plates for single and dual-circuit pumps type U. Additional intermediate block for second pressure stage type V, S 					

(Type C15, C16 - connection block with hole pattern of the pump, type C36)



Function





General parameters and dimensions







С

Associated technical data sheets:

- Type A etc.: <u>D 6905 A/1</u>
- Type AX: <u>D 6905 TÜV</u>
- Type B: <u>D 6905 B</u>
- Type C: <u>D 6905 C</u>

Suitable compact hydraulic power packs:

 See section Compact hydraulic power packs

Products with shared connection diagram:

- Two-stage valves type NE 21: <u>Page</u> <u>206</u>
- Switch units type CR: <u>Page 164</u>
- Directional spool valves type SKC: <u>SKP</u>, <u>SKH</u>
- Type SWC: <u>Page 88</u>

Suited valve banks for combination:

- Type VB: Page 130
- Type BWH, BWN: <u>Page 138</u>
- Type BVZP: Page 146
- Type SWR, SWP, SWS: <u>Page 88</u>
- Type BA: <u>Page 34</u>
- Type BVH: Page 40

1.1 Valve bank type BA

Thanks to the identical flange pattern of type BA sub-plates, they can be combined very flexibly with type A.. connection blocks. On the pump side, this enables direct mounting (without intermediate plate) to the connection blocks of the compact hydraulic power packs. Directional seated valve banks and directional spool valve banks (e.g. type BWN, BWH, BVH, VB, BVZP, SWR, SWP and SWS) can be flanged to the valve section side. Valves and intermediate plates with standard connection patterns (type NSMD2, NSWP2, NBVP16, NBMD16, NG..-1, NZP16) can be mounted individually. Additional functions for the pump or consumer side (e.g. throttle and throttle check valve, pressure-reducing valve or pressure switch) enable flexible adaptation to changing operating conditions. Hydraulic clamping systems (e.g. in machine tools) with the associated wide range of requirements are the typical application areas.

Features and benefits:

- Sub-plates for flexible combination with directional valve types with NG6 (CETOP) standard connection pattern
- Valve bank can be flanged directly to the connection block of a compact hydraulic power pack or connected as a separately arranged valve bank for pipe connection
- Pressure switches and/or any other monitoring elements can be connected directly
- Additional elements, such as orifices, throttles and check valves for P, R, A and B connections can be integrated
- Diaphragm accumulator can be mounted directly

Intended applications:

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



Nomencla- ture:	Sub-plates/directional seated valve, zero leakage
Version:	Valve section with sub-plates for pipe connection
Actuation:	Solenoid Pressure-operated Hydraulic Pneumatic Manual Mechanical Pin Roller
p _{max} :	400 bar
Q _{max} :	20 lpm



Design and order coding example

	BA2 A5	NBVP16 NBVP16 NSWP2	S G G	0 B0,8 R B0,6 R	/ABR2,0/BBR1,5 /ABR1,0/BBR1,5	/A3B9/400 /50	/S /S	/0	- 1	- G24	
									9	Solenoid voltage 12V DC, 24V DC, 230V AC, 110V AC	
	End plate Drain valve with/without pressure switches with one or two accumulator ports with/ without release valve and/or with/without drain valve										
							2	Sub-pl	ate	Check valves with release Throttle Additional pressure gauge connections	
							Additio	nal el	ements	in R Return pressure stop	
	Pressure switch/pressure gauge in A and/or B										
	Additional elements in A, B Infottle check valve in A and/or B Throttle valve in A and/or B										
	Additional elements in P Check valve Orifice										
	Switching symbol of the directional valve										
	Valve sectionsDirectional valvesType NSMD2, NSWP2, NBVP16, NBMD16, NG1, NZP16										
	Intermediate plates for series connection Type CZ: with pressure-reducing valve in P gallery 										
	 Intermediate plates for parallel connection type NZP with throttle and/or throttle check valves with pressure-reducing valves with short-circuit and by-pass valves for random switching of a 2nd speed 										
C	onnection l	olock = [Direct	mounting or packs)	nto type A, AF etc. con	nection blocks (i	for type	KA, M	IP, MPN,	HC, HK(F), HKL compact hydraulic	
	 Variant for pipe connection with/without pressure-limiting valve (A5) 										
Function

Connection blocks/adapter plates:

F		
BA2	BA2 A5	BA2 A8
Direct mounting onto type A, AF etc. connection blocks at type KA, MP, MPN, HC, HK(F), HKL compact hydraulic power packs	Version for pipe connection without pressure-limiting valve	Like version BA2 A5 but with check valve in R

Sub-plates for plate assembly valve



Additional options for the valve sections:

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



via proportional throttle in P and T gallery

Intermediate plate (series connection) with pressure-reducing Intermediate plates (parallel connection) valve for pressure reduction of the subsequent P gallery with pressure-reducing valve in P gallery .../NZP16(26)CZ... .../CZ... Μ (R) (P) ΤВ А Ρ M4 M5 Example: BAZ-CZ2/180/5R Example: .../NZP16CZ08/350/B0.8R/... Type CDK3 pressure-reducing valve set to 180 bar with check valve Type CDK0.8 pressure-reducing valve set to 350 bar with orifice and check valve in P gallery



Actuations:

М:	Solenoid actuation (p _{max} = 400 bar)	P:	Pneumatic
GM:	Solenoid actuation (p_{max} = 250 bar)	A:	Manual actuation
H:	Hydraulic actuation	T:	Pin
		К:	Roller

End plates







	Q _{max} [lpm]	p _{max} [bar]	Ports (BSPP)	Dimensions [mm]			m [kg]
			A, B, P, R, M	Н	В	т	Valve section
BA2	20	400	G 1/4, G 3/8	139	50	60	0,8

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

- BA2
- NSMD2W/GRK/B2.0/0
- NSMD2W/GRK/B2.0/0
- NSWP2D/B2.0/20/1
- NBVP16G/0
- 8 AC2001/35 L24

Type BA2 valve bank with four industrial standard valves mounted on sub-plates, two clamping functions for work piece clamping with combined option to adjust pressure and pressure switches, two additional functions for indexing and tool clamping

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

filter and pressure switch, setting: 45 bar

Parameters of the example circuit:

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







Associated technical data sheets:

- Type BA directional control valve banks: D 7788
- Type NZP intermediate plates: <u>D 7788 Z</u>

see compact hydraulic power pack section

Suitable connection block:

Type A: Page 32

Suited products for combination:

- Type NSMD clamping modules: <u>D 7787</u>
- Type NSWP directional spool valves: Page 84
- **Suitable compact hydraulic power packs:** Type NBVP directional seated valves: Page 156

Suitable accessories:

- Type DG pressure switches: Page 266
- Type AC diaphragm accumulators: Page 268

Suitable plugs:

with LEDs or to support the EMC or with features including economy circuit: <u>D 7163</u>

Compact hydraulic power packs

1.1 Valve bank type BVH

Type BVH valve banks can be very flexibly combined with type A connection blocks. Segments are mounted using a hollow screw in the P gallery. In addition to the seated valve functions, the additional functions in the P and R gallery (e.g. check valve, orifice in P gallery, filter, pressure switch in A gallery) have been integrated into the valve segment. The benefits of this technical design are the flexible bearing and the expansion options that can be easily adapted to the corresponding application at the end user. The main areas of application are hydraulic clamping systems and the machine tool industry.

Features and benefits:

- Very flexible expansion options and maintenance of valve banks at end user
- Compact and lighter design

Intended applications:

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



Nomen- clature:	Valve sections Directional seated valve Zero leakage
Version:	Valve sections for pipe connection
Actuation:	Solenoid
p _{max} :	400 bar
Q _{max} :	20 lpm

Design and order coding example

BVH 11	M/CZ/35/M/R/2	- 8	- G24		
			Solenoid v	voltage	12V DC, 24V DC, 110V AC, 230V AC
		End pla	ite 🔳 W	/ith tappe	ed plugs at P, R
			W	11th accur	nulator port and drain valve
	Valve sections	With in	dividual pr	essure rec	duction (parallel connection)
		Additio	nal elemen	its:	
		Pres	sure-reduci	ing valves	
		Orifi	ice and/or	check val	ve in P gallery
		Orifi	ice or restri	ictor cheo	k valve for A
		Retu	urn pressure	e block in	R gallery
		Pres	sure switch	nes for A	

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



Function

Connection blocks/adapter plates:

BVH

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

Valve sections:



Additional options for the valve sections:

Individual pressure reduction (parallel connection)

BVH 11 H/CZ...







Actuations:

M:	Solenoid	actuation	$(p_{max} =$	400	bar))
	Soccitoria	accaacion	(Pillax	100	Nui,	/

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

End plates:

without	-8
Tapped plug at P, R	with accumulator port and drain valve
	R - R - S

P

(A1F1/310)

- BVH 11 H/M/R/2 - BVH 11 M/M/R B2.5/3

Type BVH valve bank for direct mounting at type A (coding 2) connection block Valve sect:

- BVH 11 W/CZ 5/35/M/R/22 - 8 - G 24 for Valve section 1 with 3/2-way function switching symbol H, P check valve (coding R), no pressure switch pe A (coding 2)

Valve section 2 with 3/2-way function switching symbol M, check valve and orifice in P gallery (coding R, B, 2, 5) and pressure switch for A (coding 3)

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







	Q _{max} [lpm]	p _{max} [bar]	Ports (BSPP)	Dimensi [mm]	ons			m [kg]
			A, B, P, R, M	H	H1	В	Т	Valve section
BVH	20	400	G 1/4	60	343	40/50	60	0,8



Example circuit:

KA 281 SKT/Z 9.8

- AX 3 F 1 E/120

clamping pressure

- BVH 11 W/M/RH/2

- BVH 11 M/CZ5/35/M/RHB 2.5
- BVH 11 M/CZ5/35/M/RHB 2.5
- 8-X 24 AC 2001/60/3/A 3x400V 50 Hz

Type BVH valve bank with three valve segments,

two clamping functions with individually adjustable

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







Parameters of the example circuit:

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

Associated technical data sheets:

 Type BVH directional valve banks: <u>D 7788 BV</u>

Compact hydraulic power packs:

See section

"Compact hydraulic power packs"

Connection blocks:

Type A: <u>Page 32</u>

Combinable products:

- Directional seated valves type NBVP: <u>Page 156</u>
- Pressure-reducing valves type CDK, DK: <u>Page 196</u>

Accessories:

- Type DG pressure switches: <u>Page 266</u>
- Type AC diaphragm accumulators: <u>Page</u> <u>268</u>

Plug:

with LEDs including: <u>D 7163</u>

Pumps

1.2 Standard pumps and power packs

Radial piston pumps type R and RG	46
Variable displacement axial piston pumps type V30D and V30E	50
Variable displacement axial piston pump type V60N	54
Variable displacement axial piston pump type V40M	58



Radial piston pumps type R and RG



Variable displacement axial piston pumps type V60N



Standard pumps and power packs

Туре	Nomenclature/version	p _{max}	Q _{max}	V _{max}
R, RG	 Radial piston pump Individual pump Motor pump Hydraulic power pack 	700 bar	91.2 lpm (1450 rpm)	V _g = 64.18 cm ³ /rev
V30D, V30E	 Variable displacement axial piston pump Individual pump Pump combination 	Continuous: 350 bar Peak: 420 bar	65 392 lpm (1450 rpm)	V _{g max} : 45 270 cm ³ /rev
V60N	Variable displacement axial piston pump Individual pump Pump combination	Continuous: 350 bar Peak: 420 bar	85 185 lpm (1450 rpm)	V _{g max} : 60 130 cm ³ / rev
V40M	Variable displacement axial piston pump Individual pump Pump combination	Continuous: 250 bar Peak: 320 bar	65 lpm (1450 rpm)	V _{g max} : 45 cm ³ /rev

Standard pumps

1.2 Radial piston pumps type R and RG

The radial piston pumps consist of valve-controlled pump cylinders that are arranged radially. Higher volumetric flows can be achieved by arranging up to 6 radials in parallel. The pump is usually driven by an electric motor, which is connected to the pump via a flange and coupling. The closed pump housing allows for installation in a tank (hydraulic power pack) as well as installation outside a tank (motor pump). The possibility of a radial piston pump with several pressure outlets (several equal or different volumetric flows) is particularly innovative. Type RG with slide bearings is used in extreme operating conditions to increase the service life of the bearings. Compact control systems can be created by mounting various connection blocks and valve banks onto the cover plate of the hydraulic power packs.

Features and benefits:

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

Intended applications:

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



Nomen- clature:	Radial piston pump
Design:	Individual pump Pump complete with motor Hydraulic power pack
Omax:	700 bar
Q _{max} :	91.2 lpm (Vg = 64.18 cm³/rev)
tank max:	approx. 470 l

Design and order coding example

R 11,6	/ M 7,5	К			
	()ptions	Fluid level gauge Temperature switch Float switch		
F	unction, dri	i ve Motor ; With	pump 1/without industrial standard m	notor (output P _N in kW))
		 Hydrau Versi Cons Cove mote Com With 	ion with tank, with/without in sumable volume V _{cons.} 6 l to 450 er plate version (for installation or bination motor + pump (for installation n direct current drive (design 6	dustrial standard motor) l n on customer furnished stallation on customer 4 011)	r d tanks), with/without indust furnished cover plates and tan
Basic type, d	delivery flov	r [lpm] Ty Ad	pe R (version with roller bearin Iditional versions: With several pressure ports With separate ports for the flo e.g. as control oil supply Integrated switch-off valve at	ig) and type RG (versio ow of one or two pump t two pressure ports	on with slide bearing) elements (Q _{max} = 4,4 lpm)



Function

Individual pump

Pump complete with motor

Hydraulic power pack







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



General parameters and dimensions





Pump complete with motor



Hydraulic power pack



Design		Number of cylinders	Delivery flow Q _{pu} (lpm) (approximate reference value at 1450 rpm) and max. pressure p _{max} (bar)				e		Tank sizes	Dimensions [mm]			
			700 bar	550 bar	450 bar	250 bar	160 bar	P _N [kW]	V _{use.} [l]	D	L	L1 _{max}	m [kg] ²⁾
7631		2	0.18	0.28	0.43	0.92	-	0.250.55	645	130	53	109	3.2
		3	0.27	0.42	0.64	1.35	-						
		5	0.46	0.7	1.08	2.27	-						
6010		1	0.3	0.5	0.8	1.7	2.2	0.253	680	174	82.5	113	3.1
		2	0.6	1.0	1.6	3.3	4.4						
		3	0.9	1.5	2.5	5.1	6.5						
6011		5	1.4	2.6	4.2	8.3	10.9	0.555.5	6160	185	86	155	5.8
		7	2.1	3.7	5.8	11.8	15.3						
6012		10	2.7	5.3	8.2	16.8	21.7	2.211	20160	185	146	188	10.5
		14	4.0	7.4	11.6	23.5	30.4						
6014		20	6.1	11.0	17.4	35.0	43.4	5.522	80450	218	250	188	24.2
		28	8.0	15.0	23.0	47.0	60.8						
6016		42	12.7	22.0	34.5	70.0	91.2	1130	120450	238	311	212	39.1

The parameters listed here represent only a choice from avariety of possibilities.
Standard motor, design IM B 35 for pumps complete with motor or IM B 5 for hydraulic power packs.
Mass of the individual pump

Hydraulic power pack:

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



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





Associated technical data sheets:

- Radial piston pumps type R, RG: <u>D 6010</u>
- Motor pumps, hydraulic power packs type R, RG: <u>D 6010 H</u>
- Radial piston pumps with several pressure ports type R, RG: <u>D 6010 D, D 6010 DB</u>
- Radial piston pumps with control oil port type R: <u>D 6010 S</u>
- Hydraulic power packs with gear pump type Z: <u>D 6820</u>

Directly mountable valve banks:

- Type VB: <u>Page 130</u>
- Type BWH(N): <u>Page 138</u>
- Type SWR: <u>Page 88</u>
- Type SKP:<u>D 7230</u>

See also section "Devices for special applications"

- Press controls
- Devices for up to 700 bar

Standard pumps

1.2 Variable displacement axial piston pumps type V30D and V30E

The variable displacement axial piston pumps type V30D and V30E are designed for open circuits in industrial and mobile hydraulics and operate according to the swash plate principle. A thru-shaft is optionally available to enable the connection of additional variable displacement pumps or an auxiliary pump. In this context, type V30E represents a design according to the most recent findings in pump design. Above all this concerns the optimised self-suction speed, reduced noise emissions and pulsation, increased service life and significantly reduced weight. A wide range of controllers (modular principle) offers the user a wide range of application possibilities.Individual pumps or multiple pumps may be used for hydraulic circuits with several volumetric flows. Robust design, low performance/weight ratio, long service life (large bearing dimensions) and a swash plate angle indicator are amongst the additional benefits.

Features and benefits:

- Low noise emissions
- Wide range of controllers
- Full torque available at the second pump in tandem pump applications

Intended applications:

- Machines for forestry and agricultural purposes
- Cranes and lifting equipment
- Presses
- Municipal trucks



Nomen- clature:	Variable displacement axial piston pump
Design:	Individual pump Pump combination
p _{max} :	350 bar (continuous) 420 bar (peak)
Q _{max} :	65 392 lpm (1450 rpm)
V _{g max} :	45 270 cm ³ /rev



Design and order coding example

V30D - 095	R	SF	Ν	- 1	- 1	- XX	/LN	-2	/120	- 200	
										Pressure sp	pecification [bar]
									Torque se	tting [Nm]	Alternatively specification for power [kW] and speed [rpm]
								Additi	onal versi	ons = (= N	Conversion with L power controller Max. stroke limitation
							Controll	ers	see "Contr	oller types"	1
						Release					
					Pivoting	g angle i	ndicato	r Wi	th/without	t indicator o	or with pivoting angle pick-up
			1	Shaft ve	rsion	With/w	vithout t	hru-sh:	aft		
			Seal m	naterial	■ N ■ E ■ F	IBR (N) PDM (E) KM (V)					
	:	Shaft j	ournal	/flange		Spline sh SAE splin Parallel k	aft (DIN e shaft a ey (K)	5480) and flar	(D) nge (S)		
						DIN (W) SAE (F)					
1	Rotati	on dire	ection	Anti	-clockw	ise (L), c	lockwise	e (R)			
Basic type, nomi	nal si	ze	Indi	ividual p	umps						

Dual and multiple pumps (tandem pumps)

Function

Individual pump

Multiple pump



Controller types:

Power controller:

- To restrict the drive torque (L)
- With option to reduce the geom. delivery flow (Lf1)

Load-sensing controller:

- For proportional directional spool valve (LS)
- with pressure limitation (LSN)

Pressure controller:

- For constant pressure systems (N)
- With remote-control port (P)
- With remote-control port for systems that are very sensitive to vibration (Pb)

Flow controller:

- For maintaining a constant flow (Q)
- For maintaining a constant level at higher speeds (Qb)

Electro-hydraulic proportional control of the pump:

• For continuous delivery flow control using an electronic control card (V)

Controller:

• With hydraulic proportional control of the delivery flow (VH)

General parameters and dimensions

V30



(connection locations for clockwise operation)

	Geom. delivery volume	Delivery flow ¹⁾	Nom. pressure	Self-suction speed	Dimensions [mm] appr	sions approx.				m [kg]	
	V _g [cm³/rev]	Q _{max} [lpm]	p _{nom} (p _{max}) [bar]	n [rpm]	L	L1	H	H1	В	(with controller)	
V30E - 095	95	139	350 (420)	2600	300	63	190	50	190	59	
V30E - 160	160	232		2100	330	65	210	50	210	92	
V30E - 270	270	392		1900	399	79	326	50	242	126	
V30D - 045	45	65	350 (420)	2600	268	68	150	82	160	40 (46)	
V30D - 075	75	109		2400	310	80	170	86	178	60 (66)	
V30D - 095	95	139		2200	341	93	196	87	196	70 (76)	
V30D - 115	115	167	250 (300) ²⁾	2000	341	93	196	87	196	70 (76)	
V30D - 140	140	206	350 (420)	2200	363	90	212	85	212	85 (91)	
V30D - 160	160	238	250 (300) ²⁾	1900	363	90	212	85	212	85 (91)	
V30D - 250	265	380	350 (420)	1800	432	115	224	97	272	130 (136)	

1) 2) Approximate reference value at 1450 rpm Higher pressure is possible with reduced geom. delivery flow

Ports:

	Drain port	Auxiliary port	Suction port	Pressure port
V30E - 095	G 3/4	-	2 1/2"	1 1/4"
V30E - 160	G 3/4	-	2 1/2"	1 1/4"
V30E - 270	G 1	-	3"	1 1/2"
V30D - 045	G 1/2	G 1/4	1 1/2 "	3/4"
V30D - 075	G 3/4	G 1/4	2"	1"
V30D - 095	G 3/4	G 1/4	2"	1 1/4"
V30D - 115	G 3/4	G 1/4	2"	1 1/4"
V30D - 140	G 3/4	G 1/4	2 1/2 "	1 1/4"
V30D - 160	G 3/4	G 1/4	2 1/2 "	1 1/4"
V30D - 250	M 33x 2	Pipe ∅ 8	3"	1 1/2"



Example circuit:



Associated technical data sheets:

 Type V30D variable displacement axial piston pumps: <u>D 7960</u>, Type V30E: <u>D 7960 E</u>

Similar products:

- Type V40M variable displacement axial piston pump: Page <u>58</u>
- Variable displacement axial piston pump type V60N: Page 54
- Type K60N fixed displacement axial piston pump: D 7960 K
- Type M60N axial piston motor: <u>D 7960 M</u>

Suitable prop. directional spool valves:

- Type PSL/PSV sizes 2, 3 and 5: Page 104
- Type PSLF/PSVF sizes 3, 5 and 7: Page 110

Suitable accessories:

- Prop. amplifier type EV1M2: Page 276
- Programmable logic valve control type PLVC: <u>Page 278</u>

See also chapter "Equipment for special applications":

- Mobile hydraulics

Standard pumps

1.2 Variable displacement axial piston pump type V60N

Thanks to its sturdy construction, the variable displacement axial piston pump is designed for direct flange mounting to the power take-off on commercial vehicle gearboxes, or for standard connection using an SAE flange. The benchmark figures for this product are 130 cm³/rev and 450 bar end pressure, allowing for a wide range of applications. These are supported by a high self-suction speed rating and low noise level. Variations with thru-shaft for flange mounting additional variable displacement axial piston pumps and auxiliary pumps are also available. Several different controllers offer the user a wide range of application possibilities. Particular advantages with regard to the mutual coordination arise from a combined application of variable displacement axial piston pumps with proportional directional spool valves type PSV and possibly required load-holding valves type LHT and LHDV.

Features and benefits:

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

Intended applications:

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



Nomen- clature:	Variable displacement axial piston pump
Design:	Individual pump Pump combination
p _{max} :	400 bar (continuous), 450 bar (peak)
Q _{max} :	87 190 lpm (1450 rpm)
V _{g max} :	60 130 cm³/rev



Design and order coding example

V60N - 110	R	S F	Ν	- 1	- 0	- 03	/LSNR	-2	- 320				
								Additio	Pressure specification [bar] pnal versions With/without max. stroke limitation				
						(Controllers	Loa ■	ad-sensing controller: For proportional directional spool valve with pressure limitation (LSNR)				
								Pre ■	essure controller: For constant pressure systems (NR)				
								Pov	wer controller, intermediate plate to restrict the drive torque (/ZL)				
					F	Release							
				A	dditior	nal funct	ion						
			S	haft ve	rsion	With/w	With/without thru-shaft, radial ports						
		S	ieal m	aterial	N	BR (N), F	FKM (V)						
	9	Shaft jo	urnal/	flange	ISS/	SO 14 par AE-C, SAE	allel key sp E-B J 744 sp	lined s oline sh	haft (D) naft (S)				
					 D: S/ 	IN ISO 76 AE-C, SAE	553 (Y) E-B J 744 (F	-)					
	Rotati	on direc	tion	Anti-	clockwis	se (L), cla	ockwise (R)						
Basic type, nomi	inal si	ze 🔹	Indiv Tande	idual pu em pump	imps os								

Function



General parameters and dimensions

V60N









Characteristic values

	Geom. delivery volume	Delivery flow ¹⁾	Nom. pressure	Self-suction speed	Dimensi [mm]	m [kg]				
	V _g [cm³/rev]	Q _{max} [lpm]	p _{nom} (p _{max}) [bar]	n [rpm]	L	L1	Η	H1	В	
V60N - 060	60	87	350 (400)	2500	254	55	181	44	115	23
V60N - 090	90	130		2300	277	55	189	44	120	26,7
V60N - 110	110	160		2200	279	55	191	44	125	29
V60N - 130	130	188	400 (450)	2100	269,5	55	210	45,1	130	30,8

1) Approximate reference value at 1450 rpm

Ports:

	Drain port D	LS signal port	Suction port S	Pressure port P	
V60N - 060	3/4 ũ	G 1/4	Flange Ø 1 1/2	G 1	
V60N - 090					
V60N - 110					
V60N - 130					



Example circuit

V60N-130 RSFN-1-0-0.00 / LSNR-2-250 PSV 31/D280-2

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

PSV 31-1

- A2 L 25/25/EA1/2
- A2 L 25/25/EA1/2
- A2 H 3/3/EA1/2 DRH
- A2 H 3/3/EA1/2 DRH
- E1-G24



Associated technical data sheets:

Type V60N variable displacement axial piston pump: <u>D 7960 N</u>

Similar products:

- Variable displacement axial piston pumps type V40M: <u>Page</u> 58
- Type V30D and V30E variable displacement axial piston pumps: See also chapter "Equipment for special applications": Page 50
- Type K60N fixed displacement axial piston pump: <u>D 7960 K</u>
- Type M60N axial piston motors: <u>D 7960 M</u>

Suitable prop. directional spool valves:

- Type PSL/PSV sizes 2, 3 and 5: Page 104
- Type PSLF/PSVF sizes 3, 5 and 7: Page 110

Suitable load-holding valves:

Type LHK, LHDV, LHT: Page 212

- Mobile hydraulics

Pumps

1.2 Variable displacement axial piston pump type V40M

Thanks to its sturdy construction, the variable displacement axial piston pump is designed for a standard connection using an SAE flange. The benchmark figures for this product are 45 cm³/rev and 320 bar end pressure, allowing for a wide range of applications. These are supported by a high self-suction speed rating and low noise level.

Variations with thru-shaft for flange mounting additional variable displacement axial piston pumps and auxiliary pumps are also available. Several different controllers offer the user a wide range of application possibilities. Particular advantages with regard to the mutual coordination arise from a combined application of variable displacement axial piston pumps with proportional directional spool valves type PSV and possibly required load-holding valves type LHT and LHDV.

Features and benefits:

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

Intended applications:

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



Nomencla- ture:	Variable displacement axial piston pump
Version:	Individual pump Pump combination
p _{max} :	250 bar (continuous), 320 bar (peak)
Q _{max} :	65 l/min (1450 rpm)
V _{g max} :	45 cm ³ /rev

V40M - 045	R	Т	Х	V	- 2	- 0	- 00	/LS-DA	
								Controllers	 Load-sensing controller: for proportional directional spool valve with pressure limitation (LS-DA)
									 Power controller: can be controlled electrically, with falling characteristic curve (P1R1)
							Release		
						Additio	nal func	tion	
					Shaft ve	ersion	With/	without thru-s	haft, radial ports
				Seal m	aterial	FKM	(V)		
		1	 Flange	S/	AE-B-2-	Hole J74	44 (X)		
	S	Shaft	journa	al S	Spline s	haft SAE	3-B-B J 7	744 (T)	
	Rotati	on di	rectio	n A	nti-clo	ckwise (L), clock	wise (R)	
Basic type, nomi	nal siz	ze	Indivi Tande	dual p m pum	umps 1ps				

Design and order coding example



Function



General parameters and dimensions

V40M







	Geom. displace ment	Delivery flow ¹⁾	Nom. pressure	Self-suction speed	Dimensions [mm]				m [kg]
	V _g [cm³/rev]	Q _{max} [lpm]	p _{nom} (p _{max}) [bar]	n [rpm]	L	L1	Н	В	
V40M - 045	46,5	65	250 (320)	2900	208,5	45,9	186	175	20,9

1) Approximate reference value at 1450 rpm

Connections:

	Drain port T	LS-signal port	Suction port	Pressure port P
V40M - 045	7/8-14 UNF-28	M12 x 1.5	SAE 1 1/2" 500 psi	SAE 1" 6000 psi

Associated technical data sheets:

Variable displacement axial piston pump type V40M: <u>D 7961</u>

Similar products:

- Variable displacement axial piston pumps type V60N: Page 54
- Variable displacement axial piston pumps type V30: <u>Page 50</u>
- Fixed displacement axial piston pump type K60N: <u>D 7960 K</u>
- Axial piston motors type M60N: <u>D 7960 M</u>

Prop. directional spool valve:

- Type PSL/PSV sizes 2, 3 and 5: <u>Page 104</u>
- Type PSLF/PSVF size 3, 5 and 7: <u>Page 110</u>

Load holding valves:

Type LHK, LHDV, LHT: <u>Page 212</u>

See also chapter "Equipment for special applications":

- Mobile hydraulics

Pumps

1.3 Dual stage pump

Dual stage pumps type RZ

62



Dual stage pump type RZ



Dual-stage pumps

Туре	Nomenclature/Design	p _{max}	Q _{max}	V _{max}
RZ	Dual-stage pumpRadial piston pump and gear pump	Radial piston pump 700 bar	91.2 lpm	
	Individual pumpMotor pumpHydraulic power pack	Gear pump 150 bar	135 lpm	V _{tank max} : approx. 470 l

Dual stage pump

1.3 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 one single electric motor, which is connected with the dual-stage pump by means of a flange and a coupling. Compact control systems (e.g. for presses) can be created by mounting two-stage valves and valve banks onto the cover plate of hydraulic power packs.

Features and benefits:

- Two-stage circuits
- Hydraulic power packs with direct valve mounting
- Intended applications:
- Presses
- Construction and construction materials machinery



Nomen- clature:	Dual stage pump (radial piston and gear pump)
Design:	Individual pump Pump complete with motor Hydraulic power pack
p _{max} :	700 bar (radial piston pump) 150 bar (gear pump)
Q _{max} :	Radial piston pump, 91.2 lpm (high pressure) ($V_g = 64.18 \text{ cm}^3/\text{rev}$) Gear pump,135 lpm (low pressure) ($V_g = 89.6 \text{ cm}^3/\text{rev}$)
V _{tank max} :	approx. 470 l

Design and order coding example



RZ 0,9	/2 - 16 W 7,5				
	Function, drive [kW]	Motor pump With /without industrial standard motor			
		 Hydraulic power packs Version with tank, Consumable volume V_{nom} 6 l to 450 l Cover plate version (for installation on customer furnished tanks), with/without industrial standard motor With built-in two-stage valves type NE or switch units type CR 			
	 Hydraulic power packs for direct pipe connection With tank, consumable volume V_{nom} 12 l to 400 l With/without industrial standard motor 				
(ear pump, delivery flow low pre	ssure section [lpm] Gear pump size 1 to 3			
Basic type,	delivery flow high pressure secti	ion [lpm] Type RZ (radial piston pump/gear pump), Type RGZ (version with slide bearing for increased service life), Type RF (version where the high pressure section features a 2-hole SAE-flange)			
		 Individual pump (high and low pressure section or only high pressure section alone) 			

- Motor pump
- Hydraulic power pack

Function

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







Pump complete with motor

Hydraulic power pack





General parameters and dimensions

Individual pump



Hydraulic power pack



For dimensions of motor pumps and hydraulic power packs, see Page 46

High-pressure section (like radial piston pump type R)

Design	Delivery flow Q _{pu} [lpm] and max. pressure p _{max} [bar] (approx. reference value at 1450 rpm)			Max. Combina- permissible tion with gear drive pumps power ¹⁾		Tank sizes ²⁾ (selectable)	Dimensions [mm]		m [kg]
	700 bar	450 bar	250 bar	P _N [kW]	Size	Vusable [l]	H	D	
7631	RZ 0,18	RZ 0,64	RZ 2,27	1.5	1	13 42	58	130	3.1
6910	RZ 0,9	RZ 2,5	RZ 5,1	3	2	22 80	85.5	175	3.1
6911	RZ 1,4	RZ 5,8	RZ 11,8	11	2 and 3	32 400	85	185	6.3
6912	RZ 2,7	RZ 8,2	RZ 16,8	11		60 400	125	185	10.5
6914	RZ 8,0	RZ 23,0	RZ 47,0	22		100 400	221	218	23.9
6916	RZ 12,7	RZ 34,5	RZ 70,0	30		100 400	320	238	39.1

Industry standard motor shape IM B 35 for motor pumps or IM B 5 for hydraulic power packs Minimum size determined by overall height of the pump

1) 2)

Low-pressure section (gear pump)

Size	Delivery flow $Q_{pu}[lpm]$ and matrix	Dimensions [mm]	m [kg]		
	120 bar	80 bar	40 60 bar	H1	
/1	5.2	8.8	11.3	70 86	1.2
/2	12.3	16	37	96 132	3.1
/3	24	110	135	140 178	8.4

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



Example circuit:

RZ 4,0/2-12,3-B 75-V 5,5 - 3 x 690/400V 50 H

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

GR 2-1-1-3/8 C-G 24



Associated technical data sheets:

- Dual-stage pumps type RZ: <u>D 6910</u>
- Motorpumps and hydraulic power packs type RZ: <u>D 6910 H</u>
- Dual stage pump type RF: <u>D 7410</u>

Similar products:

 Radial piston pumps and hydraulic power packs type R and RG: <u>Page 46</u>

Valves:

- Two-stage valves type NE: <u>Page 206</u>
- Switching valves type CR: Page 164
- See also section "Devices for special applications":
- Press controls
- Devices for up to 700 bar

Pumps



Air driven hydraulic pumps type LP

68



Air driven hydraulic pump type LP



Air-driven hydraulic pumps

Туре	Nomenclature/Design	p air max	P hydr max	Q _{max}
LP	Air-driven hydraulic pump	10 bar	160 1500 bar	0.9 12 lpm
	 Individual pump 			
	 Hydraulic power pack 			

Air driven hydraulic pumps

1.4 Air driven hydraulic pumps type LP

The hydraulic pumps type LP are reciprocating, valve-controlled plunger pumps that are available in three sizes. They are basically oscillating pneumatic/hydraulic pressure intensifiers. Stroke reversal is controlled automatically. The stroke frequency is dependent on the air pressure set and the current hydraulic counter pressure, and comes to a complete stop when the pressure limit is reached. As an air-driven hydraulic power pack, the tank version of this type of pump can be combined with directional seated valves for use in different applications. This type of pump is used in laboratory presses, jig construction and lubrication technology, for example. Since they are supplied with energy by means of compressed air, they can be used in potentially explosive atmospheres.

Features and benefits:

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

Intended applications:

- Construction and construction materials machinery
- Jig construction
- Testing and laboratory equipment



Nomen- clature:	Air driven hydraulic pumps
Design:	Individual pump Hydraulic power pack
Phydraulicmax :	1601500 bar
p _{airmax} :	10 bar
Q _{max} :	0.912 lpm



Design and order coding example

LP 125 - 16	E /S 81
	Additional elements Suction parts for hydraulic pumps Tanks for hydraulic pumps
	Design Hydraulic pump Ready-to-connect version Individual version for self-installation
	 Hydraulic power pack (with type VB, BWH, BWN valve banks) Tank version, usable volume V_{usable} 5 l to 28 l Cover plate version (for installation in self-manufactured oil tanks)
Basic type, size	Type LP, size 80, 125, 160

Function



General parameters and dimensions

LP







No piping for type LP...-..

Basic type and size		p _{max} [bar]	Pressure ratio	Geom. volume per double stroke V _{hydr} [cm ³]	Tapped port (air) Pipe diameter for pressure connection (hydr)	Dimensions [mm]				m [kg]
						Н	H1	В	Т	
LP80-	8	700	1:200	1.5	G 1/4 Ø6 mm	119	94	121	85	5
	10	630	1:63	2.3						
	12	430	1:43	3.4						
	16	240	1:24	6						
LP125-	8	1500	1:243	2	G 3/8	159	114	156	135	8.5
	10	1500	1:155	3.1	Ø8 mm, Ø10 mm					
	12	700	1:108	4.5						
	16	600	1:60	8						
	18	470	1:47	10.2						
	20	380	1:38	12.6						
	25	240	1:24	19.6						
	30	160	1:16	28.3						
LP160-	8	1500	1:400	2	G 1/2	228	136	156	175	11.5
	10	1500	1:255	3.1	Ø8 mm, Ø10 mm					
	12	700	1:177	4.5						
	16	700	1:100	8						
	18	700	1:78	10.2						
	20	620	1:63	12.6						
	25	390	1:40	19.6						
	30	265	1:24	28.3						



Example circuit:

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



Associated technical data sheets:

- Hydraulic pumps type LP: <u>D 7280</u>
- Hydraulic power packs type LP: <u>D 7280 H</u>

Valve banks:

- Type VB: <u>Page 130</u>
- Type BWH(N): Page 138

See also section "Devices for special applications":

- Press controls
- Devices for explosion hazardous areas (conforming ATEX)
- Devices for up to 700 bar
Pumps

1.5 Hand pumps

Hand pumps type H, HE, HD and DH

74



Hand pumps type H, HE, HD, and DH



Hand pumps

Туре	Nomenclature/Design	Actuation	p _{max}	Q _{max}
H, HE, HD, DH	Piston pumpSingle actingDouble acting	Hand pump	80 800 bar	4 64 cm³/stroke

Hand pumps

1.5 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.

Features and benefits:

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

Intended applications:

- Ship building
- Mining machinery
- Jigs
- Test and laboratory equipment



Nomen- clature:	Piston pump
Design:	Single acting hand pump Double acting hand pump
p _{max} :	80 800 bar
V _{max} :	4 64 cm ³ /stroke

Design and order coding example

HD 13	AS	- K 0,5	- 110						
		I	Pressure setting (bar)						
	With/without tank Usable volume V _{use} . 0,35 l and 0,5 l								
	Additio	nal element	ts 🛛 Drain valve (A)						
			 Pressure limiting valve (tool or manually adjustable) (S) 						
Basic type,	size	Type H (sin Type HE (si Type DH (d Type HD (d	ngle acting, open design), ingle acting, encapsulated design) louble acting, open design) louble acting, encapsulated design)						

- With/without pressure resistant suction port
- Versions for manifold mounting

Function

Design with pressure limiting valve and drain valve





General parameters and dimensions



DH..



HE.. and HD..



	p _{max} [bar]	V _{max} [cm ³ /stroke]	Tapped ports (BSPP)		m [kg]	
			Р	S		
H 16	350	6	G 1/4	G 1/4	3.1	
H 20	220	9.4				
H 25	150	14.7				
HE 3	800	3	G 1/4	G 1/4 and G 3/8	8 4.8	
HE 3	800	3				
HD 13	350	13				
HD 20	220	20				
HD 30	150	30				
DH 40	150	51	G 3/8	G 3/8	6.2 6.6	
DH 45	100	64				

Associated technical data sheets::

Hand pumps type H: <u>D 7147/1</u>

See also section "Devices for special applications":

- Devices for up to 700 bar

Valves

2.1 Directional spool valves

Directional spool valves type SG and SP	80
Directional spool valves type SW, SWP and NSWP	84
Directional spool valves type SWR and SWS	88
Directional spool valves type HSRL and HSF	94
Manually actuated directional spool valves type DL	98
Proportional directional spool valves type PSL and PSV	104
Prop. directional spool valves type PSLF and PSVF - Manifold	
mounting design	110
Clamping modules type NSMD2	116



Directional spool valves type SWR and SWS



Proportional directional spool valves type PSL and PSV



On/off directional spool valves

Туре	Nomenclature/version	Actuation	p _{max}	Q _{max}
SG, SP	 Directional spool valve, individual valve Individual valve for pipe connection Individual manifold mounting valve 	- Solenoid - Manual - Mechanical - Pressure-actuated	200 400 bar	12 100 lpm
SW, SWP, NSWP	 Directional spool valve, individual valve For pipe connection Individual manifold mounting valve Directional spool valve, valve bank With sub-plates Combination with hydraulic power packs 	- Solenoid	315 bar	12 25 lpm
SWR, SWS	 Directional spool valve, valve bank Connected in series Combination with hydraulic power packs 	- Solenoid	315 bar	12 25 lpm
HSRL, HSF	 Directional spool valve, individual valve Individual manifold mounting valve Directional spool valve, valve bank Connected in series 	- Electro-hydraulic - Hydraulic	up to 400 bar	80 160 lpm

Throttling directional spool valve

Туре	Nomenclature/version	Actuation	p max	Q _{max}
DL	Throttling directional spool valve, valve bankConnected in series	- Manual - Pressure	250 315 bar	12 90 lpm

Proportional directional spool valve

Туре	Nomenclature/version	Actuation	p max	Q _{max}	
PSL, PSV	 Prop. directional spool valve (Load-Sensing), valve bank Connected in series 	- Manual - Electro-hydraulic - Pressure	400 420 bar	Q _{consumer max} 3 240 lpm Q _{Pu max} approx. 300 lpm	
PSLF, PSVF, SLF	 Prop. directional spool valve (Load-Sensing), individual valve Individual manifold mounting valve Valve bank With sub-plates 	- Manual - Electro-hydraulic - Pressure	400 420 bar	Q _{consumer max} 3 470 lpm Q _{Pu max} approx. 1000 lpm	

Valve combinations

Туре	Nomenclature/version	Actuation	p max	Q _{max}
NSMD	Combination of directional spool valve and pressure-reducing valve As individual valve Individual manifold mounting valve	- Solenoid	120 bar	25 lpm
	As valve bank Valve banks are available with BA			



Directional spool valves

2.1 Directional spool valves type SG and SP

Directional spool valves type SG and SP can be supplied in 5 different sizes and are available in two versions, either for pipe connection (SG) with and without pressure-limiting valve, or as a manifold mounting valve (SP). They are used to control the direction of movement of consumers such as hydrostatic motors and hydraulic cylinders.

The sturdy design means that these valves are suitable for a wide range of applications, such as ship building or mobile hydraulics. The different actuations can also be used for this purpose.

Features and benefits:

- Sturdy design
- Suited for maritime applications
- Various actuations

Intended applications:

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



Design and order coding example

SP 1 SG 3	D E	3E	- A - MD 3/24	- 120	
				Pressure s	etting pressure limiting valve [bar]
			Actuation mod	le	
		Pressu	re limiting val	ve	
	Functi	on	 Parallel- or s Directional s negative (sl SP 1 with/w 	series conne spool valves ightly floati rithout chec	ection either with positive (blocked between switching positions) or ng position) overlap k valve insert
Basic ty	/pe and	size	Directional sp Directional sp	ool valve S ool valves t	G 0 to 5, SP 1, SP 3, SP 5 ype SP for manifold mounting, sizes 1, 3, 5



Function

Basic symbol

Symbol SG SP G С D Ε Ν W R ۷ Ζ U Individual valve for Individual valve for + + + + X $X | \stackrel{\scriptscriptstyle \perp}{}_{\scriptscriptstyle \rm T} \stackrel{\scriptscriptstyle \perp}{}_{\scriptscriptstyle \rm T} | \stackrel{\scriptscriptstyle \perp}{}_{\scriptscriptstyle \rm T} |$ L L pipe connection manifold mounting - F ł H а а а а B_ Ρ Ρ В 0 0 0 0 A_ R b b ┢ RHF B With pressure limiting F S Х L Н Y RHP В A valve Ŀ [R

-Symbols Z, U, X: Only size 2, 3, and 5

Actuations:

Manual		Solenoid		Mechanical		Pressure		Double acting		
А, АК	C, CK	ME, MD	MU	RE, RD	BE, BD	NE, ND	NU	NM	KD	KM
Spring return	Detent			Roller head	Pin head	Pneumatic		Hydraulic	Pneumatic / manual	Hydraulic / manual
	of the prove									
		Solenoid 12V DC, 2 230V AC o voltage of	voltage: 4V DC, other n request	Actuation fo 90 280 N on size	orce: I depending	Control pressure: Pneumatic 5 10 bar Hydraulic 12 20 bar				



General parameters and dimensions

SG with manual actuation



SP with solenoid actuation





	Q _{max} [lpm]	Operating pressure p _{max} [bar] for actuation			Ports (BSPP)	Dimensions [mm]				m _{max} [kg]
		Solenoid	Mechanical	Manual/ pressure		Η	H1	В	Т	
SG 0	12	200	400	400	G 1/4, G 3/8	59.5	151	39.5	51	0.8 1.0
SG 1	20	200	400	400	G 3/8	59.5	151	39.5	51	0.8 1.0
SG 2	30	315	400	400	G 3/8	max. 100.5	342	49.5	73	2.5 5.7
SG 3	50	315	400	400	G 1/2	max. 100.5	342	49.5	73	2.5 5.7
SG 5	100	200	315	400	G 1	110	342	50	80	2.9 6.1
SP 1	20	200	400	400	-	59.5	151	40	51	0.8 1,0
SP 3	50	315	400	400	-	94.5	342	49.5	73	2.5 5.7

Associated technical data sheets:

- Directional spool valves type SG, SP: <u>D 5650/1</u>
- Actuations:
 - Manual: <u>D 6511/1</u>
 - Solenoid: <u>D 7055</u>
 - Mechanical: <u>D 5870</u>
 - Pressure: <u>D 6250</u>

Similar products:

 Directional spool valve connected in parallel and in series type SKP, SKH: <u>D 7230</u>

Plugs:

- With LEDs etc.: <u>D 7163</u>
- With economy circuit: <u>D 7813</u>, <u>D 7833</u>

Directional spool valves

2.1 Directional spool valves type SW, SWP and NSWP

These directional spool valves are designed as individual valves either for pipe connection (type SW) or for manifold mounting (type SWP, NSWP) or as valve bank (type SWP, NSWP). Actuation is via directly acting pressure resistant single stroke solenoids (wet armature); type NSWP may feature twin solenoids enabling two speed rates or prop. solenoids which may be combined also with a stroke limitation. Versions with ATEX-approval are available as well. The individual manifold mounting valves can be combined with sub-plates enabling pipe connection plus an optional pressure limiting valve. The valve sections type NSWP can be combined with various options either on the pump side e.g. check valves, throttles, or orifices plus orifices or restrictor check valves on the consumer side.

Features and benefits:

- Compact valve banks
- Simple actuation of proportional functions
- Various versions
- Combinations with NG6 available

Intended applications:

- Machine tools chipping (milling, drilling, turning, grinding)
- Construction and construction materials machinery
- Offshore and marine technology
- Road vehicle construction



Nomen- clature:	Directional spool valve
Design:	Individual valve for pipe connection Individual manifold mounting valve Valve bank with sub-plates Combination with hydraulic power packs
Actuation:	Solenoid
p _{max} :	315 bar
Q _{max} :	12 25 lpm



Design and order coding example

NSWP2	G	/M	/R	/ ABR1,0	/50	/G24	- 3/8						
						Indiv. connection block		nection block	For direct installation in the pipe work, ports G 3/8 (BSPP) (type NSWP and SWP2), with/without check valve (manually or tool adjustable) between P and R (type SWP1)				
						voltage of	r the actu	ation solenoids	Solenoids with various plug versions				
Pressure switch or pressure gauge at A or B													
Additional elements at A and/or B Restrictor check valve or orifice													
			Additio	nal elements	at P	Check val	ve or orific	ce					
	:	Solenoi	d versi	on ON/O Soler Prop Doub Soler)FF-soler noid with . solenoi ole solen noid vers	noid (p _{max} = h detent id with/wit oid (two s sion confor	= 315 bar) thout strol peed rates rming ATE)	ke limitation (limi ;) K (p _{max} = 210 bar)	iting Q _{max})				
	Functi	on	Indiv Indiv	. valve with ch . valve with 6,	1eck valv /2-way f	ve or orific function	e in galler	ry P and/or check	valve in gallery R (type SWP)				
Basic type, s	size	Direct NSWP	ional sp size 2,	ool valve SW, connection ho	SWP size	e 1 and 2 ern NG 6 (C	ETOP)						

Function

Sub-plate for pipe connection

- 1/4 S(R)

И B A Ρ ł R - 3/8 И В

Sub-plate with pressure limiting valve¹⁾

Only for type SWP 1
 Only for type NSWP and SWP 2

Valve sections

Basic symbols

Basic sym	ibols	Symbo	Symbol										
Individua	l valve	May be	e connect	ed eithe	er in par	allel or i	in series	within a	valve ba	ank			
SW	SWP / NSWP	G	D	E	0	C ³⁾	Ν	В	W	К	Q	R ³⁾	U ³⁾
		MX + + + ⊻ Only c SW1)		$\frac{1}{1}$	\mathbb{A}	$\frac{1}{1}$	bank (o	willy type	Spo	pol valve	es suited	for prop	
		L	F		Н	S		Y	G		1	D	
									<u>XIIIX</u>				

3) Only for type SWR 1

Sub-plate²⁾



General parameters and dimensions





				-	~81		~81		
	Q _{max} [lpm]	p _{max} [bar]	Ports (BSPP)	Dimensions [mm]			m [kg]		
				Н	В	Т	Individual directional spool valve	Sub-plate	
SW/SWP 1	12	315	G 1/4	77 90	40	40 44	1.1 1.5	0.6 0.7	
SW/SWP 2	25	315	G 3/8, G 1/4	78 82.5	60 70	40 45	1.1 2.4	approx. 0.8	
NSWP2			NG 6						

Circuit example:

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



Combinable products:

- Valve bank type BA: <u>Page 34</u>
- Intermediate plate type NZP: <u>D 7788 Z</u>
- 6/2-way directional valve: **Sk 7951-J-6/2**

Associated technical data sheets:

- Directional spool valves type SW: <u>D 7451</u>
- Directional spool valves type SWP: <u>D 7451 P</u>
- Directional spool valves type SWR: <u>D 7451 R</u>
- Directional spool valves type NSWP: D 7451 N

Plugs:

- With LEDs etc.: <u>D 7163</u>
- With economy circuit: <u>D 7813</u>, <u>D 7833</u>

Similar products:

- Valve banks type SWR and SWS: <u>Page 88</u>
- Clamping modules type NSMD: <u>Page 116D 7787</u>

See also section "Devices for special applications":

- Industrial trucks
- Devices for explosion hazardous areas, conforming ATEX
- Proportional valves

Directional spool valves

2.1 **Directional spool valves type SWR and SWS**

These directional spool valves are designed as valve bank. Actuation is via directly acting pressure resistant single stroke solenoids (wet armature); type SWS may be controlled also via twin solenoids enabling two speed rates or via prop. solenoids optionally with a stroke limitation. Versions with ATEX-approval are available as well. The valve sections consist of an end plate and a connection block (for pipe connection) or an adapter plate (for direct mounting to the hydraulic power packs), held together by a tension rod.

With type SWS, the valve sections can be fitted with additional functions, such as double check valves, load-holding valves or precharge valves etc., in ancillary blocks on the consumer side. It is also possible to integrate a check valve, throttle, orifice or pressure compensator on the pump side. The directional spool valves are primarily used in mobile hydraulics.

Features and benefits:

- Combination with lifting modules available (for fork lifts)
- Proportional movements can be controlled independently from the load
- Wide range of ancillary blocks
- Compact

Intended applications:

- Material handling (industrial trucks etc.)
- Wind turbines
- Construction and construction materials machinery
- Handling and assembly technology (industrial robots etc.)



Nomen- clature:	Directional spool valve
Design:	Valve bank Combination with hydraulic power packs
Actuation:	Solenoid
p _{max} :	315 bar
Q _{max} :	12 25 lpm



Design and order coding example

SWR1	A-6/23	0 - GG	- 1	- G24							
			9	Solenoid	1 voltage 12V DC, 24V DC, 110V AC, 230V ACSolenoids with various plug versions						
	 End plate Additional ports P and/or R (P can be blocked) Idle circulation valve (ON/OFF, proportional) End spool valve 										
		Valve sec	tions	DirecAddit	ectional spool valve ditional options for the valve sections:						
				 O) Co Va 	Options upstream (orifice, flow controller) Consumer-side additional functions in ancillary block, e.g. double check valves, shock valves (load-holding valves etc.)						
	Connectio	on block/ada	pter pla	te =	Pressure limiting valve (for pipe connection) For direct mounting at compact hydraulic power packs (type HK, HC, MP) For direct mounting at hydraulic power packs type R Idle circulation valve 3-way flow controller Adapter plates with optional connection of a pressure switch type DG3 for gallery P						
Basic type	e, size	Type SWR 1 a Type SWC 1 fo	nd SWS a	2 mounting	ng at compact hydraulic power packs type KA, HC, MP, HK						

Function

Connection blocks:



With tool adjustable pressure limiting valve (for pipe connection)

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

Valve sections:

Basic symbol

Symbol



-											
G	D	E	0	C	Ν	В	W	К	Q	R	U
						MX HX	WIIX	ATTX			MT TW
Only connected in series within a valve bank						Spool valves suited for prop. actuation					
L	F	Н	S		Y	G			D		



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



End plates:

SWR 1/SWS 2





SWR 1, SWS 2





	Q _{max} [lpm]	p _{max} [bar]	Ports	Dimensions [mm]		m _{max} [kg]		
				Н	В	Т	Individual section	Connection block
SWR 1	12	315	G 1/4	77 - 90	40	40	1.1 - 1.5	0.6 - 0.7
SWS 2	25	315	G 3/8, G 1/4	78 - 82.5	60	40	1.1 - 2.4	approx. 0.8



Circuit example:

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

Associated technical data sheets:

- Directional spool valve banks type SWR: <u>D 7451 R</u>
- Directional spool valve banks type SWS: <u>D 7951</u>

Suited products for combination:

Pressure switches type DG3..., DG5.E: <u>Page 266</u>

Suitable plugs:

- With LEDs etc.: <u>D 7163</u>
- With economy circuit: <u>D 7813</u>, <u>D 7833</u>

See also chapter "Equipment for special applications":

- Forklift trucks and lifting equipment
- Mobile hydraulics
- Devices for explosive environments (ATEX-compliant)
- Proportional valves

Directional spool valves

2.1 Directional spool valves type HSRL and HSF

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 taken internally from the main circuit or fed externally from a separate control oil circuit. Harsh switching operations and the risk of decompression surges, particularly in the event of high pressure and large consumer volumes, can be avoided (except with HSRL 3) by using adjustable thread type throttles (adjustable response time). Standard connection blocks or connection blocks with an idle circulation valve, a pressure-limiting valve and integrated pressure-reducing valve are available for series connection. With the HSRL 3 version it is also possible to arbitrarily select different pressure levels.

Features and benefits:

- Soft shifting of high flow
- Suitable for high pressures due to steel housing
- Hydraulic pilot actuation via compact twin solenoids
- Versions conforming ATEX

Intended applications:

- Mining equipment (incl. oil exploration)
- Cranes, lifting-lowering devices
- Construction and construction materials machinery
- Material handling (forklift trucks etc.)

Design and order coding example



Nomen- :lature:	Directional spool valve
Design:	Individual manifold mounting valve Valve bank in series connection
Actuation:	Electro-hydraulic Hydraulic
D _{max} :	400 bar
Q _{max} :	80 160 lpm

HSR3	/B31E	- C1WG	- 1	- G24	- 300						
					Pressure	setting pressure limiting valve [bar]					
Solenoid voltage 12V DC, 24V DC, 98V DC, 205V DC, 110V AC, 230V AC at HSRL: Solenoid conforming ATEX											
	End plate Internal or external control oil return										
	,	Valve sectio	ns W	/ith/witho	ut adjusta	ble switching speed					
	Connection	block •	With/w	vithout pre	essure lim	iting valve (tool or manually adjustable)					
		•	Intern	al or exter	nal contro	oil supply (max. 160 bar)					
	Type HSRL: Ancillary blocks to the connection block with various pressure stages										
Basic type	and size	Type HSF:	Manifol	d mountin	a						

Type HSRL: Size 3 directional spool valve bank

Function

Connection blocks (HSR, HSRL):

C 321



With internal control oil supply picked up from P gallery, idle circulation valve and pressure-limiting valve, optional ancillary blocks for three additional pressure stages

Valve sections:

Basic symbol		Symbol											
HSF	HSRL	G	D	E	С	W	В	L	Н	F			
							XH						
Manifold mounting valve	Valve section	All symbols	are also avai	lable with ac	ljustable res	ponse time (n	not for type I	HSRL 3)					
End plates: HSRL													



General parameters and dimensions



HSRL 3



End plate

	Q _{max} [l/min]	p _{max} [bar]	p _{contr.} [bar]	Ports (BSPP)		Dimensions [mm]			m [kg]		
				A, B, P, R	M, X, Z	Н	В	Т	Individual spool valve or valve section	Connection block	
HSF 3						137	59	126			
HSRL 3						see illustration			2.0	1.7 4.0	
HSF 4						157	70	184			



Circuit example:

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

Size 3 valve bank type HSRL, connection block with integrated pressure-reducing valve, idle circulation valve, pilot-controlled pressurelimiting valve, main pressure-limiting valve factory set to 200 bar, second pressure stage set to 100 bar, two valve sections with the symbols D and G and a standard end plate, solenoid voltage 24V DC



Associated technical data sheets::

- Directional spool valve type HSR: <u>D 7493</u>
- Directional spool valve type HSRL: **Sk 7493 RL**
- Directional spool valve type HSF: <u>D 7493 E</u>
- Directional spool valve type HSL: D 7493 L

Plugs:

- With LEDs etc.: <u>D 7163</u>
- With economy circuit: <u>D 7813</u>, <u>D 7833</u>

Directional spool valves

2.1 Manually actuated directional spool valves type DL

The directional spool valve bank type DL is used for smooth manual measuring for general hydraulic systems with single and double-acting consumers as well as stationary and mobile lifting devices.

This measuring process is caused by the bypass pump venting line gradually closing and the consumer line simultaneously opening. The movement begins when the throttling effect in the bypass channel causes the pressure to reach the consumer level.

The DLS directional spool valves are designed for industrial trucks (forklift trucks). The primary function (hydraulic cylinder) is therefore integrated into the connection block. A version with a priority flow divider in the connection block is also available. Different additional functions for the valve sections (e.g. shock valves) extend the range of possible applications.

Features and benefits:

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

Intended applications:

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



Nomen- clature:	Throttling directional spool valve
Design:	Valve bank, featuring integrated by-pass idle pump circulation
Actuation:	Manual: Spring return, detent Pressure: Pneumatic
p _{max} :	250 315 bar
Q _{max} :	12 90 lpm



Design and order coding example

DL3	1	- 3	- GGD	- B/E1	- 2	- 210	
					End pla	Pressure s te	pecification [bar]
				Actuation,	mounti	ng	
			Valve sect	tions –	Directio Valve se	nal spool ection opti	valve ons:
					 Seco Inter Lock Addi Addi shoc Redu 	ndary pres mediate p -out circu tional fun tional fun k valves, l cing inter	sure limiting valve for consumer port A or B or A and B late with pressure-limiting valve for all downstream valve sections t for all downstream consumers ctions on the pump side (orifice, 2-way flow control valve) ctions on the consumer side in the ancillary block (e.g. double check valves, pad-holding valves etc.) (size 3) mediate plate (size 3 into 2) with 3-way flow control valve
	1	Port siz	ze G 1/4	4, G 3/8, G	1/2 (BS	PP)	
	Conne	ction l	olock	With/with With prior With shocl With drop-	out pres ity flow < valve rate bra	sure limiti divider (e. king valve	ng valve g. for hydraulic steering circuit)
Basic ty	pe, siz	e Ty	pe DL, typ	e DLS for in	dustrial	trucks (e.g	J. fork lifts), type DLSR for variable displacement pumps, size 1 to 4

Function Connection blocks:



www.hawe.de | 2013 | 99

Valve sections:



to reduced spool valve play

Versions of valve sections:

- Additional function on the pump side (orifice, 2-way flow control valve)
- Valve sections for size 3 with consumer-side additional functions in ancillary block (e.g. double check valves, shock valves, load-holding valves etc.)
- Reducing intermediate plate (size 3 into 2) with 3-way flow control valve
- Valve section with lock-out circuit for all downstream consumers
- Size 4 also available without check valve in P
- Manual operation with spring return for switching position "a" and detent for switching position "b"
- Manual operation with detent in both switching positions
- Manual operation with combinations of contact switch, switch cam and switch carrier
- Manual operation with different mounting directions
- Manual operation with closed lever housing for sizes 3 and 4
- Pneumatic operation for sizes 3 and 4
- Displacement transducer or contact switch at the valve spool



Additional options for the valve sections:

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



Secondary pressure-limiting valve at consumer port A or B, or A and B

End plates:

Intermediate plate with pressure-limiting valve for all downstream valve sections

Example: DL 21-2-GG X5 D-B/E1-2-210

(P)

(R) Ц (P)

M

-



End plate for subsequent connection of a DL

General parameters and dimensions

Example circuit:

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

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

Symbol







Connection block

Valve sections

	Q _{max} [lpm]	p _{max} [bar]	Tapped ports			Dimensions [mm]	m [kg]		
			Characteris- tic value	А, В	H, P, R	Н	В	Т	
DL 1	12 16	315	1	G 1/4	G 1/4	approx. 192	31,5	45	0,5
DL 2	20 30	315	1	G 1/4	G 3/8	approx. 278	34,5	50	0,85
			2	G 3/8	G 3/8				
DL 3 3	30 60	250	2	G 3/8	G 1/2	approx. 351	39,5	60	1,4
			3	G 1/2	G 1/2				
DL 4	90	250	3	G 1/2	G 3/4	approx. 368	39,5	70	1,8

Associated technical data sheets:

Directional spool valves type DL: <u>D 7260</u>

See also section "Devices for special applications":

- Industrial trucks
- Hydraulic for mobile applications

Directional spool valves

2.1 Proportional directional spool valves type PSL and PSV

The directional spool valve bank in series design is available in three sizes in type PSL for constant delivery pump systems and type PSV for variable displacement pump systems (pressure/flow controller). It is intended for load-independent, continuous control of the movement speed of hydraulic consumers. Several consumers can be operated simultaneously and independently from each other. The application area of this valve type is mostly in mobile hydraulics (e.g. crane control). Being able to select different maximum volumetric flows for consumer ports A and B as well as the option to use various additional functions (e.g. secondary pressure limitation, function deactivation, in the basic valve, in intermediate plates and ancillary blocks) guarantees optimal adaptation to the respective control tasks.

Features and benefits:

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

Intended applications:

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



Nomencla- ture:	Prop. directional spool valves as per load-sensing principle					
Version:	Valve bank in series connection					
Actuation:	Manual Return spring Detent Electro-hydraulic Pressure-actuated Hydraulic Pneumatic					
p _{max} :	400 420 bar					
Q _{max} . consumer:	3 240 lpm					
Q _{pu max} :	approx. 300 lpm					



Design and order coding example



Type HMPL (hydraulic oil supply by constant pump) for industrial trucks, sizes 2 and 3 Type HMPV (hydraulic oil supply by control pump) for industrial trucks, sizes 2 and 3

Function



Connection block for constant delivery pump Consistence of the systems with incorporated 3-way controller with and pressure-limiting valve

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

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

Additional versions of connection blocks:

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

Valve sections:



Versions of valve sections:

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



Characteristic values for max. volumetric flows:

	Ч А, В							
Size 2	3	6	10	16	25	40		
Size 3	3	6	10	16	25	40	63	80
Size 5	16	25	40	63	80	120	160	

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

0

• Versions with 2-way input controller and check valve function

Additional functions in the ancillary block:

- Shock and servo-suction valves
- Load-holding valves
- Differential circuits
- Check valves with release, no leakage
- Floating and block functions can be switched
- Proportional seated valves as per D 7490/1 for lifting and lowering using plunger cylinders





Actuations:

Basic type	Brief description	Switching symbol (example)
A	Manual actuation	٩٢.
С	Detent (continuous)	
К	Manual actuation via mechanical joystick	
E EA	Electro-hydraulic actuation in combination with manual actuation CAN: Actuation variant with direct CAN actuation	Combination of electro-hydraulic and manual
H, P HA, PA	Hydraulic and pneumatic actuation in combination with manual actuation	actuation
HEA	Combination of H, E and A actuation	

Intermediate plates:

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

End plates:



Standard end plate

With additional Y-port for LS-input signal

Additional versions of end plates:

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





Connection block

	Flow Oper. [lpm] pressure [bar]		Ports (BSPP)	Dimensions [mm]				m [kg]		
	Q _{max}	Q pu max	p _{max}	P, R	А, В	Н	H1	В	Т	Per valve section ¹⁾
PSL/PSV 2	3 54	80	420	G 1/2, 3/4-16 UNF-2B	G 3/8, 3/4-16 UNF-2B	approx. 272	approx. 150	40	60	1.8 2.9
PSL/PSV 3	3 120	200	420	G 1/2, G 3/4, G 1, 1 1/16-12 UNF-2B	G 1/2, G 3/4, 7/8-14 UNF-2B	approx. 364	approx. 195	50	80	3.3 4.1
PSL/PSV 5	16 240	300	400	G 1, G 1 1/4, 1 5/8-12 UN-2B	G 1, 5/16-12 UNF-2B	approx. 400	approx. 224	62.5	100	3.7 4.5

1) Dep. on actuation and additional functions



- E2 - G24

Example circuit:

PSL 41/350 - 3

-32 J 25/16 A300 F1/EA
-42 0 80/63 C250/EA
-42 J 63/63 A100 B120 F3/EA
-31 L 40/16/A

	-31 L 40/16/A	
 Type PSL valve bank for constant pump systems Connection block: Coding for thread size (here 4 = G 3/4) Coding for pilot pressure-reducing valve (here 1) Coding for set pressure at pressure-theorem 	 -31 L 40/16/A 1. Valve section: (exemplary for all subsequent valve sections): Directional spool valve block with coding for consumer connection size (here 3 = G 1/2) Coding for the type of directional spool valve block (here 2) Switching symbol (here J) Coding for max. consumer volumetric flow to ports A and B (here 25 and 16 lpm) Coding of additional functions (here A 300; secondary pressure-limiting 	End plate: - Coding for end plate (here E2) - Coding for 24V DC solenoid voltage (here G24)
Size: 3	 valve at port A set to 300 bar, function deactivated for port A (here F1)) Coding for actuation type (here EA) 	



Suited products for combination:

- Type LHT, LHDV load-holding valves: <u>Page 212</u>
- Type KFB hydraulic joystick: <u>D 6600</u>, <u>D 6600-01</u>
- Additional electronic components
- Type EJ joystick: <u>D 7844</u>
- Type EV1M2, EV1D1 and EV22K2 prop. amplifier (module): D 7831/1
- Programmable logic valve control type PLVC: <u>Page 278</u>
- See "Electronics" section Page 274

Associated technical data sheets:

- Type PSL/PSV prop. directional spool valves, size 2: <u>D 7700-2</u>
- Type PSL/PSV, size 3: <u>D 7700-3</u>
- Type PSL/PSV, size 5: <u>D 7700-5</u>
- Type PSL/PSV prop. directional spool valves with direct CAN actuation: **D** 7700 CAN
- Type HMPL/HMPV connection blocks Sizes 2 and 3: D 7700 H

See also section "Devices for special applications":

- Mobile hydraulics
- Devices for explosive environments (ATEX-compliant)
- Proportional valves _

Directional spool valves

2.1 Prop. directional spool valves type PSLF and PSVF - Manifold mounting design

The directional spool valve bank type PSLF/PSVF consists of valve sections attached via manifolds. Type PSLF is designed for constant delivery pump systems (pressure/ flow controller) whereas the type PSVF 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 independently of each other. The main field of application is mobile hydraulics (e.g. boom controls of concrete pumps etc.). Main advantage against type PSL/PSV is simplified servicing as individual valve sections can be replaced easily. The main field of application is mobile hydraulics (e.g. crane controls etc.).

Being able to select different maximum volumetric flows for consumer ports A and B, as well as the option to use various additional functions (e.g. function deactivation) guarantees optimal adaptation to the respective control tasks.

Features and benefits:

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

Intended applications:

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



Nomen- clature:	Prop. directional spool valve acc. to the Load-Sensing principle					
Design:	Individual manifold mounting valve Valve bank via individual manifold mounting valves					
Actuation:	Manual Return spring Detent Electro-hydraulic Pressure Hydraulic Pneumatic					
p _{max} :	400 420 bar					
Q _{max} . consumer:	3 470 lpm					
Q _{pu max} :	approx. 1000 lpm					

Design and order coding example

PSLF	A1/380/4	- 3	- A2J40/40/EA/3	- E2	- G24				
					Solenoid v	voltage	12V DC, 24V DC Operated using a p Magnets with diffe Explosion-proof magnets	roportional amplifier rent plug versions	or PLVC
				End plate	es			.9	
			Valve sections with ac	tuation					
		Size							
C	connection blo	ock	Port G or UNF (SAE-1 Pressure-limiting valv	2) /e (pilot-	controlled	main pres	ssure-limiting valve) in	connection block	
Basic type	Type PSLF Type PSVF size 3, 5 a	(supply (supply nd 7	via constant pump), via variable displaceme	ent pump)),				

Function

Connection blocks:



Connection block for constant delivery pump systems with incorporated 3-way flow controller and pressure limiting valve

Additional versions of connection blocks:

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

Valve sections:



Versions of valve sections:

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



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

Coding for max. consumer flow:

	Q _{A, B}							
Size 3	3	6	10	16	25	40	63	80
Size 5	16	25	40	63	80	120	160	
Size 7	120	160	250	320	400			

Characteristic value corresponds to the max. volumetric flow (lpm) at the consumer ports A or B for the version with input controller

• Volumetric flows for A and/or B can be selected individually

- Increasing the control pressure enables 60 lpm (size 2), 120 lpm (size 3) and 240 lpm (size 5) per consumer port side.
- Version with 2-way input controller and check valve function

Actuations:

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

manual actuation



End plates:



Additional versions of end plates:

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

General parameters and dimensions

PSVF





Connection block

	Flow [lpm]		Oper. pressure [bar]	Ports (BSPP)		Dimensions [mm]			m [kg]		
	Q _{max}	\mathbf{Q}_{PU} max	p _{max}	P, R	А, В	H1	В	т	T1	1)	2)
PSLF/PSVF 3	3 120	200	420	G 3/4, 1 1/16-12 UN-2B	G 1/2, G 3/4, 7/8-14 UNF-2B	approx. 195	50	80	50	3.3 4.1	6.6 7.6
PSLF/PSVF 5	16 210	350	400	G 1, G 1 1/4, SAE 1 1/2	G 1, SAE 1 1/2	approx. 224	62.5	100	100	3.7 4.5	10.9 16.3
PSLF/PSVF 7	120-140	1000	400	G 1 1/2, SAE 1 1/2	G 1 1/4, SAE 1	approx. 305	106	101	95	13	23

Per valve section depending on actuation and additional functions Per valve section complete with manifold

1) 2)



Example circuit:

PS

PSVF A1/380/4-3	- A2 J 40/40 A200 B200 /E /3 AN210 BN210 - A2 J 80/40 A280 B130 /E /3 AN290 BN140 - A2 J 25/16 /EA /3	- E1 - G24
 Valve bank type PSVF for variable displacement pump system Connection block: Coding for flange construction (here A.) Coding for pilot pressure-reducing valve (here 1) Coding for set pressure at pressure-limiting valve (here 380 bar) Coding for thread size of sub-plate (here /4 = G 3/4) Size: 3 	 Valve section: (exemplary for all subsequent valve sections): Directional spool valve block with coding for flange construction (here A.) Coding for basic function of the directional spool valve block (here 2) Symbol (here J) Coding for max. consumer volumetric flow at port A and B (here 40 and 40 lpm) Coding of additional functions (here A 200 B 200; secondary pressure-limiting valve at port A and B set to 200 bar) Coding for the actuation type (here E = electrical-hydraulic) Coding for sub-plate (here 3AN210 BN210, G 1/2 with shock and servo-suction valve) 	 End plate: Coding for end plate (here E1) Coding for solenoid voltage 24V DC (here G24)



Suited products for combination:

- Load-holding valves type LHT, LHDV: Page 212D 7100, D 7770, D 7918
- Hydraulic joystick type KFB: D 6600++

Electronic accessory components

- Joystick type EJ: <u>D 7844</u>
- Prop. amplifier (module) type EV1M2, EV1D1 and EV22K2: <u>D 7831</u>, <u>D 7817/1</u>, <u>D 7831 D</u>
- Programmable logic valve control type PLVC: <u>Page 278</u>
- see "Electronics" section Page 274

Associated technical data sheets:

- Prop. directional spool valve type PSLF/PSVF size 3, 5: <u>D 7700-F</u>
- Prop. directional spool valve type PSLF/PSVF size 7: <u>D 7700-7F</u>

See also chapter "Equipment for special applications"

- Mobile hydraulics
- Devices for explosive areas (ATEX-compliant)
- Proportional valves

Directional spool valve

2.1 Clamping modules type NSMD2

The clamping modules type NSMD2 are used to actuate power-operated clamping devices such as hydraulically actuated hollow or solid clamping cylinders for automatic lathes. They are available as manifold mounting valves with a standard connection diagram according to DIN 24340-A6. The clamp/release functions of the clamping cylinder, pressure control and, if required, the electrical pressure monitoring are combined in one device. The clamping pressure at the consumer side A or A and B and the pressure switch can be adjusted simultaneously with a manual, mechanical or electro-proportional adjustment device. A special safety circuit monitors the switching position of the valve. 4/3- or 4/2-way directional functions with spring-centred actuation, the latter also with detent actuation, allows for adjustment to the respective application.

The throttling options in the spool end position as well as the rapid and creeping movements are available as an additional function for one or both consumer ports.

Features and benefits:

- Directional valve, pressure-reducing valve and pressure switch in one device
- Adjustment of pressure-reducing valve and pressure switch with an adjustment device

(manual or electro-proportional)

- The controlled pressure is picked up directly at the consumer port
- Valve with connection diagram according to DIN 24340-A4

Intended applications:

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

Design and order coding example



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

NSMD 2	D1	60	R	- G24	
				Solenoid v	voltage 12V DC, 24V DC, 110V AC, 230V AC Solenoids with various plug versions
			Means	s of adjust	 tment for the claming pressure Slotted head screw + hexagon nut Wing screw + wing nut Lockable turning handle Electro-proportional adjustment with/without additional function monitoring
		Additio	onal fu	Inctions	ThrottleRapid and creeping movement (one or both directions)
	Functio	n 🔹	With With	pressure s orifice (flo	switch low limitation in accumulator mode)
Basic type, s	ize	Type NS	SMD siz	ze 2 with c	connection hole pattern conf. NG 6



Function

Basic symbols



D, E, G, D1, E1, G1

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

Further functions:

G1/MD

Pressure reducing function and throttle in switching positions a and b



G/MM6

Rapid traverse and creeping in both directions



G/MMDA7

G/MMA7

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



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



General parameters and dimensions

NSMD2 K... F В M 40 R max.35 85,5 59 79,5 max.35 ∄__{ М× b a IE 89 Ø8 (P,R,A,B) ø2,5 (M)

NSMD2 G...





	Q _{max} [lpm]	p _{max} [bar]	Clamping pressure range [bar]	Trigger flow [lpm]	Connection hole pattern ¹⁾	Dime [mm	ensio]	ns	m [kg]	
						Η	В	Т	Individual valve ²⁾	Additional function
NSMD2	25	120	5 50 8 80	2 4 3 5 4 6	Hole pattern conf. DIN 24340-A6	see illustration		ation	2.2 3.8	+ 0.6 1.1

1) 2)

Port Mx; G 1/8 (BSPP) Depending on flow pattern symbol andactuation mode



Circuit example:

NSMD2K/M/GDK/B2,5-G24

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

NSMD2G1/MD/E4VK/B1-G12

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

Circuit example:

HK 43L/1M-Z 9,8-AL 21F2-F60/70-2-BA 2

- NSMD2K/M/GDK/B2,5/0 - NSMD2D/MMDA7/GDK/B2/0-G24



Associated technical data sheets:

Clamping modules type NSMD: <u>D 7787</u>

Products:

- Directional valves type NSWP2: <u>Page 84</u>
- Directional seated valves type NBVP16: <u>Page 156</u>

Plates:

- Valve banks type BA2: <u>Page 34</u>
- Intermediate plate NG6 type NZP: D 7788 Z

Plugs:

- With LEDs or
 - to support the EMV etc.: D 7163
- With economy circuit: <u>D 7813</u>, <u>D 7833</u>

Valves

2.2 Directional seated valves

Directional seated valves with various actuations	124
Directional seated valve bank type VB	130
Directional seated valves type WN and WH	136
Directional seated valve bank type BWH and BWN	138
Directional seated valves type VZP	144
Directional seated valve bank type BVZP	146
$2/2\mbox{-way}$ directional seated value cartridges type EM, EMP and EMC	152
Directional seated valves type BVG, BVE, BVP and NBVP	156
Directional seated valves type VP	160
Lifting/lowering valves type HSV	162
Switch units (press control valves) type CR	164
Lifting modules and lifting/lowering valves type HMB, HMC, HMT, and HSV, HZV etc.	166
Directional seated valves type VH, VHR and VHP	170
Shut-off valves type DA and EA	172



Directional seated valve bank type VB



Directional seated valves type BVG, BVE, BVP and NBVP



(Solenoid-actuated) seated valves

Туре	Nomenclature/Design	Actuation	p _{max}	Q _{max}
VB	Directional seated valve, zero leakage, valve bank For pipe connection For combination with hydraulic power packs	- Solenoid - Pressure - Manual	500 700 bar	6 120 lpm
WN, WH	 Directional seated valve, zero leakage, individual valve Individual valve for manifold mounting Combination with connection block for pipe connection 	- Solenoid	350 450 bar	5 60 lpm
BWH, BWN	 Directional seated valve, zero leakage, valve bank For pipe connection For combination with hydraulic power packs 	- Solenoid	350 450 bar	5 60 lpm
VZP	 Directional seated valve, zero leakage, individual valve Individual valve for manifold mounting 	- Solenoid	250 450 bar	5 15 lpm
BVZP	 Directional seated valve, zero leakage, valve bank For pipe connection Combination with hydraulic power packs 	- Solenoid	450 bar	15 lpm
EM, EMP, EMC	 Directional seated valve, zero leakage, individual valve Screw-in valve Combination with connection block for pipe connection Combination with connection block for swivel fitting 	- Solenoid	450 bar	1 160 lpm
BVG, BVE, NBVP	Directional seated valve, zero leakage, individual valve Screw-in valve For pipe connection Individual valve for manifold mounting	- Solenoid - Hydraulic - Pneumatic - Manual	400 bar	20 300 lpm
VP	 Directional seated valve, zero leakage, individual valve Individual valve for manifold mounting 	- Solenoid - Hydraulic - Pneumatic	400 bar	15 lpm

Valve combinations

Туре	Nomenclature/Design	Actuation	p _{max}	Q _{max}
HSV	 Individual valve for pipe connection 	- Solenoid	315 400 bar	20 120 lpm
CR	 Individual valve for pipe connection 	- Solenoid - Manual	HP 400 bar NP 30 60 bar	HP 8 20 lpm NP 80 160 lpm A→ R 160 300 lpm
HMB, HMC, HMT	 Valve bank 	- Solenoid	315 bar	120 lpm



Manually actuated seated valves

Туре	Nomenclature/Design	Actuation	p _{max}	Q _{max}
VH, VHR, VHP	 Directional seated valve, zero leakage Individual valve for pipe connection Individual valve for manifold mounting Valve bank 	- Manual	500 700 bar	12 25 lpm
DA, EA	Directional seated valve, zero leakageIndividual valve for pipe connection	- Manual	500 bar	60 150 lpm

Seated valves

2.2 Directional seated valves with various actuations

These directional seated valves with various actuation modes comprise manifold mounting valves that use spring-loaded balls as valve elements and therefore do not show any leakage. The actuation element used moves the valve to the appropriate switching position using an angled lever and tappet.

The basic versions are designed as 2/2- and 3/2-way directional valves. 3/3- and 4/3way functions are possible if two valves are housed in one valve block, whereas 4/2way functions require an additional intermediate plate. The variants of size G..-22 can be used as a reinforced version for fluctuating, pulsating continuous loading and high switching frequency in the upper pressure range.

Connection blocks can be flange-mounted to incorporate the valves into the pipe systems. Optional additional functions in the connection blocks (e.g. pressure-limiting or bypass check valve) extend the range of applications of this valve type. It is possible to combine several valves connected in parallel in one valve bank (type VB).

Features and benefits:

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

Intended applications:

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



Nomen- clature:	Directional seated valve, zero leakage
Design:	Individual valve, manifold mounting combination with sub- plates for pipe connection
Actuation:	Solenoid Pressure (hydraulic, pneumatic) Mechanical (roller, pin) Manual (hand lever, adjusting knob)
p _{max} :	350 700 bar
Q _{max} :	6 120 lpm



Design and order coding example

G	R2	- 3	R	- 1/2	- G24				
					Solenoid vo	oltage	12V DC, 24	V DC, 110V	AL, 230V AL
]	Indiv. con	nection blo	ocks for	pipe conne	ction A	dditional versions: Connection blocks with by-pass check valve or pressure limiting valve between P and R Connection block with bridge rectifier circuit. Check valves in "GRAETZ"-circuitry ensure flow direction through the valve
			Ådditi	onal elen	ients I	With ch With ch With re Lift mo	eck valve ins eck valve ins turn pressure nitoring (size	sert for por sert for por e stop for p e 3 and 4)	t P t P ort R
		Size	Size O	to 4					
			Siz	e 1 also a	vailable wit	h indust	rial connecti	ion hole pa	ttern NG 6 (CETOP), type NG
F	Functio	n	2/2-v 3/2-v 3/3-v 4/3-v 4/2-v	vay directi vay directi vay directi vay directi vay directi	onal valve (onal valve (onal valve (onal valve (ional valve (R2, S2) 3, Z3) 21, 39) 22, 48, 4, Z4)	49)		
Actuat	ion	SoleHydrPnerMec	noid ((raulic (umatic hanica	G, WG) (H) (P) L (K, T, F,	D)				

Function



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



General parameters and dimensions

Individual valve







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

	Q _{max} [lpm]	p _{max} [bar]								Ports (BSPP)
Size		Solenoid		Pressure		Mechanica	al	Manual		
		G	WG	Н	Р	К	т	F	D	P, R, A, B
0	6	300 500		500	-	-		-	500	G 1/4
12	12	350 500	(700)	500 700		400 700		400 700		G 1/4 and G 3/8
2, 22	25	350 500	(700)	500		400 500		400 500		G 3/8 and G 1/2
3	65	350 400		400		350	-	350	-	G 1/2 and G 3/4
4	120	350		-		-				G 3/4 and G 1



Example circuit:

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

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

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



Associated technical data sheets:

- Directional seated valves: <u>D 7300</u>
- Directional seated valves with standard connection diagram (CETOP3, NG 6): <u>D 7300 N</u>
- Directional seated valves with lift monitoring: **D** 7300 H

Valve banks:

Valve banks type VB: <u>Page 130</u>

Plugs:

- With LEDs etc.: <u>D 7163</u>
- With economy circuit: <u>D 7813</u>, <u>D 7833</u>

See also section "Devices for special applications":

- Devices for explosion hazardous areas, conforming ATEX
- Devices for up to 700 bar

Seated valves

2.2 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 sub-plates and connected in parallel plus the end plate. The whole valve bank is held together with one or two tension rods.

Through selection of the sub-plate, different symbols can be achieved with the individual valves, including in conjunction with additional functions (e.g. pressure switches in the consumer channel). These valve banks may be either directly flangemounted to a pipe system via a connection block or installed directly onto hydraulic power packs (type HK, HC, MP, MPN and KA) using an adapter plate.

Various end plates (e.g. with pressure switch in the P gallery or accumulator drain valve) extend the range of possible applications.

Particularly in conjunction with hydraulic power packs, the compact design enables hydraulic control systems for high pressure and with low spatial requirements to be achieved.

Features and benefits:

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

Intended applications:

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



Nomen- clature:	Directional seated valve, zero leakage
Design:	Valve bank for pipe connection
Actuation:	Solenoid Pressure: Hydraulic, Pneumatic Manual: Hand lever, Turn knob
p _{max} :	500 700 bar
Q _{max} :	6 120 lpm



Design and order coding example

VB11	F	M DCN	IR5 1	WG230	
				Solenoid voltage 12V D	C, 24V DC, 110V AC, 230V AC
			Port	ze G 1/4 (1), G 3/8 (2),	, G 1/2 (3) (BSPP)
		Valve	sections	Symbols: 2/2-way direction 4/3-way directional valve,	nal valve, 3/2-way directional valve, 3/3-way directional valv 4/2-way directional valve
				 Valve section options Pressure switch for P or Pressure reducing valve Orifices in gallery P and 	r the consumer side reducing the pressure in the downstream gallery P d/or return pressure stop in gallery R
				Sub-plates With 2-way flow control Pressure reducing valve With pressure limiting v With idle circulation va	ller by-passing to the tank reducing the pressure in the downstream gallery P valve and throttle lve and/or shuttle valve
				Intermediate plates With pressure reduction 	for gallery P or throttle for port A (parallel connection)
		Actuation			
	Conne	ection block	/adapter ı	 For pipe connecti For direct mounti For direct mounti 	on ng at compact hydraulic power packs ng at hydraulic power packs
asic typ	e, size	Type VB	, size 01,	, 21, 31, 41	

Function

Connection blocks:



J, G39, G49 only available for VB 21, 22
G not available for VB 41

HX, LX, NX, RX only available for VB 11



End plates:



- /2, /3 ... /65 only with type VB01 and VB11

General parameters and dimensions





	Q _{max} [lpm]	p _{max} [bar]		Ports (BSPP)	Dimensions [mm]			m [kg]				
		Solenoid	Pressure		Manual						per valve section	
		Μ	Н	Р	F	D	P, R, A, B	Н	В	Т		
VB 01	6	300 500	-	500	-	500	G 1/4	110 135	38	40	0.6 1.25	
VB 11	12	350 500 (700)	500 700		400 700		G 1/4 and G 3/8	139 174	46	50	1.1 2.3	
VB 21	25	350 500 (700)	500		400 500		G 3/8 and G 1/2	180 220	58	63	2.0 4.6	
VB 22								172 221	58	70	2.2 - 4.8	
VB 31	65	350 400	400		- 350		G 1/2 and G 3/4	202 252	72	80	4.5 9.1	
VB 41	120	350	-		-		G 3/4 and G 1	265 312	82	100	8.9 14	



Circuit example:

MP24A - H1,39/B5 - A1/300

Compact hydraulic power pack type MP size 2, connection block with Valve bank type VB size 0 with 3 valves (actuation mode M pressure limiting valve (tool adjustable)

- VB01FM - FRN/32 - 1 - WG230

(solenoid), solenoid voltage 230V 50/60 Hz) and end plate. Here 32 with pressure switch and drain valve

Parameters of the circuit example:

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



血 0 Ш Ш Ш 血 265 Ð 258



Suites compact hydraulic power packs:

- Type MP, MPN, MPNW, MPW: Page 22
- Type HC, HCW, HCG: Page 14
- Type HK, HKF, HKL: Page 26
- Type NPC: Page 12
- Type KA, KAW: Page 18
- Connection blocks type A: Page 32

Corresponding pamphlets (data sheets):

Valve banks type VB: <u>D 7302</u>

Suited valves:

Directional seated valves with various actuations: Page 124

Accessories:

- Pressure switches type DG 3.., DG 5 E: Page 266
- Pressure-reducing valves type CDK: <u>Page 196</u>

Plugs:

With LEDs etc.: <u>D 7163</u>

Suites hydraulic power packs:

Type R: Page 46

Type RZ: Page 62

Type Z: D 6820

- With economy circuit: <u>D 7813</u>, <u>D 7833</u>
- See also section "Devices for special applications":
- Devices for up to 700 bar

Seated valves

2.2 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.

Connection blocks can be flange-mounted to incorporate the valves into the pipe systems. Optional additional functions in the connection blocks (e.g. pressurelimiting or bypass check valve) extend the range of applications of this valve type. By combining two valves in one connection block, 3/3- and 4/3-way functions can be achieved.

The type WN (size 1 only) has a simpler design than the WH types (no moving seals and no separate solenoid discharge). Therefore the permissible operating pressure for these more cost-effective variants is lower than for the type WH.

It is possible to combine several valves connected in parallel in one valve bank (type BWN and BWH).

Features and benefits:

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

Intended applications:

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

Design and order coding example

WN1	н	1	- 1/4	- G24
				Solenoid v
			Indiv. con	nection bl
		Additi	ional elem	nents 🛛
				-
	Functi	on	■ 2/2-wa	ay directio
			■ 3/2-wa	ay directio
			■ 3/3-wa	ay directio
			■ 4/2-wa	ay directio
asic typ	e, size	Ту	/pe WN, siz	ze 1
		ly	/pe WH, siz	ze 1 to 4



Nomen- clature:	Directional seated valve, zero leakage
Jesign:	Individual valve, manifold mounting combination with connection blocks for pipe connection
	a. 1. 11
Actuation:	Solenoid
D _{max} :	350 450 bar
Q _{max} :	5 60 lpm

F



Function



Symbols show type WH Type WN 1 without de-pressuring duct for the solenoid (add. leakage duct is not necessary)

General parameters and dimensions

Individual valve





Valve with sub-plate for pipe connection





	Q _{max} [lpm]	p _{max} [bar]	Ports (BSPP)	Dimensions (individual valve) [mm]		m _{max} [kg]	Dimensions (with sub-plate) [mm]			m [kg]	
				н	В	Т		H1	B1	T1	
WN 1	5	320 350	G 1/4	86.5	35	35	0.6	111.5	40	35	0.9
WH 1	8	450	G 1/4	86.5	35	35	0.6	111.5	40	35	0.9
WH 2	15	350	G 1/4	97.0	35	35	0.65 0.7	125	40	40	1.0
WH 3	30	350	G 3/8	95.5	45	45	1.2 1.3	128	50	50	1.8
WH 4	60	350	G 1/2	118.0	60	60	2.7 3.0	158 173	70	70	3.6 4.0

Associated technical data sheets:

Directional seated valves type WN1, WH: <u>D 7470 A/1</u>

Valve banks:

■ Type BWN1, BWH: Page 138

Plugs:

- With LEDs etc.: <u>D 7163</u>
- With economy circuit: <u>D 7813</u>, <u>D 7833</u>

Seated valves

2.2 Directional seated valve bank type BWH and BWN

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.

Through selection of the sub-plate, different symbols can be achieved with the individual valves, including in conjunction with additional functions (e.g. pressure switches or pressure-limiting valves in the consumer channel). These valve banks may be either directly flange-mounted to a pipe system via a connection block (with or without pressure-limiting valve) or installed directly onto hydraulic power packs (type HK, HC, MP, MPN, KA and NPC) using an adapter plate. Various end plates (e.g. with pressure switch in the P gallery or accumulator drain valve) extend the range of possible applications.

Features and benefits:

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

Intended applications:

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



Nomen- clature: Directional seated valve, zero leakage Design: Valve bank For pipe connection Combination with hydraulic power packs Actuation: Solenoid pmax: 350 450 bar Qmax: 5 60 lpm		
Design: Valve bank For pipe connection Combination with hydraulic power packs Actuation: Solenoid pmax: 350 450 bar Qmax: 5 60 lpm	Nomen- clature:	Directional seated valve, zero leakage
Actuation: Solenoid pmax: 350 450 bar Qmax: 5 60 lpm	Design:	Valve bank For pipe connection Combination with hydraulic power packs
pmax: 350 450 bar Qmax: 5 60 lpm	Actuation:	Solenoid
Q _{max} : 5 60 lpm	p _{max} :	350 450 bar
	Q _{max} :	5 60 lpm



Design and order coding example

BWH2 A-1/300 - FH5N5 - 1 - 1 - G24					
Solenoid voltage 12V DC, 24V DC, 110V AC, 230V AC Versions with M12-plug and 8-Watt solenoid Port size G 1/4, G 3/8 (BSPP)					
 End plate With one or two pressure switches With accumulator drain valve With additional pressure limiting valve in gallery P 					
Valve sections Directional valves type WH or WN Valve section options:					
 Return pressure stop Pressure switch for the consumer ports or for gallery P Pressure limiting valves at the consumer port Pressure reducing valve reducing the pressure in the downstream P gallery 	 Return pressure stop Pressure switch for the consumer ports or for gallery P Pressure limiting valves at the consumer port Pressure reducing valve reducing the pressure in the downstream P gallery 				
 Additional sections: Pressure reducing valve Indiv. sub-plate with pressure switch Separation plate for gallery P 					
 For pipe connection, with/without pressure limiting valve, manually or tool adjustable, with/without prop. pressure limiting valve For direct mounting at compact hydraulic power packs For direct mounting at hydraulic power packs Adapter plates for combination with directional valves type BVZP or SWR/SWP 					
Basic type, size Type BWN, size 1 and type BWH, size 1 to 3					

Function

(R)[|] (P)

0

(R)

(P)

Ι

(R)

(F

В

Connection blocks/adapter plates:



М

Т

В

Pressure switches in the consumer or pump channel. The pressure switches (type DG 3..) are directly flange-mounted to the sub-plate.

Pressure-limiting valves in the consumer channel (for 3/2- or 3/3-way directional valves, for size 1). The pressure-limiting valve is

Δ

J

A

Δ

R

U

4

A

Κ

٥D

h

Ó

B

0

A

В

А

L

Pressure-reducing valves for pressure reduction in the subsequent pump channel.

А

S

AΒ

Ν

Н

Α

Y

Ŧ

(A) B

Additional options for the valve sections:

directly incorporated in the sub-plate.







For pipe connection:



	Q _{max} [lpm]	p _{max} [bar]	Ports P, R, A, B (BSPP)	Dimensions [mn	m [kg]		
				Н	Т	В	
BWN 1	5	350	G 1/4	116.5 131.5	38	40	0.8 0.9
BWH 1	8	450	G 1/4	116.5 131.5	38	40	0.8 0.9
BWH 2	15	350	G 1/4	122 157.5	38	50	0.9 1.1
BWH 3	30	350	G 3/8	155.5 168	50	60	1.9 2.4
BWH 4	60	350	G 1/2	158 213	70	92	4.1 6.1

- Mass [kg] per valve section: + 0,3 kg with added pressure switch



Circuit example:

HC 24/0,64 - A2/400

Hydraulic power pack type HC, size 2, connection block with pressure limiting valve (manually adjustable)

Main parameter of the circuit examplet:

- Q_{pu} = 0.64 lpm (at 1450 rpm)
- $p_{max pu} = 700 \text{ bar}$
- p_{system} = 400 bar (setting of the pressure limiting valve)
- V_{usable} = approx. 1.5 l



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

- BWH1F1 - D H5 R/150 - 36 - 1 - G24

Valve bank type BWH, size 1 with three valve sections and end plate with pressure switch



R M1 R M1 M2 64 148 max.75

Associated publications:

- Directional seated valve banks type BWN1, BWH: <u>D 7470 B/1</u>
- Directional seated valves type WN1, WH: <u>D 7470 A/1</u>

Connection block:

Type A: Page 32

Compact hydraulic power packs:

- Type HC, HCW, HCG: Page 14
- Type HK, HKF, HKL: Page 26

- Type NPC: <u>Page 12</u>
- Type KA, KAW: <u>Page 18</u>

Hydraulic power packs:

Type R: <u>Page 46</u>

Hydraulic accessories:

- Pressure switches type DG 3.., DG 5E: <u>Page 266</u>
- Pressure-reducing valves type CDK: <u>Page 196</u>
2.2 Directional seated valves type VZP

These type VZP use spring-loaded balls or cones as valve elements and therefore do not show any leakage.

The twin layout of the 3/2- and 2/2-way directional seated valves means that all functional elements for valve function and actuation share one housing, making them very compact.

Depending on pairing, these valves can fulfil either one 4/4-, 4/3-, 3/3-way function or two independent 3/2- and 2/2-way functions. When compared with individual valves for manifold mounting of conventional layout, the twin design is more advantageous due to lower spatial requirements and the possibility to directly mount pressure switches for monitoring the consumer pressure. This compact design offers particular advantages in type BVZP valve banks consisting of several valves of this type connected in parallel.

Features and benefits:

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

Intended applications:

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

Design and order coding example



Nomen- clature:	Directional seated valve, zero leakage
Design:	Individual valve, manifold mounting
Actuation:	Solenoid
p _{max} :	250 450 bar
Q _{max} :	5 15 lpm

VZP1	Н	12B1,0	- G12	
			Solenoid voltag	 e 12V DC, 24V DC, 110V AC, 230V AC e Versions with M12-plug and 8-Watt solenoid
		Additional	elements =] =] = [Indiv. valves with check valve insert in gallery P Indiv. valves with return pressure stop in gallery R Pressure switch for the consumer ports
	Functi	on = 4/ = 4/ = 3/ = 2/	'2-way functions '3-way directiona '3-way directiona '2- and 3/2-way o	via directional spool valve l seated valve (G, D, E, O) l seated valve (J, P) directional seated valve (F, D - H, M, N, R)
Basic type	e, size	Twin val	ve type VZP, size	1

Connection blocks for pipe connection



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



- 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)



General parameters and dimensions

VZP 1 (example with mounted pressure switches)



	Q _{max} [lpm]	p _{max} [bar]	Dimensions [mm]			m [kg]
			Н	В	Т	
VZP 1	5 15	250 450	137 142	35 39	92	1.9 2.2

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

Associated technical data sheets:

Directional seated valves type VZP: <u>D 7785 A</u>

Valve banks:

Type BVZP: Page 146

Accessories:

Pressure switches type DG 3.., DG 5E: <u>Page 266</u>

Plugs:

 With LEDs or to support the EMV etc.: <u>D 7163</u>

т

2.2 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. Connection blocks with or without pressure-limiting valve can be mounted for pipe connection. Combination with hydraulic power packs (type HK, HC, MP, MPN and KA) and other directional valve types is achieved using appropriate adapter plates. Various end plates (e.g. with and without pressure switch in the P gallery) extend the range of possible applications. Particularly in conjunction with hydraulic power packs, the compact design enables complete hydraulic control systems with low spatial requirements to be achieved.

Features and benefits:

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

Intended applications:

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



Nomen- clature:	Directional seated valve, zero leakage			
Desing:	Valve bank For pipe connection Combination with hydraulic power packs 			
Actuation:	Solenoid			
p _{max} :	450 bar			
Q _{max} :	15 lpm			



Design and order coding example

BVZP1	A-1/400	- G33/22	- 1	- 1	- G24
				Port siz	Solenoid voltage 12V DC, 24V DC, 110V AC, 230V AC Versions with M12-plug and 8-Watt solenoid ze G 1/4 (BSPP)
			End plat	te 🔹	With/without pressure switch or prepared for retro-fitting of a pressure switches Adapter plates for adding other valve banks (type BWN(H)1/BWH 2)
		Valve sections		4/2-wa 4/3-wa 3/3-wa 2/2- an Pressure	y functions via directional spool valve y directional seated valve (G, D, E, O) y directional seated valve (J, P) nd 3/2-way directional seated valve (F, D - H, M, N, R) e reducing valve for gallery P
			Ada =	litiona Pressure Pressure	<mark>l elements</mark> e switch in consumer port e-reducing valve in the consumer port
	Connection b	lock/adapter	plates	 Fo Fo 	or pipe connection Pressure limiting valve (manually of tool adjustable) Drain valve (for discharging the accumulator) Pressure switch
Basic type,	size Type	BVZP, size 1		■ Fo	or direct mounting at compact hydraulic power packs with connection block with/ ithout prop. 3-way flow controller and optional pre-load valve in gallery R

A 1

Connection blocks:





For pipe connection, with tool adjustable pressure limiting valve (/...- pressure specification in bar)

For direct mounting onto hydraulic power packs with connection block (type KA, HC, MP, MPN and HK), prepared for retrofitting of one or two pressure switches connected to gallery P

Valve sections:

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



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

Ball seated valves with 3/2- or 2/2-way function up to 450 bar



Valve sections



Options for the valve section:

- Sub-plate with throttle and restrictor check valves in the consumer port
- Valve section with 4/2-way function, directional spool valve
- Pressure reducing valve reducing the pressure for one valve section only (connected in parallel)
- Pressure reducing valve reducing the pressure for all subsequent valves (connected in series)
- Pressure reducing valve with orifice/throttle and by-pass check valve in the consumer port

Additional versions:

- 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:



BVZP 1

Πī

Example: BVZP1 A-1/200 - G 52/22 - R5 M2/0 - 1 - 1 - G24

Т

End plate

Valve sections



Connection bl	ock

В

	Q _{max} [lpm]	p _{max} [bar]	Ports (BSPP)	Dimensions [mm]			m [kg]	
			A, B, P, R, M	Н	В	Т	Valve section	
BVZP 1	15	450	G 1/4	max. 182	40	92	2.9 - 3.2	

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



Circuit example:

HK 448/1 - H7,0 - AS1/150

Hydraulic power pack type HK, size 4; connection block with integrated idle circulation valve and pressure limiting valve BVZP1 FEH10F V15/G12 - G22/0 - R5 M2/20 - CZ5/80/5R - H12 H12/0 - 1 - 1 - G24

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 circuit example:

- Q_{pu} = 7.0 lpm (at 1450 rpm)
- p_{max pu} = 215 bar
- p_{system} = 150 bar (setting of the pressure limiting valve)
- V_{consum} = approx. 3.7 l





Associated technical data sheets:

Valve banks type BVZP: <u>D 7785 B</u>

Products:

- Directional seated valves type VZP1: <u>Page 144</u>
- Valve banks type BWN1, BWH: Page 138
- Pressure-reducing valves type CDK and DK: <u>Page 196</u>
- Slot-type throttles type Q, QR, QV: <u>Page 232</u>

Accessories:

Pressure switches type DG 3.., DG 5E: <u>Page 266</u>

Plugs:

 With LEDs or to support the EMV or with economy circuit etc.: <u>D 7163</u>

Directional seated valves

2.2 2/2-way directional seated valve cartridges type EM, EMP and EMC

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, by-pass throttle, pressure switch, 2-way flow control valve etc.

Features and benefits:

- Zero leakage in blocked state
- Directly switching up to approx. 3 lpm and piloted up to 160 lpm
- Minimized back pressure even at high flows
- Long service life due to hardened valve seats

Intended applications:

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



Nomen- clature:	Directional seated valve, zero leakage
Design:	Screw-in valve Combination Combination with connection block for pipe connection Combination with connection block for swivel fitting Combination with connection block for manifold mounting
Actuation:	Solenoid
p _{max} :	450 bar
Q _{max} :	1 160 lpm

Design and order coding example

EM 21	V - 3/8	- G24	
		Solenoid volta	 12V DC, 24V DC, 110V AC, 230V AC Versions with Versions with M12-plug and 8-Watt solenoid Quarter-turn plug, plugs of Co. KOSTAL or AMP
	Connec	tion blocks Ve	ersions with Drain valve Drain valve and drop-rate braking valve Drain valve and by-pass check valve Bypass- throttle Pressure switch 2-way flow controller
	Function	V - 2/2-way va S - 2/2-way va	lve (NC-type) lve (NO-type)
Basic type,	size = Ty = Ty = Ty	/pe EM: ON/OFF-v /pe EMP: Prop. va /pe EMC: proporti	alve, size 1 to 4 lve, size 1 to 4 onal valve, load compensated, size 3



	Flow in arrowed direction			Arbitrary flow direction	Flow in arr	owed direction	Arbitrary flow direction	
	Energized op	pen			Energized o	closed		
Directly actuated	EM .1 D				EM .1 DS			
Pilot actuated	EM .1 V	EMP .1 V	EMC .31 V		EM .1 S	EMP .1 S	EM .2 S	

General parameters and dimensions



Valve compl. with connection block for pipe connection



	Q _{max} [lpm]			Screw-in va	lve	Valve with	connecti	on block			
		p _{max} [bar]	G	m [kg]	Ports (BSPP)	Dimen [mm]	sions			m [kg]	
						H1	H2	В	Т		
EM 11 (D, DS)	5	450	M 14 x 1.5	0.3	G 1/4	40	approx. 120	20	35	0.6	
EM 21 (D, DS)	3	400	M 18 x 1.5	0.35	G 1/4	50	approx. 120	30	45	0.7	
EM 1 (V, S)	M 1 (V, S) 20 450	450	M 14 x 1.5	0.3	G 1/4	40	approx.	20	35	0.6	
					G 3/8		120	25	45		
EM/EMP 2 (V, S)	40	40 400	M 18 x 1.5	0.35	G 3/8	50	approx.	30	45	0.7	
					G 1/2		120		50		
EM/EMP 3 (V, S)	80	400	M 18 x 1.5	0.4	G 1/2	60	approx.	40	55	1.0	
					G 3/4		133		60		
EM/EMP 4 (V, S)	160	160 400	M 33 x 2	0.6	G 3/4	70	approx. 150	40	65	1.2	
					G 1			50	70		

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



Example circuit:

KA 442 LFK/HH 13.1/13.1 -SS-A 1 F 3/200 -BA 2 -NBVP 16 G/R-GM/NZP 16 TSPG/TB 0/3 -NBVP 16 G/R-GM/3 -2-G 24 -X 84 G-9/250 2 x (00/2201 50 Hz (00 km/2/11 PC)



Suitable products:

- Intermediate plates NG 6 type NZP: D 7788 Z
- Connection blocks type HMPL and HMPV: <u>Page 104</u>
- Lifting/lowering valves type HSV: <u>Page 162</u>
- Lifting modules type HST, HMT etc.: Page 166

Associated technical data sheets:

 Directional seated valves type EM, EMP: <u>D 7490/1</u>, <u>D 7490/1E</u>

Accessories:

- Pressure switches type DG 3.., DG 5E: Page 266
- Drop rate braking valve type SB, SQ, SJ: Page 222
- Suitable prop. amplifier type EV1M2 (module), EV1G1 (module) and EV1D (module): <u>Page 276</u>

Plugs:

- With LED etc.: <u>D 7163</u>
- With economy circuit: <u>D 7813</u>, <u>D 7833</u>
- See also section "Devices for special applications"
- Screw-in valves and installation kits

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

The group of directional seated valves type BVG, BVE and BVP includes 2/2- and 3/2-way directional valves in two sizes. Size 1 valves feature a version with standard connection diagram NG 6 (type NBVP) and a version with 4/3-way function. They are designed as zero-leakage, cone seated valves. All ports are equally pressure-resistant due to an internal static pressure balance. The valves can be connected via pipes (type BVG), screwed onto self-manufactured base plates (type BVP) and industrial standard connection plates (type NBVP)or screwed into self-manufactured valve blocks as a screw-in valve (type BVE). The various actuation modes (type BVE with solenoid actuation only) enable use of these valves in a wide range of applications. Additional elements for ports P, R, A and B (e.g. orifices, check valves and restrictor check valves) can be incorporated in the valve block to tailor the range of possible applications to the special requirements of the customer.

By retracting the spring, the zero or neutral position is automatically adopted when in a non-actuated state. With solenoid actuation, the detented version adopts the home or switching position via a brief control impulse from the solenoid located opposite.

Features and benefits:

- Zero-leakage, cone seated construction
- Pressure switch can be directly mounted
- Complete system solution with compact hydraulic power packs made from the modular system
- ATEX-compliant version

Intended applications:

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



Nomen- clature:	Directional seated valve, zero leakage
Design:	Individual valve for pipe connection Individual valve, Manifold mounting
Actuation:	Solenoid Hydraulic Pneumatic Manual
p _{max} :	400 bar
Q _{max} :	20 300 lpm



BVG1	- R	/B2	- 1/4	- WGM 230					
				Actuations:	Solenoid, hydraulic, pneumatic, manual				
	Connection size or connection block								
		Additior	1al elemer	nts Orifice NBVP: pressu	e in one port orifice and/or check valve in the P gallery, orifice, restrictor check valve and Ire switches in port A, B, return pressure stop in T				
	Function	n =	2/2-way d 3/2-way d 4/3-way d	irectional valve irectional valve irectional valve	(R, S), also available in version with lift monitoring (RK, SK) (Z, Y), also available in version with lift monitoring (ZK) (G, D)				
Basic type	e, size	Type B Type B Type N	BVG and BV BVE, size 1, IBVP (with	P, size 1 and 3 3 and 5 standard conne	ction diagram NG 6), size 1				

Actuations:

Solenoid	Hydraulic	Pneumatic	Manual
		∲ ┌ ╴┐ 上 - └└	
 Solenoid voltages: 12V DC, 24V DC, 110V AC, 230V AC BVP 1, NBVP16 also available in ATEX-compliant version Version with M12 plug and 8-watt solenoid 	Control pressure: $p_{contr.min} = 24 \text{ bar}$ $p_{contr.max} = 320 \text{ bar}$	Control pressure: $p_{contr. min} = 2 3.5$ bar $p_{contr. max} = 15$ bar	Actuation torque: approx. 1.5 3 Nm

Design and order coding example



Additional flow pattern symbols available **G, D:** only type NBVP16 -



General parameters and dimensions











(solenoid actuation)

	Q _{max} [lpm]	p _{max} [bar]	Ports (BSPP)	Dimensions	m _{max} [kg]		
			A, B, C	H _{max}	B _{max}	T _{max}	
BVG 1	20	400/250 ¹⁾	G 1/4, G 3/8	115 (130)	60	40	1.6
BVP 1					35	39	1.0
NBVP 16	20	400/2501)	NG 6	230	45	45	2.1
BVG 3	50	320	G 1/2	145	80	50	3.3
BVP 3				155	50	76	2.4
BVE 1	20	500	-	121	37	-	0.4
BVE 3	70	400		122.5	45	-	0.7
BVE 5	300	400	-	206.5	72	-	1.5

¹) with solenoid actuation GM.. and WGM

- BVE 3: screw-in valve, also available with connection block for pipe connection

Associated technical data sheets: Directional seated valves

- Type BVG, BVP: <u>D 7400</u>
- Type BVG1, BVP1: <u>D 7765</u>
- Type BVE: <u>D 7921</u>
- Type NBVP: <u>D 7765 N</u>

Products:

- Type BA: <u>Page 34</u>
- Type NZP: <u>Page 34</u>
- Type BVH: Page 40

Plugs:

- With LED etc.: <u>D 7163</u>
- With economy circuit: <u>D 7813</u>, <u>D 7833</u>

2.2 Directional seated valves type VP

Type VP 1 valves are designed as zero-leakage, cone-seated valves and can be used as 2/2-, 3/2- and 4/2-way directional valves. The internal pressure balance enables free selection of the flow direction and maximum pressure resistance of all ports. Due to the air-switching actuation, there is no risk of interaction between actuation elements and the medium used. No sticking or resinification as a result of increased temperatures is possible.

The preferred area of application is hydraulic lubrication systems that use high-viscosity grease or oils. Other fluids in the relevant viscosity range can also be considered provided they have the appropriate seal compatibility.

Features and benefits:

- Freely selectable flow direction
- No interaction between actuation elements and medium
- No sticking or resinification as a result of increased temperatures is possible.

Intended applications:

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



Directional seated valve, zero leakage
Manifold mounting
Solenoid Hydraulic Pneumatic
400 bar
15 lpm

Design and order coding example

VP1	- R	- 3/4	- G24	
			Actuation	Solenoid
				Mechanical: roller, feeler
				Manual: lever, turn-knob
	(ptional	connection	block For direct pipe connection
	Functio	n 2/2- 3/2- 4/2-	way directio way directio way directio	onal seated valve (R, S) onal seated valve (Z) onal seated valve (W, G)
Basic typ	oe, size	Type \	/P, size 1	
		 Ver 	rsions confor	rming ATEX
Actuatio				

Actuation: Solenoid Hydraulic Pneumatic Image: 12V DC; 24V DC; 110V AC, 230V AC Image: 12V DC; 24V DC; 110V AC, 230V AC Control pressure: pcontrol min = 24 bar pcontrol min = 24 bar pcontrol max = 320 bar Control pressure: pcontrol max = 15 bar





General parameters and dimensions

Individual valve Example: VP1R-G24





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





	Q _{max} [lpm]	p _{max} [bar]	Ports (BSPP)	Dimensions [mm]	m _{max} [kg]		
			A, B, C	H _{max}	B _{max}	T _{max}	
VP 1	15	400	G 1/4, G 3/8, G 3/4	127	40	50	1.0
VP 1 with sub-plate				147 177	50 100	45 80	1.5 2.2

- H_{max}: Figures apply to solenoid actuation

Associated technical data sheets:

Directional seated valves type VP: <u>D 7915</u>

Similar products:

 Directional seated valves type BVG1, BVP1, BVE, NBVP16: Page 156

Plugs:

- With LEDs or
- to support the EMV etc.: D 7163
- With economy circuit: <u>D 7813</u>, <u>D 7833</u>

2.2 Lifting/lowering valves type HSV

The lifting/lowering valves type HSV are preferentially used for controlling lifting equipment with single-acting cylinders. The valve block combines the functions of a 2/2-way directional seated valve with solenoid actuation for lowering the raised load. It is optionally available with an adjustable throttle to limit the lowering speed or a 2-way flow control valve to guarantee the lowering speed is as load-independent as possible. A pressure-limiting valve is incorporated to limit the permissible load. An additionally installed check valve prevents uncontrolled lowering of the load. Flangemounting on self-manufactured connection plates is possible.

Features and benefits:

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

Intended applications:

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



Nomen- clature:	 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 _{max} :	315 400 bar
•	20 400 l
Q _{max} :	20 120 lpm

Design and order coding example

HSV41	- R1	- R-150	- G24		
			Solenoid v	oltage	12V DC, 24V DC, 110V AC, 230V AC HSV 21 and HSV 22 version conforming ATEX
		Pressure lim	iting valve	e Man pres	ually or tool adjustable, sure setting in bar

Function

Basic type, size Type HSV, size 2, 4, 6 and 7





General parameters and dimensions



	Q _{max} [lpm]	p _{max} [bar]	Ports (BSPP)	Dimensior	m [kg]			
			Р	A, R	Н	Т	T1	
HSV 21	20	315	G 3/8	G 3/8	see illustration			2.2
HSV 22	30	315	G 3/8	G 1/2	see illustration			2.2
HSV 41	40	400	G 1/2	G 1/2	112	50	140	2.2
HSV 61	60	350	G 1/2	G 1/2	100	63	166.5	2.5
HSV 71	120	315	G 3/4	G 3/4	100	80	160	3.1

Associated technical data sheets:

Lifting/lowering valves type HSV, HZV: <u>D 7032</u>

Plugs:

- With LEDs or to support the EMV etc.: <u>D 7163</u>
- With economy circuit: <u>D 7813</u>, <u>D 7833</u>

2.2 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.

Features and benefits:

- Optimized for the controls of bottom ram presses
- Smooth, gentle switching
- No pressure drop during press operation due to zero leakage
- Fully automatic switching of the low-pressure pump to circulation

Intended applications:

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



clature:	 2/2-directional seated valve Ball-type check valve Pressure valve
Design:	Individual valve for pipe connection
Actuation:	Solenoid Manual
p _{max} :	HP 400 bar LP 30 60 bar
Q _{max} :	HP 8 20 lpm LP 80 160 lpm A → R 160 300 lpm

Design and order coding example





CR 4M and CR 5M

CR 4H





General parameters and dimensions

CR 4M

Actuation solenoid Pressure limiting valve





	Q _{max} [lpm]			p _{max} [bar]		Ports (BSPP)				Dimensions [mm]			m [kg]
	HP	NP	A→R	HP	NP	A and R	HP	NP	М	Н	В	т	
CR 4M	8	80	200	400	30 60	G 1	G 1/4	G 3/4	G 1/4	max. 247.5	50	100	5.2
CR 4H	8	80	200	400	30 60	G 1	G 1/4	G 3/4	G 1/4	max. 202	50	100	4.7
CR 5M	20	160	300	400	30 60	G 1 1/4	G 3/8	G 1	G 1/4	max 277.5	63	135	10.0

Associated technical data sheets:

- Switch units type CR: <u>D 7150</u>
- Similar products:
- Two-stage valves type NE: <u>Page 206</u>

Hydraulic power packs:

- Hydraulic power packs type RZ: <u>Page 62</u>
- Compact hydraulic power packs type MP, MPN, MPNW, MPW: <u>Page 22</u>

Plugs:

- With LEDs or to support the EMV etc.: <u>D 7163</u>
- See also section "Devices for special applications"
- Press controls
- Devices for up to 700 bar

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

They are a combination of different valves (flow control valves, throttles, directional valves) for main lift and, in some cases, other additional functions. The lifting modules and lifting/lowering valves are for controlling lifting devices, especially highrack stackers, order pickers, reach trucks and mobile lifting units. The design of the internal control system is extremely flexible. This enables solutions that are not only precisely tailored to the relevant drive concept (fixed or variable displacement pump) and the customer-specific application, but also affordable.

Control systems for secondary or additional functions can be achieved using directional seated valves or directional spool valves (type SWR or SWS). These valves are directly flange-mounted to the main valve in the form of mounting blocks, therefore making the whole valve combination extremely space-saving.

Features and benefits:

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

Intended applications:

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



Nomencla- ture:	Valve combination according to type consisting of: 3-way flow control valves 2-way flow control valves 2-way seated valves Directional spool functions				
Design:	Valve bank				
Actuation:	Solenoid				
p _{max} :	315 bar				
Q _{max} :	120 lpm				

Design and order coding example

HMT34	- 1/200	- FH5N5	- 30EP12/G24
			 End plate With two P ports and one R port With prop. idle circulation valve With solenoid valve for the parking brake
	V. a	alve section ncillary- an	ns, Diverse intermediate blocks for d intermediate blocks Function rotating/stifting/lifting/lowering Directional valve sections type SWR 1 with additional functions Directional valve sections type SWS 2
	Connection bl	lock Pres Add = 0	sure setting [bar] of the pressure limiting valve itional versions Connection blocks type SWR
			With flow dividerWith/without pressure limiting valveWith shut-off valve for P and H (lift)
Basic type	Lift module:	s and lifting	/lowering valves



Drive concept an field of application:

Drive	concent	Application
DIIVe	concept	Application

	1	2	3	Scissor lift	Miniature stacker, Walkie stacker	Counter balance truck	Reach truck	Order picker (warehouse)	
								no man aloft	man aloft
HSV	х			х	х				
HZV	х			х	х				х
HSN			х					х	х
HST	х	х			x	(x)		х	х
НМВ	(x)	х			(x)			х	х
НМС	х				(x)				х
НМТ		х				х	х	х	х
HMS	х	х	х					х	х
HMF	х	х	х					х	х
HMR		х	х					х	х
SWRSE	х	х					х	х	х
HSW	х				x				

Drive concept:

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

Circuit examples:

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

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 (BSPP)) 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







Intermediate blocks (main and initial lift):

Size 2 T 23 T 2 T 3, T 34, T 44 T 25 T 3, T 34, T 44 T 25 T 3, T 34, T 44 T 25

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

Size 1 and 2	Size 1 and 2	Size 2	Size 2
1	2	20E	30E



General parameters and dimensions

HMT 34 ...





HMC 33 ... Intermediate blocks (T3)

Lifting module

130

50

50

Æ

Ð₽₽₽

Directional spool valve sections

End plate

 \oplus

⊕₅∣⊕

40

€

4C



	Q _{max} [lpm]	p _{max} (bar)	Note	Ports (BSPP)
HSV 21	20	315 400	Individual device	P, R, A = G 3/8
HSV 22	30			P = G 3/8; A, R = G 1/2
HSV 41	40			P, R, $A = G 1/2$
HSV 61	60			P, R, $A = G 1/2$
HSV 71	160			P, R, $A = G 3/4$
HSN	50 -100			H, R = G 3/4; P1 = G 3/8; P = (flange connection)
HST 2	20 - 40	315	Connection blocks	P, R, H = G 1/2; M = G 3/8
HST 3	30 - 60		of lifting module	P, R, H = G 3/4; M = G 3/8
HMB 2	30		- SWR/SWS-Valve sections	P, R = G $1/2$; M = G $1/4$
HMB 33	90		- Intermediate blocks	P, R = G 3/4; M, R1 = G 1/4
HMC 2	30		- Lifu plates	P, R, A = G 1/2; M = G 1/8
HMC 3 (33)	90			P, R = G 3/4; M, R1 = G 1/4; C = G 3/8
HMT 3	70 - 90			H, P, R = G 1/2; M = G 3/8
HMT 34	70 - 90			H = G 3/4; P, R = G 1/2; M = G 3/8
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, R 2 = G 3/4; P1, D = G 3/8; M = G 1/4
HSW 2	25			H, R = G 1/2; P1, P 2 = G 3/8; M = G 1/8
SWR 1 SE	12			P, R, R1 = G 1/4; M = G 1/8
SWR 2 SE	25			P, R = G 3/8; M = G 1/4

- HMB 2, HMC 2, SWR 1 SE: Hole pattern SWR 1, T2; adaptor plates from X12 to SWR 2

- SWR 1 SE, SWR 2 SE: also for external additional functions

Associated technical data sheets:

- Type HMC: <u>D 7650</u>
- Type HMT: Sk 7758 HMT
- Type HMB: Sk 7650 B2, SK 7650 B33
- Type HST: Sk 7650 HST ff
- Type HSW: Sk 7650 HSW
- Type HTML: Sk 7982 HTML

Information on additional lifting modules on inquiry

Similar products:

- Type SWR, SWS 2: Page 88
- Connection blocks type HMPL and HMPV:<u>Page 104</u>

Plugs:

- With LED's and others: <u>D 7163</u>
- With economy circuit: <u>D 7813D 7833</u>

See also section "Devices for special applications"

- Devices for industrial trucks and hoists

2.2 Directional seated valves type VH, VHR and VHP

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 transferring 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.

Features and benefits:

- Max. pressure 700 bar (manual actuation)
- Actuation using hand lever with automatic centring in zero position or with notch
- Different arrangements in valve bank possible
- Leakage-free seated valve technology

Intended applications

- Machines for construction and construction material
- Offshore and marine technology
- Process engineering systems
- Oil hydraulics and pneumatics



Nomen- clature:	Directional seated valve, zero leakage
Design:	Individual valve for pipe connection Individual valve, manifold mounting, bankable
Actuation:	Manual
p _{max} :	500 700 bar
Q _{max} :	12 25 lpm

Design and order coding example

VH 1 VHR 1	H1 G1/N1/E1		
	Function/valve	e sections with actuation	Hand lever with automatic return (1) or detent (2)
			 Additional versions: Actuation with idle position monitoring via contact switch, available either as indiv. valve or valve bank
Basic type,	, size Type \ Type \ Type \ Type \ Size 1	/H (Individual valve for pipe /HP (Individual valve, manif /HR (Valve bank) Land 2	e connection) fold mounting)

Actuations:



- Return spring: The automatic return is limited to operating pressure of 50 bar. The hand lever has to be returned manually at operating pressure between 50 ... 700 bar.





- Type L and S individual valve only, not for type VHR

General parameters and dimensions





	Q _{max} [lpm]	p _{max} [bar]	Ports	Dimensions [mm]			m [kg]	
				Н	H1	В	Т	Valve section
VH 1, VHP 1, VHR 1	12	700	G 1/4	50	approx. 172	50	90	1.6
VH 2, VHR 2	25	500	G 3/8	60	approx. 162	60	120	3

Associated technical data sheets:

Directional seated valves type VH, VHR, VHP: <u>D 7647</u>

Similar products:

- Directional seated valves type BVG 1, BVP 1, NBVP 16: <u>Page 156</u>
- Shut-off valves type DA, EA: <u>Page 172</u>

See also section "Devices for special applications"

- Devices for up to 700 bar

2.2 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.

Features and benefits:

- Zero leakage blocking of a hydraulic line
- Pressures up to 500 bar manually switchable
- Flows up to 150 lpm
- Single or double-blocking

Intended applications:

- Rolling mill equipment
- Shipbuilding
- Construction and construction materials machinery
- Mining machinery



Nomen- clature:	Directional seated valve, zero leakage
Design:	Individual valve for pipe connection
Actuation:	Manual
p _{max} :	500 bar
Q _{max} :	60 150 lpm

Design and order coding example

EA 3

Basic type, size Type DA (doppeltwirkend) size 2, 3, Typ EA (einfachwirkend), size 2, 3





General parameters and dimensions





	Q _{max} [lpm]	p _{max} [bar]	Ports (BSPP)	Dimensions [mm]		m [kg]
			А, В	L	SW = a/f	
DA 2, EA 2	60	500	G 3/4	165	SW 36	1.3 - 1.5
DA 2B, EA 2B	60	500	G 3/4	165	SW 36	1.3 - 1.5
DA 3, EA 3	150	500	G 1	200	SW 50	3.0 - 3.2

Associated technical data sheets:

Shut-off valves type DA, EA: <u>D 1741</u>

Similar products:

Directional seated valves type VH, VHR, VHP: Page 170

Valves

2.3 Pressure valves

Directly controlled pressure limiting and sequence valves	
type MV, SV	178
Pressure limiting valves type CMV and CSV	182
Piloted pressure limiting valves type DV, AS etc.	184
Sequence valves with check valve type VR	186
Proportional pressure limiting valves type PMV and PDV	188
Miniature pressure reducing valves type ADC, AM etc.	190
Pressure reducing valves type ADM and VDM	192
Pressure-reducing valves type CDK, CLK, DK, DLZ and DZ	196
Miniature proportional pressure reducing valves type PM	200
Proportional pressure reducing valves type PDM	202
Circulation valve type CNE	204
Two stage valves type NE	206
Shut-off valves type LV and ALZ	208
Pressure controlled shut-off valves type DSV and CDSV	210
Load holding valves type LHK, LHDV, and LHT	212



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



Proportional pressurelimiting valves type PMV and PDV



Pressure-limiting and sequence valves (also proportional)

Туре	Design	Adjustability	p _{max}	Q _{max}
MV, SV	Individual valve for pipe connection or manifold mountingScrew-in valve, assembly kit	- Tool adjustable - Manually adjustable	700 bar	5 160 lpm
CMV(Z), CSV(Z)	Screw-in valveDirectly controlled	- Tool adjustable - Manually adjustable	500 bar	60 lpm
DV, AS	 Individual valve for pipe connection or manifold mounting 	- Tool adjustable - Manually adjustable	420 bar	120 lpm
VR	Insert valveVersion with housing	- Tool adjustable	315 bar ∆p _{max} : 15 bar	120 lpm
PMV, PDV	 Individual valve for pipe connection or manifold mounting 	- Electro-proportional	700 bar	120 lpm

Pressure-reducing valves (also proportional)

Туре	Design	Adjustability	p _{max}	Q _{max}
ADC, AM	Screw-in valvefor pipe connection	- Tool adjustable	р _{тах Р} : 300 400 bar р _{тах А} : 15 100 bar	2 10 lpm
ADM, VDM	Individual valve for pipe connection or manifold mountingDirectly controlled or piloted	- Tool adjustable - Manually adjustable	p _{max P} : 300 - 400 bar p _{max A} : 250 - 400 bar	120 lpm
CDK, CLK, DK, DLZ, DZ	Screw-in valve (2-way principle)Combination with connection block	- Tool adjustable - Manually adjustable	500 bar	22 lpm
РМ	Assembly kitIndividual valve for manifold mounting	- Electro-proportional	p _{max P} : 40 bar p _{max A} : 19 bar	approx. 2 lpm
PDM	 Individual valve for pipe connection or manifold mounting 	- Electro-proportional	p _{max P} : 400 bar p _{max A} : 5 - 350 bar	120 lpm



Externally pressure-controlled relief valves (switch-off, follow-up valves)

Туре	Nomenclature/Design	Adjustability	p _{max}	Q _{max}
CNE 2	2-way idle circulation valveScrew-in valve	- Tool adjustable	500 bar p _{max adjust} : 450 bar	30 lpm
NE	Two-stage valve (high-pressure/low-pressure stage)Individual valve for pipe connection	- Tool adjustable	500 700/ 3080 bar	25/ 180 lpm
LV, ALZ	 Shut-off valve (idle circulation valve, directly controlled or piloted) Individual valve for pipe connection or manifold mounting 	- Tool adjustable - Manually adjustable	350 bar	120 lpm
DSV, CDSV	Individual valve for pipe connection or manifold mountingScrew-in valve	- Tool adjustable - Manually adjustable	600 bar	60 lpm

Load-holding valves

Туре	Nomenclature/Design	p _{max}	Q _{max}
LHK,	Load-holding valve, over centre valve	360 450 bar	250 lpm
LHDV,	 Individual valve for pipe connection or manifold mounting 		
LHI	 Screw-in valve, version for banjo bolt mounting 		

Pressure valves

2.3 Directly controlled pressure limiting and sequence valves type MV, SV

Pressure valves influence the pressure in hydraulic systems.

Pressure-limiting valves (safety or overpressure valve) safeguard the system against excessive pressure or limit the operation pressure. Sequence valves generate a constant pressure difference between the inlet and outlet flow.

A damping device is fitted as standard in the directly controlled valves to ensure quiet operation, but an undamped variant is also available for special operating conditions. Pressure-limiting valves with unit approval and CE mark (type MV.X) are also available.

Features and benefits:

- Operating pressures up to 700 bar
- Various adjustment options
- Numerous configurations

Intended applications:

- General hydraulic systems
- Test benches
- Hydraulic tools



Nomen- clature:	Pressure limiting valve, sequence valves (directly controlled)
Design:	Individual valve for pipe connection Screw-in valve Individual manifold mounting valve Assembly kit
Adjustment:	Tool adjustable Manually adjustable
p _{max} :	700 bar
Q _{max} :	5 160 l/min

Design and order coding example

MVS 52	В	R	Х	- 650			
				Pressure s	setting]		
	Optionally without dampening (X)						
	Adjustability (while pressuri						Tool adjustable
							Manually adjustable
							Adjustable with turn knob (self-locking/lockable)
P	ressu	re ran	ige an	d flow	Pressure rang	es A,	B, C, E and F
Basic type, si	ze	Туре	MV,	DMV and	SV		
		Addi	tional	l versions			
	 Multiple pressure limiting valves (2, 3, 4, 5 valves in parallel) 						
		- D		1	1	• .	

- Pressure-limiting valves with unit approval (TÜV valves) (type MVX, MVSX, MVEX, MVPX, SVX, size 4, 5 and 6)
- Various actuations: ball head for controls via cam, lever etc. (type MVG and MVP only)



	MV ¹⁾	MVS MVG	MVE	SV	MVP	DMV	MVCS MVGC	SVC	MVB
		P.	:] . R] . L					· R	P R C
Function	Pressure limiting valve	re Pressure limiting valve and differential pressure ng regulators				Pressure limiting valve	Pressure-limiting valve with free return flow $R \rightarrow P$ via a bypass check valve		Pressure limiting valve and differen- tial pressure regulators
Brief description	Corner valve for pipe connection	Corner valve for pipe connection	Screw-in valve	Straight-way valve for straight pipe installation	Manifold mounting valve	Twin valve as shock valve for hydraulic motors	Corner valve for pipe connection	Straight-way valve for straight pipe installation	Assembly kit
Size	4, 5, 6	13, 14, 4, 5, 6, 8	13, 14, 4, 5, 6, 8	4, 5, 6, 8	13, 14, 4, 5, 6, 8	4, 5, 6, 8	13, 14, 4, 5, 6	4, 5, 6	4, 5, 6, 8
p _{perm R} [bar]	20	500	500	500	500	350	500	500	200

1) Only size 4, 5, 6, and 8 Type MVG and MVGC only size 13 and 14






MVG



See following table for dimensions





	Size	Dimer [mm]	isions		m [kg]	Size	Pressure range/ Flow	Ports (BSPP) ¹⁾	
		H _{max}	B/SW	T _{max}					
MV, MVS, MVCS, MVE	4	126	24	48	0.3	4	F: 80/20	G 1/4, G 3/8	
	5	142	29	60	0.4		E: 160/20 C: 315/20		
	6	164	36	70	0.7		B: 500/20		
	8	208	40	60	2.0	A	A: 700/12		
DMV	4	107	40	52	0.7	5	F: 80/40	G 3/8, G 1/2	
	5	123	50	65	1.3		E: 160/40 C: 315/40		
	6	142.5	60	75	1.8		B: 500/40		
	8	192	80	96	4.5		A: 700/20		
MVP	4	102	28	35	0.3	6	F: 80/75	G 1/2 G 3/4	
	5	113	32	40	0.5		E: 160/75 C: 315/75		
	6	133	35	50	0.8		B: 500/75		
	8	172	50	60	1.6		A: 700/40		
	13, 14	82	29	50	0.3	8	E: 160/160	G 3/4, G 1	
MVE	13, 14	75	SW 27	-	0.1		C: 315/160 Bi: 500/160		
MVG, MVGC	13, 14	94	20	42	0.3	13	H: 700/5	G 1/4	
SV, SVC	4	-	SW 22	87	0.2	14	N: 50/8	G 1/4	
	5	-	SW 27	108	0.4		M: 200/8 H: 400/8		
	6	-	SW 32	132	0.9				
SV	8	-	SW 41	157	0.9				

1) For pipe connection versions only

Associated technical data sheets:

- Pressure limiting valves type MV etc.: <u>D 7000/1</u>
- Miniature pressure limiting valves type MVGetc.: <u>D 3726</u>
- Pressure limiting valves (assembly kits) type MV:
 <u>D 7000 E/1</u>
- Multiple pressure limiting valves type MV: <u>D 7000 M</u>
- Pressure limiting valves with type approval (TÜV) type MVX etc.:
 <u>D 7000 TÜV</u>

Similar products:

- Screw-in pressure valves type CMV, CSV: <u>Page 182</u>
- Piloted pressure valves type DV: <u>Page 184</u>
- Piloted pressure valves type A: <u>Page 184</u>

See also section "Devices for special applications":

- Devices for up to 700 bar

2.3 Pressure limiting valves type CMV and CSV

Pressure valves influence the pressure in hydraulic systems. Pressure-limiting valves (safety or overpressure valve) safeguard the system against excessive pressure or limit the operation pressure. Sequence valves generate a constant pressure difference between the inlet and outlet flow, where the flow in the opposite direction (return flow) is free via a bypass check valve.

One advantage of the valves described here is the easily produced mounting hole (see dimensions). Type CMV is also available as a CE-marked pressure-limiting valve with unit approval, e.g. as a safety valve for accumulators in accordance with Pressure Equipment Directive 97/23 EC. Types CMVZ and CSVZ are not influenced by the pressure conditions downstream and are therefore suitable for use in loss-free sequence control systems.

Features and benefits:

- Operating pressures up to 500 bar
- Various adjustment options
- Easily produced mounting hole

Intended applications:

- General hydraulic systems
- Test benches
- Hydraulic tools



Nomen- clature:	Pressure limiting valve, sequence valves (directly controlled)
Design:	Screw-in valve
Adjustment:	Tool adjustable Manually adjustable
p _{max} :	500 bar
Q _{max} :	60 lpm

Design and order coding example

CMV 3	F	R	- 200	- 1/4					
			1	Indiv. con	nection blo	ock for pipe connection			
			Pressure s	etting [ba	ar]				
Adjustability (while pressurized) Tool or manually adjusta									
	Pressu	re rar	ige Pre	ssure rang	es B, C, E a	nd F			
Basic type,	size	Тур Тур	e CMV (pre e CSV (pre	essure limi ssure diffe	ting valve), erence valve	size 1 to 3), size 2 to 3			
	Additional versions:								
			Sequence v	alves CMV/	Z or CSVZ				
			Version wit	th unit app	proval type	CMVX			

Undamped version (CMV)



Function









Pressure limiting valve (port R pressure resistant)

General parameters and dimensions

CMV/CMVZ







	Size	Q _{max} [lpm]	Pressure range p _{max} [bar]	М	SW = a/f	Dimensio [mm]	ons	m [g]
						\mathbf{H}_{\max}	$H1_{max}$	
CMV, CMVZ	1	20	F: 80 E: 160 C: 315 B: 500	M 16 x 1.5	SW 22	78	57	90
	2	40		M 20 x 1.5	SW 24	94	72	160
	3	60		M 24 x 1.5	SW 30	114	83	275
CSV, CSVZ	2	40		M 20 x 1.5	SW 24	104	73	150
	3	60		M 24 x 1.5	SW 30	122	82	300

Associated technical data sheets:

- Pressure-limiting valves type CMV, CSV: <u>D 7710 MV</u>
- Pressure-limiting valves with unit approval type CMVX: <u>D 7710 TÜV</u>

Similar products:

- Pressure-limiting valves type MV, SV etc.: Page 178
- Miniature pressure-limiting valves type MVG etc.: Page 178
- Piloted pressure valves type DV: <u>Page 184</u>
- Piloted pressure valves type AS: <u>Page 184</u>

See also section "Devices for special applications"

- Screw-in valves and installation kits
- Devices for up to 700 bar

2.3 Piloted pressure limiting valves type DV, AS etc.

Pressure valves influence the pressure in hydraulic systems. Pressure-limiting valves (safety or overpressure valve) safeguard the system against excessive pressure or limit the operation pressure. Sequence valves generate a constant pressure difference between the inlet and outlet flow. Follow-up valves (release valves) block the flow until a set pressure value is reached (free flow once this value is exceeded). Compared with pressure valves of the type DV, the types AS and AE have an additional check valve in the consumer port.

Features and benefits:

- Various adjustment options
- Various additional functions

Intended applications:

- General hydraulic systems
- Test benches



Nomen- clature:	Pressure limiting valve Sequence valve Follow-up valve (piloted)
Design:	Individual valve for pipe connection Individual valve manifold mounting
Adjustment:	Tool adjustable Manually adjustable
p _{max} :	420 bar
Q _{max} :	120 lpm

Design and order coding example







Pressure limiting, sequence valve

Follow-up valve

Pressure limiting, sequence valve, follow-up valve or 2/2-way directional valve (remote controlled, depending on the kind of valve connected to port X)



Pressure limiting valve



Release valve (remote controlled), combined function as pressure limiting valve possible (type ASE)





DV...P



Type, size	Q _{max} [lpm]	Pressure range: pmax [bar]Ports (BSPP)Dimensions [mm]					m [kg] ¹⁾		
DV, DVE, DF				Н	В	B1	Т	T1	
3	50	N: 100	G 1/2	30	60	-	66	-	1,1 / -
4	80	H: 420	G 3/4	40	65	60	71	78	1,5 / 2,0
5	120		G 1	50	80	88	73	81	2,0 / 2,5

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





Type, size	Q _{max} [lpm]	Pressure range: p _{max} [bar]	Ports (BSPP)	Dimensions [mm]					m [kg] ¹⁾	
AS, ASE, AE				Н	H1	В	B1	Т	T1	
3	50	M: 200	G 1/2	40	-	60	-	80	-	1.8
4	80	H: 350/300 (type AE)	G 3/4	40	40	70	80	94	60	2.2
5	120		G 1	6.3	40	100	94	85	80	4.1

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

Associated technical data sheets:

- Piloted pressure valves type DV: <u>D 4350</u>
- Piloted pressure valves type AS, AE: <u>D 6170</u>

Similar products:

- Pressure limiting valves type MV, SV etc.: <u>Page 178</u>
- Miniature pressure limiting valves type MVG etc.: <u>Page 178</u>
- Pressure limiting valves type CMV(Z): <u>Page 182</u>

2.3 Sequence valves with check valve type VR

Pressure valves influence 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 $V \rightarrow F$.

These pre-load valves are used, for example, as drop protection in fork lift trucks, safeguarding the lifting cylinder during lowering to prevent continued travel if the fork accidentally gets caught (accident protection), or preventing undesired oscillations by increasing the back pressure when used as pre-load valve in return pipes.

Features and benefits:

Compact screw-in valve

- **Intended applications:**
- Industrial trucks
- Lifting devices



Nomen- clature:	Sequence valve
Design:	Screw-in valve Combination with housing for pipe connection
Adjustment:	Fixed (non-adjustable)
p _{max} : ∆p _{max} :	315 bar 15 bar
Q _{max} :	120 lpm

Design and order coding example VR 3 3 C Design with housing Cartridge valve Versions with housing for pipe connection Design with metric fine thread Pre-load pressure Open-up pressure Δp_{max} 3 to 15 bar

Basic type, size Type VR, size 1 to 4



Function

VR



رتيب Screw-in valve V V V V

Version with housing for pipe connection

General parameters and dimensions



VR 4 9 E





┲┱<mark>╽┍╴╴╶┲╶┱═══</mark> ┠╶┧╟┽╵╶<u>┲</u>╎╵┝╴╴╶<mark>╤</mark>

L1

VR 1 15 G Version with housing



	Q _{max} [lpm]	∆p _{max} [bar] ¹⁾	Dimensions [mm]					m [g] ²⁾
			G (BSPP)	L	L1	L2	SW = a/f	
VR 1	15	3, 5, 7, 9, 12, 15	G 1/4 (A)	31	78	66	SW 19	15/120
VR 2	40	3, 5, 7, 9, 12, 15	G 3/8 (A)	36	82	70	SW 22	25/160
VR 3	65	3, 5, 7, 9, 12	G 1/2 (A)	42	96	80	SW 27	40/270
VR 4	120	3, 5, 7, 9, 12	G 3/4 (A)	54	106	100	SW 32	80/400

(D

SW

1) The selected pre-load pressure e.g. opening pressure cannot beltered

2) Individual valve/design with housing

Associated technical data sheets:

Sequence valves type VR: <u>D 7340</u>

Similar products:

- Pressure limiting valves type MV, SV etc.: Page 178
- Miniature pressure limiting valves MVG etc.: <u>Page 178</u>
- Piloted pressure valves type DV: Page 184
- Pressure limiting valves type CMV: <u>Page 182</u>

See also section "Devices for special applications":

- Industrial trucks
- Screw-in valves and installation kits

2.3 Proportional pressure limiting valves type PMV and PDV

These pressure limiting valves are electrically remote controlled and rule the hydraulic pressure within the system. These pressure limiting valves are electrically remote controlled and safe guard the system against an excessive pressure whose value can be altered.

The valve series described here are directly controlled (type PMV) or piloted (type PDV). A minimum pressure of 3 bar or more is required for proper functioning of the integrated prop. pressure-reducing valve.

Features and benefits:

Max. operating pressure 700 bar

Intended applications:

- General hydraulics
- Test benches



Nomen- clature:	Prop. pressure-limiting valve (directly controlled or piloted)
Design:	Individual valve for pipe connection Individual valve Manifold mounting
Adjustment:	Electro-proportional
p _{max} :	700 bar
Q _{max} :	120 lpm

in the

Design and order coding example

PDV4G PMVP4	H - 44	- G24 - G24		
		Nominal	voltage of proportional solenoid	12V DC, 24V DC Controls via prop. amplifier or PLVC
	Pressur	e range [ba	ar]	
Basic type,	connect	tion size	Type PMV (pipe connection), type	PMVP (manifold mounting)
			 Optionally with separate contro main pump circuit (type PMVS, 	ol oil supply, i.e. pressure reduction right above 0 bar, no leakage PMVPS)
			Type PDV	
			 Additionally with 2/2-way sole 	noid valves for arbitrary idle circulation

Function

PMV, PDV

P F F F

Pipe connection

Manifold mounting valve



ΡΜ۷



PMVP





PDV..P



	Size	Q _{max} [lpm]	Pressure range p _{max} [bar]	Ports (BSPP) 1)	Dimensions [mm]			m [kg]	
					Н	В	Т		
PMV/PMVP	4	16	41: 180 42: 290 43: 440 44: 700	G 1/4, G 3/8	97/95	35	135	1,2 / 1,1	
	5	16 60	41: 110 42: 180 43: 270 44: 450	G 1/4, G 3/8, G 1/2	98/95	35/40	140	1.2	
	6	60 75	41: 80 42: 130 43: 190 44: 320	G 3/8, G 1/2, G 3/4	102/95	40/50	150/140	1,5/1,3	
	8 120 41: 45 42: 70 43: 110 44: 180	G 3/4, G 1	107/97	45/60	160/150	1,9/1,7			
PDV.G/PDV.P	3	40	N: 130	G 1/2	96	66	150	1.8	
	4	80	M: 200 H: 350	G 3/4	99.5	71/78	155/150	2,2/2,7	
	5	120		G 1	104.5	73/81	170/178	2.7/3.2	

1) For pipe connection versions only

Associated technical data sheets:

- Prop. pressure limiting valves type PMV(S), PMVP(S): <u>D 7485/1</u> Prop. amplifier (module) type EV1M2: <u>Page 276</u>
- Prop. pressure valves type PDV: <u>D 7486</u>
- Type NPMVP: <u>D 7485 N</u>
- Type NZP: <u>D 7788 Z</u>

Electronic accessories:

- Prop. amplifier (module) type EV1D1: Page 276
- Prop. amplifier (card version) type EV 22K2: <u>Page 276</u>
- Programmable logic valve control type PLVC: <u>Page 278</u>

See also section "Devices for special applications"

- Proportional valves
- Devices for up to 700 bar

2.3 Miniature pressure reducing valves type ADC, AM etc.

The task of pressure-reducing valves is to maintain a largely constant outlet pressure despite a higher and changing inlet pressure. These valves are used when a secondary circuit has to be fed with a lower but constant pressure level by a main (primary) oil circuit with a higher and varying pressure level. The valves mentioned here are suitable for the supply of control circuits with low oil consumption. There is a design-related permanent leakage flow, which has to be led back to the tank in a de-pressurized line via port R. A reversal of the flow direction is possible up to approx. 30% of Q_{max} . A bypass check valve has to be provided for higher reversed flow. These pressure-reducing valves 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.

Features and benefits:

- Compact design
- Numerous configurations

Intended applications:

• For control oil supply in pilot circuits



Nomen- clature:	Pressure reducing valve
Design:	Screw-in valve Valve for pipe connection
Adjustment:	Fixed (non-adjustable)
P _{max P} : P _{max A} :	300 400 bar 15 100 bar
Q _{max} :	2 10 lpm

Design and order coding example

ADC 1	- 25	- 1/4	
		Design	 Cartridge valve Design with housing for direct pipe connection Version with housing for manifold mounting (type AM 11)
F	Pressure	downstre	am Pressure at port A [bar]
Basic type	Type / Type /	ADC, AM ADM, ADM	E

Type ADM 1 adjustable version available

Function

ADC, AM, ADM, ADME



Screw-in valve



Pipe installation



20

General parameters and dimensions

ADC 1-.25

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

AM 1 - 20 -1/4

Pressure-reducing valve type AM 1,

version for pipe connection (ports G 1/4

(BSPP)), pressure at A approx. 20 bar

ADME 1-...

ADM 1-70

59

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







	Q _{max} [lpm]	p _{max} [bar]	Outlet pressure [bar] at A	Ports (BSPP) ¹⁾	m _{max} [kg]		
					Screw-in valve	Pipe installation	
ADC 1	2	300	15, 25	G 1/4	0.03	0.32	
AM 1	2	400	20, 30, 40, 100	G 1/4	0.03	0.3	
ADM 1	810	300	15, 20, 30, 70	G 1/4	-	0.34	
ADME	8	300	15, 20, 30	-	0.05	-	

1) In version for pipe connection only

Associated technical data sheets:

Miniature pressure-reducing valves type ADC etc.: <u>D 7458</u>

Similar products:

- Pressure-reducing valves type ADM, VDM: Page 192
- Pressure-reducing valves type CDK: <u>Page 196</u>

Prop. pressure-reducing valves type PDM: <u>Page 202</u>

 Miniature prop. pressure-reducing valves type PM, PMZ: <u>Page</u> 200

See also section "Devices for special applications"

- Screw-in valves and installation kits

2.3 Pressure reducing valves type ADM and VDM

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. These valves are usually used when a secondary circuit has to be fed with a lower but constant pressure level by a main (primary) circuit with a higher and varying pressure level. These valves are either directly controlled (type ADM) or hydraulically piloted (type VDM). There is a design related permanent leakage flow apparent at L, which has to be led back to the tank via a de-pressurized line. 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 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.

Features and benefits:

- With safety valve function
- Various adjustment options
- Various additional functions

Design and order coding example

Intended applications:

- General hydraulics
- Jigs
- Test benches



Nomen- clature:	Pressure-reducing valve (directly controlled or piloted)
Design:	Individual valve for pipe connection Individual valve Manifold mounting
Adjustment:	Tool adjustable Manually adjustable
P _{max P} : P _{max A} :	300 400 bar 250 400 bar
Q _{max} :	120 lpm

ADM 22 D R - 250 Pressure setting [bar] Pressure setting [bar] Adjustability in operation • Tool adjustable (-) • Manually adjustable (R) • Adjustable with turn knob (self-locking -V/lockable -H) • Pressure range Pressure ranges for outlet pressure at A Basic type, size Type ADM (non-piloted), size 1 to 3





Function







Valve for pipe connection

General parameters and dimensions

ADM 22 DR

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

pressure manually adjustable (coding R)

Directly controlled pressure-reducing valve type ADM, size 2 for pipe connection

(ports G 3/8 (BSPP), coding 2),

Pressure range 30 to 120 bar (coding D), Manually adjustable pressure (coding R)







Valve for pipe connection

ADM...P Manifold mounting valve



Manifold mounting valve

VDM...G Valve for pipe connection

VDM 5 PH - 250

Piloted pressure reducing valve type VDM size 5, manifold mounting (coding P), pressure range 10 to 400 bar (coding H), pressure tool adjustable to 250 bar Piloted pressure-reducing valve type VDM, size 5 for manifold mounting (coding P), pressure range 10 to 400 bar (coding H), tool adjustable pressure to 250 bar



	Q _{max} [lpm]	p _{max} [bar]	p _{max A} [bar]	Ports (BSPP) ²⁾	Leakage flow Q _{leak} [lpm]	Dimensions [mm]				m _{max} [kg] ³⁾		
						Н	H1	В	B1	Т	T1	
ADM 1	12	300	F: 30	G 1/4	approx. <0.05	30	35	45	35	141	-	0.6/0.6
ADM 2	25		D: 120 C: 160 A: 250	G 1/4, G 3/8	approx. <0.05	30	40	50	40	162	-	0.7/0.85
ADM 3	60		F: 25 D: 100 C: 160 A: 250	G 3/8, G 1/2	approx. <0.07	30	40	50	40	174	-	1.0/1.1
VDM 3	40	400	N: 100	G 1/2	approx. <0.4	30	-	60	-	66	-	1.1/
VDM 4	70		H: 400 ¹⁾	G 3/4		40	40	65	60	71	78	1.5/2.0
VDM 5	120			G 1		50	50	80	88	73	81	2.0/2.5

1) Max. pressure difference is 300 bar between inlet and outlet

2) Design for pipe connection

3) Version for pipe connection / manifold mounting



Example circuit:

HK 43 LDT/1 M - ZZ 2.7/9.8

-AN 21 F 2-D45-F50 -BA 2 -NSMD 2 K/GRK/0 -1-G 24



Associated technical data sheets:

- Pressure-reducing valves type ADM: <u>D 7120</u>
- Pressure-reducing valves type VDM, VDX: <u>D 5579</u>

Similar products:

- Miniature pressure-reducing valves type ADC etc.: <u>Page 190</u>
- Miniature prop. pressure-reducing valves type PM, PMZ: <u>Page</u> 200
- Pressure-reducing valves type CDK: <u>Page 196</u>
- Prop. pressure-reducing valves type PDM: <u>Page 202</u>

2.3 Pressure-reducing valves type CDK, CLK, DK, DLZ and DZ

The task of pressure-reducing valves is to maintain a largely constant outlet pressure despite a higher and changing inlet pressure. These valves are used when a secondary circuit has to be fed with a lower but constant pressure level by a main (primary) oil circuit with a higher and varying pressure level. The valve described here is directly controlled. Compared with conventional, piston-type pressure-reducing valves suffering from leaking oil, where an additional drain port is required, this type is designed according to the 2-way principle, i.e. it has zero leakage when in a closed state. Type CLK has an additional override compensation. A reversal of the flow direction is possible up to approx. 2 x Q_{max}.

Features and benefits:

- Zero leakage in closed state
- Version with integrated overpressure function
- Easily produced mounting hole

Intended applications:

- General hydraulic systems
- Jigs
- Test benches



clature:	Pressure reducing valve (2-way valve)
Design:	Screw-in valve combination with a connection block for Pipe connection Manifold mounting
Adjustment:	Tool adjustable Manually (adjustable)
p _{max} :	500 bar
Q _{max} :	22 lpm

Design and order coding example

CDK 3 -2	R	- 250	
	P	ressure se	etting [bar]
A	djustr	nent 🛛	Tool adjustable (-)
			 Manually adjustable (R)
			 Adjustable with turn knob (self-locking -V/lockable -H)
Basic type and	press	ure range	e Type CDK, type CLK (with additional override compensation)
			Screw-in valve
			Version with connection block for pipe connection with/without press
			 Version with connection block for manifold mounting with/without preserved.
			- The intermediate plate design NCC (terre NZD)

In intermediate plate design NG6 (type NZP)



DK 2	R	/160	/4R
	F	Pressure	Additional elements Orifice/throttle Setting [bar]
4	\djust	ment	 Tool adjustable (-) Manually adjustable (R) Adjustable with turn knob (self-locking -V/lockable -H)
Basic type	and p	pressure	range Type DK (with tracked pressure switch) Type DZ with type CDK Type DLZ with type CLK
			 With bypass check valve

- Manifold mounting
- Version with connection block for pipe connection



	Q _{max} [lpm]	Pressure range pm	_{ax} [bar]	Ports (BSPP)	m [kg]
CDK 3, CLK 3	6 22	08: 450 ¹⁾ 081: 500 ¹⁾ 1: 300 11: 380	2: 200	-	0.7
CDK 31/4-DG3.			21: 250 5: 130	G1/4	1.25
CDK 3P			51: 165	-	1.4
DZ, DLZ, DK				-	

1) Only available as type CDK and DK



Example of a version with large flows $Q_{A\rightarrow P}$ Example: $Q_P = 15$ lpm [formula]



Application example for large flows

- 1. e.g. type RK 2G in acc. with D 7445
- 2. $Q_{return} = 45 \text{ lpm}$
- **3.** $Q_P = 15 \text{ lpm}$
- 4. Type CDK 3-2-1/4



Example of a version

with undesired return flow

Application example for undesired return flow

- e.g. type RK 1E in acc. with D 7445 (shown here screwed into port A of the CDK 3 valve)
- 2. Type CDK 3- 2-1/4-DG 34



shown here with seated valves type BVZP 1 in acc.

Use in the valve bank,

with D 7785 B

Application example in the valve bank

 Type CDK 3-2-100 shown here incorporated as -/CZ 2/100...

Associated technical data sheets:

- Pressure-reducing valves type CDK: <u>D 7745</u>
- Pressure-reducing valves type CLK: <u>D 7745 L</u>
- Pressure reducing valve with tracked pressure switch type DK, DZ: D 7941

Similar products:

- Pressure-reducing valves type ADM, VDM, VDX: <u>Page 192</u>
- Miniature pressure-reducing valves type ADC etc.: <u>Page 190</u>
- Prop. pressure-reducing valves type PDM: <u>Page 202</u>

Intermediate plates:

Intermediate plate NG 6 type NZP: <u>D 7788 Z</u>

Accessories:

Pressure switches type DG 3., DG 5 E: <u>Page 266</u>

See also section "Devices for special applications"

- Screw-in valves and installation kits

2.3 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 permanent leakage flow apparent at R, which has to be led back to the tank via a depressurized line. 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.

Features and benefits:

- Compact design
- Numerous configurations

Intended applications:

For control oil supply in piloting circuits



Nomen- clature:	Prop. pressure reducing valve
Design:	Assembly kit Individual valve Manifold mounting
Adjustment:	Electro-proportional
p _{max P} : p _{max A} :	40 bar 19 bar
Q _{max} :	approx 2 lpm

Design and order coding example



- Assembly kit (type PM 1, PMZ 01, PMZ 11)
- For manifold mounting (type PM 11, PM 12)
- Version in valve bank (type PMZ) with up to 10 prop. pressure-reducing valve sections









PM 11





Design

PMZ 1







PM 12





Pressure range (prop. adjustable nom. pressure difference $\Lambda \mathbf{p} = \mathbf{p}_{\Lambda} - \mathbf{n}_{P}$)[har]

			$\Delta \mathbf{p} = \mathbf{p}_{\mathbf{A}} - \mathbf{p}_{\mathbf{A}} / \mathbf{p}_{\mathbf{A}} $
PM 1	Assembly kit	Individual valve	0 9
PMZ 1, PMZ 01		Twin valve	0 4.5 and 0 11.5
PM 11	Valve for manifold mounting	Individual valve	0 5.5 and 0 14
PM 12		Twin valve	0 7.5 and 0 19

Associated technical data sheets:

Miniature prop. pressure reducing valves type PM, PMZ: <u>D 7625</u> Type EV22K (card version): <u>Page 276</u>

Similar products:

Prop. pressure reducing valves type PDM: Page 276

Prop. amplifier:

- Type EV1M (module): <u>Page 276</u>
- Type EV1G (module): <u>Page 276</u>

- Type EV1D (module): Page 276

Additional electrical components:

Programmable logical valve control type PLVC: Page 278

See also section "Devices for special applications":

- Proportional valves

2.3 Proportional pressure reducing valves type PDM

The task of proportional pressure reducing valves in a hydraulic circuit is to maintain a rather constant outlet pressure (port A) despite a higher and changing inlet pressure (port P). 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 permanent leakage flow apparent at L, which has to be led back to the tank via a depressurized line. 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.

Features and benefits:

With safety valve function

Intended applications:

- General hydraulics
- Jigs
- Test benches



Nomen- clature:	Prop. pressure-reducing valve (directly controlled or piloted)
Design:	Individual valve for pipe connection Individual valve Manifold mounting
Adjustment:	Electro-proportional
p _{max P} : p _{max A} :	400 bar 5 350 bar
Q _{max} :	120 lpm

Design and order coding example

PDMP 2 PDM 4 G	- 43	- G24		
		Nom. volta	ige prop. solenoid	12V DC, 24V DC, controls via prop. amplifier or PLVC
	Pressure	range	Pressure ranges for pr	essure downstream at A
Basic type, s	ize, desig	jn Type	PDM (pipe connectio	n), size 11, 21, 22
		Туре	PDMP (manifold mou	nting), size 11, 22
		Туре	PDM, size 3 to 5	
		Pipe	connection (G), mani	ifold mounting (P)

Function

PDM

	Piloted	Piloted
Valve for pipe connection:	Manifold mounting valve:	



PDM 11, PDM 21, PDM 22

Valve for pipe connection



PDMP 11 and PDMP 22 Manifold mounting valve



Т

PDM 3 to 5





PDM 4P and PDM 5P



		Q _{max} [lpm]	Pressure range p _{max A} [bar]	Ports (BSPP) ¹⁾	Leakage flow Q _{leak} [lpm]	Dimensions [mm]			m [kg]
						Н	В	Т	
PDM 11	Directly	12	41: 80	G 1/4	< 0.5	113	35	135	1.5
PDMP 11	controlled		42: 130 43: 200 44: 320	-		108	35	135	1.4
PDM 21/22		20	41: 45	G 1/4, G 3/8	< 0.5	113	35	142	1.6
PDMP 22			42: 70 43: 110 44: 180	-		108	40	142	1.3
PDM 3 G	Piloted	40	N: 130	G 1/2	< 0.8	96	66	150	1.8
PDM 4 G		70	M: 200 H: 350	G 3/4		99.5	71	155	2.2
PDM 5 G		120		G 1		104.5	73	170	2.7
PDM 4 P		70		-	-	99.5	78	150	2.7
PDM 5 P		120		-	-	104.5	81	178	3.2

1) Version for pipe connection

Associated technical data sheets:

Prop. pressure reducing valves type PDM: <u>D 7486</u>, <u>D 7584/1</u>

Similar products:

 Miniature prop. pressure reducing valves type PM, PMZ: <u>Page 200</u>

Prop. amplifier:

- Type EV1M (module): <u>Page 276</u>
- Type EV1G (module): Page 276

- Type EV1D (module): <u>Page 276D 7831 D</u>
- Type EV22K (card version): <u>Page 276</u>

Additional electrical components:

 Programmable logical valve control type PLVC: <u>Page 278</u>

See also section "Devices for special applications":

- Proportional valves

2.3 Circulation valve type CNE

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. Contrary to version CNE 2, CNE 21 features an additional thread seal and CNE 22 and 23 a thread seal plus a piston seal. The idle circulation valves type CNE are screw-in valves where the mounting hole can be easily manufactured.

Features and benefits:

- Compact design
- Easily produced mounting hole

Intended applications:

- Accumulator charged systems
- Jigs



Nomen- clature:	2-way circulation valve
Design:	Screw-in valve
Adjustment:	Tool adjustable
p _{max} : P _{max} adjust:	500 bar 450 bar
Q _{max} :	30 lpm

Design and order coding example

CNE 2	С	- 50		
	Pressu	Pressure Ire range	setting	[bar]

Basic type, size Pressure controlled 2-way valve type CNE

Additional versions:

- Additionally sealed tapped journal to minimize the internal leakage loss (type CNE 21)
- Additionally sealed tapped journal and piston to minimise leakage loss (type CNE 22 and CNE 23)



Function



General parameters and dimensions

CNE 2







Circulation valve integrated in connection block type AN 21 F2 for compact hydraulic power packs type HK with two pump circuits



	Q _{max} [lpm]	Oper. pressure p _{max} [bar] with		Dimensions [mm]				
		Р	Z	Н	H1	SW = a/f	SW1	
CNE 2	30	E: 30	500	70	96	22	24	
CNE 21		D: 45 C: 60						
CNE 23		B: 75 A: 90 M: 120 L: 150						
CNE 22	30	C: 320 B: 450	500	120	147	30	27	

Associated technical data sheets:

Idle circulation valves type CNE: <u>D 7710 NE</u>

Similar products:

- Two-stage valves type NE: <u>Page 206</u>
- Switch units type CR: <u>Page 164</u>
- Shut-off valves type LV, ALZ: <u>Page 208</u>
- Switching valves type AE: <u>Page 184</u>

Connection blocks:

- Two-stage connection blocks type NA: <u>D 6905 A/1</u>
- Connection blocks type AN, AL: <u>D 6905 A/1</u>

See also section "Devices for special applications"

 Screw-in valves and installation kits and devices for up to 700 bar

2.3 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.

Features and benefits:

- Max. operating pressure 700 bar
- Direct mounting to hydraulic power packs
- Direct combination with valve control

Intended applications:

- Presses
- Test benches
- Hydraulic tools



Nomen- clature:	Two stage valve (high pressure (HP) / low pressure (LP) stage)
Design:	Individual valve for pipe connection
Adjustment:	Tool adjustable
p _{max} :	500 700 (HP) / 30 80 (LP) bar
Q _{max} :	25 (HP) / 180 (LP) lpm

Design and order coding example

NE 20 - 650/20

Pressure setting [bar] High- /low pressure

Basic type NE 20, 70 and 80

Additional versions:

- Direct mounting at hydraulic power packs type MP and RZ
- Valve banks type BV can be directly mounted (type NE 21)

Function











NE 70, NE 80





	Q _{max} [lpm]		p _{max} [bar]		Ports (BSPP)			Dimensions [mm]			m [kg]
	HD	ND	HD	ND	A, R	НР	NP	H	В	Т	
NE 20	10	40	20 700	16 80	G 1/2	G 1/4	G 1/2	110	70	50	2.1
NE 70	16	100	(0) 500	(0) 60	G 1	G 1/4	G 3/4	131	100	50	3.4
NE 80	25	180	(0) 500	(0) 30	G 1 1/4	G 3/8	G 1	259	120	60	7.0

Associated technical data sheets:

Two-stage valves type NE: <u>D 7161</u>

Pumps:

- Compact hydraulic power packs type MP, MPN, MPW, MPNW: <u>Page 22</u>
- Dual-stage pump type RZ: <u>Page 62</u>

Similar products:

- Idle circulation valves type CNE: <u>Page 204</u>
- (Press) switch units type CR: Page 164
- Directional seated valves type VB: <u>Page 130</u>

See also section "Devices for special applications":

- Press control
- Devices for up to 700 bar

2.3 Shut-off valves type LV and ALZ

These shut-off valves automatically switch 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.

Features and benefits:

- Various means of adjustment
- Various additional functions

Intended applications:

- General hydraulics
- Test benches



clature:	Shut-off valve (idle circulation valve, direct controlled or piloted)
Design:	Individual valve for pipe connection Individual valve Manifold mounting
Adjustment:	Tool adjustable manually adjustable
p _{max} :	350 bar
Q _{max} :	120 lpm

Design and order coding example

LV 10 P ALZ 3 G	D CR	- 180 - 250	
		Pressure s	etting [bar]
	Pressur	re range	Tool adjustable (-)Manually adjustable (R)
Basic type,	size, de	sign Ty	pe LV, size 10, 20, 25
		-	Pipe connection (-) Manifold mounting (P) Design with low switching hysteresis (type LV 25)
		Ту	pe ALZ, size 3 to 5
			Pipe connection (G)

- Manifold mounting (P)
- Arbitrary idle pump circulation via 2/2-way solenoid valve

Function

LV, ALZ

For pipe connection:











£







 \oplus

ш



	Control	Control Q _{max} Pressure range: [lpm] p _{max} [bar]	Ports (BSPP) ¹⁾	Dimensions [mm]			m [kg]	
					Н	В	Т	
LV 10	Direct	12	F: 60 E: 140 D: 240 C: 350	G 1/4	155	45	32	0.9
LV 20, LV25		25	F: 80 E: 140 D: 220 C: 350	G 3/8	205	50	32	1.2
ALZ 3 G	Piloted	50	F: 60	G 1/2	80	40	99	2.0
ALZ 4 G		80	E: 140 D: 240	G 3/4	94	40	109	2.4
ALZ 5 G		120	C: 350	G 1	105	63	135	4.3
ALZ 4 P		80		G 3/4	60	40	119	2.1
ALZ 5 P		120		G 1	80	40	133	4.3

1) For pipe connection versions only

Associated technical data sheets:

- Shut-off valves type LV: <u>D 7529</u>
- Shut-off valves type ALZ: <u>D 6170-ALZ</u>
- Shut-off valves type AL: <u>D 6170</u>

Similar products:

- Release valves type AE: <u>Page 184</u>
- Connection blocks type AL: <u>Page 32</u>

2.3 Pressure controlled shut-off valves type DSV and CDSV

These pressure-controlled shut-off valves in the seated valve version block the flow to consumers located downstream without any leakage as soon as the set pressure value is reached or exceeded in the consumer line B. The valves will open again if the pressure on the inlet side A drops below the set value defined by the spring tension. While type DSV is designed for manifold mounting or pipe connection, type CDSV is a screw-in valve with easily machined mounting holes. It is frequently used to safeguard pressure gauges, for example.

Features and benefits:

- Various adjustment options
- Various additional functions

Intended applications:

- General hydraulic systems
- Test benches
- (Pressure gauge) protection valve



Nomen- clature:	Shut-off valve
Design:	Individual valve for pipe connection Manifold mounting Screw-in valve
Adjustment:	Tool adjustable manually adjustable
p _{max} :	600 bar
Q _{max} :	60 lpm

Design and order coding example

CDSV 1	А	- 1/4	- 400				
			Pressure setting [bar]				
	1	Design with connection block (-1/4) Cartridge valve (-)					
	Pressu	re range	Tool adjustable (-) or manually adjustable (R)				
Basic type,	size	Type CDS	W (cartridge valve), size 1				

DSV 21-1	В	- 200	
		Pressure s	etting [har]
	Pressu	re range	Tool adjustable (-) or manually adjustable (R)
Basic type, siz	e T	ype DSV (pipe connection), type DSVP (manifold mounting), size 1, 2, 3



Function







General parameters and dimensions

CDSV 1







DSV 2-2 Version for pipe connection



DSVP 21-1 Manifold mounting valve





	Design	Size	Q _{max} [lpm]	p _{max} [bar]	Ports (BSPP)	H _{max} [mm]	SW = a/f	m [kg]
CDSV 1	Screw-in valve	1	10	C: 120 B: 350 A: 600	M 16 x 1.5	69	SW 22	0.13
DSV 21)	Version for pipe connection	1	20	D: 40 C: 100 B: 220 A: 600	G 1/4	185	SW 36	0.7
		2	40	D: 20 C: 60 B: 120 A: 400	G 3/8	193	SW 36	0.9
		3	60	D: 20 C: 60 B: 120 A: 400	G 1/2	193	SW 46	1.1
DSVP 2 ¹⁾	Manifold mounting valve	1	20	D: 40 C: 100 B: 220 A: 600	G 1/4	181	-	1.1

1) Manifold mounting valve only in size 1

Associated technical data sheets:

- Shut-off valves type DSV, DSVP: <u>D 3990</u>
- Shut-off valves type CDSV: <u>D 7876</u>

See also section "Devices for special applications":

- Screw-in valves and installation kits
- Devices for up to 700 bar

2.3 Load holding valves type LHK, LHDV, and LHT

Load-holding valves are pressure valves that always act on the outlet side of doubleacting consumers. They block the outlet duct with their set pressure (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 with residual pressure in order to drop the load.

Type LHK valves are intended for use in applications that are not particularly prone to oscillations.

Load-holding valves of type LHT and type LHDV featuring special damping properties are especially well suited for applications together with prop. directional spool valves ("Load Sensing" directional spool valves) e.g. type PSL/PSV.

Many additional options are available such as shock valves and shuttle valves with or without restrictor check valve (delayed release of hydraulic brakes) etc.

Features and benefits:

- Operating pressures up to 420 bar
- Various adjustment options
- Various configurations

Intended applications:

- Cranes
- Construction machinery
- Lifting devices



Nomen- clature:	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 _{max} :	360 450 bar
Q _{max} :	250 lpm

Design and order coding example

LHK44	G	- 11	- 160	
			Pressure s	etting load-holding pressure [bar]
		Design	Various I	nousing designs available
[Damp	ening	Without/v	ith, or with restrictor check valve
Basic type,	size	Type L	HK (valve o	only, without shock valve), size 2 to 4
		Additi	ional versi	ons:

- Some available with release ratio 1:2 and 1:7
- Version available as assembly kit



- Type LHT
- Type LHTE, with discharge pressure compensation

Function





LHDV 33 G-25WD-...



LHK 44 G-21-...





Н



В

LHDV 33 - 25 WD - B 6 - 200/200 - 240/240 Twin valve





	Design	Q _{max} [lpm]	p _{max} [bar]	Release ratio	Ports (BSPP)	Dimensions [mm]			m [kg]
						H/H1	B/B1	T/T1	
LHK 22	Individual valve	20	400	1:4.6	G 3/8	97	32	32	0.5
	Twin valve ²⁾					98	60	30	2.7
LHK 33	Individual valve	60	360	1:4.4	G 1/2	123	40	40	1.0
	Twin valve ²⁾					125291	80	4060	2.7
LHK 44	Individual valve	100	350	1:4.4	G 3/4	170	45	45	1.6
	Twin valve ²⁾					170	90	50	3.5
LHDV 33	Individual valve ²⁾	80	420	1:81:1.2 ¹⁾	G 1/2	170	50	40	1.8
	Twin valve					170	88	70	4.7
LHT 2	Individual valve	25	400	1:8,1:4	G 1/4	132	40	24.8	1.2
	Twin valve					132	50	24.8	0.8
LHT 3	Individual valve ²⁾	130	450	1:71:0.53 ¹⁾	G 1/2	128	70	40	1.6
LHT 5	Individual valve ²⁾	250	450	1:61:0.79 ¹⁾	G 1	113	50	50	1.0

1)

Release ratio can be altered simply by changing the orifice Note: Design may be significantly different to the illustrated version! 2)



Example circuit:

LHK 33-G 11-210 MPN 44-H 13,1-B 55 L20-SKT -A 1 D 10V E150-2 -BA 2-NBVP 16 G/R-GM/NZP 16 VP 20/3 -1-G 24 -X 84 V-9/250 -3 x 400/230V 50 Hz



Associated technical data sheets:

- Load holding valves type LHK: <u>D 7100</u>
- Type LHDV: <u>D 7770</u>
- Type LHT: <u>D 7918</u>

Additional integrable functions:

- Prop. directional spool valves type PSL, PSV, PSLF: Page 104
- Prop. directional spool valves type PSLF, PSVF: <u>Page 110</u>

See also section "Devices for special applications":

- Industrial trucks
- Mobile hydraulics
- Screw-in valves and installation kits
Valves

2.4 Metering valves

Flow control valves type SF, SD, SK, and SU	218
2-way flow control valves type SB, SQ and SJ	222
Flow control valves type SE and SEH with electro-proportion- al actuation	224
Flow dividers type TQ and TV	228
Orifices and restrictor check valves type EB, BE, and BC	230
Throttles type Q, QR, QV, and FG	232
Throttles and restrictor check valves type ED, RD, and RDF	234
Throttles and restrictor check valves type CQ, CQR, and CQV $% \left(\mathcal{A}^{\prime}_{\mathrm{CQ}}\right) =0$	236
Throttle and shut-off valves type AV, AVT, and CAV	238



Flow control valves

with electro-proportional actuation type SE and SEH



Throttles type Q, QR, QV and FG



Flow control valves

Туре	Nomenclature/Design	Adjustability	p _{max}	Q _{max}
SF, SD, SK, SU	 2-way and 3-way flow control valve Individual valve for pipe connection Manifold mounting valve 	- Mechanical - Solenoid	315 bar	0,3 130 l/min
SB, SQ, SJ	 2-way metering valve, lowering brake valve Insert valve Version with housing for pipe connection 	- Tool adjustable	315 bar	0,25 400 l/min
SE, SEH	 2-way and 3-way flow control valve Individual valve for pipe connection Manifold mounting valve 	- Electro- proportional	315 bar	0,1 120 l/min

Flow dividers

Туре	Nomenclature/Design	Adjustability	p _{max}	Q _{max}
τα, τν	 Flow divider with or without priority division Individual valve for pipe connection Manifold mounting valve 	- Non-adjustable	300 350 bar	7,5 200 lpm nom. total flow

Orifices, restrictor check valves

Туре	Nomenclature/Design	p _{max}	Q _{max}
EB, BE, BC	Orifice, restrictor check valve	400 700 bar	0,5 120 l/min
	Plug-in valve		
	Insert valve		
	 Version with housing for pipe connection 		

Throttles and throttle shut-off valves

Туре	Nomenclature/Design	Adjustability	p _{max}	Q _{max}
Q, QR, QV, FG	 Throttle, restrictor check valve Screw-in valve Individual valve for pipe connection Angle valve Banjo bolt Swivel fitting 	- Tool adjustable	300 400 bar	0 80 lpm
ED, RD, RDF	Throttle, restrictor check valveIndividual valve for pipe connection	- Tool adjustable, - Manually adjustable	500 bar	12130 lpm
CQ, CQR, CQV	Throttle, restrictor check valve Screw-in valve	- Tool adjustable	700 bar	50 l/min
AV, AVT, CAV	 Throttle and shut-off valve With and without bypass check valve Individual valve for pipe connection Screw-in valve 	- Tool adjustable, - Manually adjustable	500 630 bar	50 l/min

2.4 Flow control valves type SF, SD, SK, and SU

The flow control valves type SF, SD, SK and SU are available in 2 and 3-way versions. They enable continuous adjustment of the oil flow settings in oil-hydraulic systems. With the type SU, a choice can be made between two constant flows.

The flow rate is kept constant within a close tolerance regardless of the system pressure and viscosity of the hydraulic oil.

Additional control functions (pressure-limiting valve and idle circulation valve integrated in the valve or implemented externally via Z control port) enable adjustment to specific requirements.

The 2-way flow control valves are available with bypass check valve and bridge circuit for free selection of the flow direction.

The various actuation modes make these flow control valves suitable for a broad range of applications.

Features and benefits:

- Various actuation modes
- Also in combination with bypass check valves

Intended applications:

- Construction machinery
- Machine tools
- General hydraulic systems



Nomen- clature:	2-way flow control valve 3-way flow control valve
Design:	Individual valves for pipe mounting Manifold mounting
Adjustment:	Mechanical Adjusting knob Roller actuation Adjusting screw Solenoid (switching between two constant consumer flows)
p _{max} :	315 bar
Q _{max} :	0,3 130 lpm



- 3	/15	- S	- G24	- 120	
sic type, o	Flow design, s	Flow ste	solenoid v ng and add ag and add Type SD Type SD Type SU only wit Version Size 3 to Size 3 to	Fices Q _{max} : , with turn with adju: with roller , solenoid th pipe mo as 2-way- o 5 o 5	 setting [bar] of the pressure limiting valve (S) G 12, G 24, WG 110 and WG 230 Pipe connection (no coding) Manifold mounting (P) Valve with bypass check valve (R, PR) Check valve bridge circuit (B) Pressure-limiting valve (S) Pressure-limiting and circulation valve (S-WN1F, S-WN1D) a: 3, 6, 15, 36, 50, 60, 70, 90, 130 lpm n-knob sting knob actuation actuation (open version) actuation, switching between to fixed values (only size 3 and punting design) (-2) and 3-way- (3) flow control valve
unction					
-way				3-way	
ipe mount	ting				
1					





2-way	3-way
Manifold mounting valve	

Actuations:



General parameters and dimensions

Version for pipe connection











		Q _{max} [lpm] ¹⁾	Ports (BSPP) ²⁾	Dime	nsions [mm]				m [kg] ³⁾
2-way	3-way			Н	H 1	В	B 1	Т	T1	
S. 2-3		0,3 60	G 1/2	50	40	80	60	50	60	1,4 2,1
	S. 3-3			50	40	80	93	50	60	1,4 2,1
S. 2-4		0,6 90	G 3/4	60	50	88	70	60	70	2
	S. 3-4			60	50	88	100	60	70	2,0 2,6
S. 2-5		1,0 130	G 1	70	50	100	80	70	80	3,1
	S. 3-5			70	50	100	106	70	80	2,8 3,7

Different Q_{max} available, see Design and order coding example: "Orifice steps" For pipe connection versions Depending on actuations

1) 2) 3)



Item	Number	Description
4	2	SMK 20-G 1/4-PC
3	2	DG 364-35
2	2	SD 2-3/6P
1	1	20 201 H 00



Associated technical data sheets:

• 2-way and 3-way flow control valves type S: <u>D 6233</u>

Similar products:

- Drop rate braking valves type SB, SQ: Page 222
- Prop. flow control valves type SE, SEH: Page 224

Plugs:

• With LED etc.: <u>D 7163</u>

2.4 2-way flow control valves type SB, SQ and SJ

The 2-way metering valves (lowering brake valves) type SB or SQ are preferentially used for flow control tasks of single-acting cylinders. In doing so, the lowering speed is largely kept constant regardless of the size of the load. The integrated sliding metering orifice enables completely free flow in the opposite direction. While with type SB, there is a slight load dependence preventing the occurrence of oscillations (e.g. required for fork lift trucks), type SQ has largely load-independent Δp -Q characteristics.

These flow control valves are preferentially used to limit control flows in pilot circuits. The DSJ version for flow limitation in both flow directions is intended for doubleacting consumers.

The valve is characterized in particular by its low hysteresis range and its easily machined mounting hole. It can be adjusted from the outside using a tool. The main flow is channelled to other consumers or is fed away as throttling loss to the tank via the pressure-limiting valve.

Features and benefits:

- Oscillation damping or load-independent
- Compact screw-in valve

Intended applications:

- General hydraulic systems
- Industrial trucks
- Lifting equipment



Nomen- clature:	2-way flow control valve (drop rate braking valve)
Design:	Screw-in type with housing for in-line installation
Adjustment:	Fixed (pre-set) Tool adjustable from outside
p _{max} :	315 bar
Q _{max} :	0,25 400 lpm

Design and order coding example

SB 2	1	C - 30	
		Respor	nse flow [l/min] Desired factory set response flow within the respective range
	1	Design Ad	djustable or non adjustable version
			Screw-in version (C)
			Version with housing for pipe mounting (E, F, G)
		A	dditional versions
			With metric of UNF-thread
			With thread adaptor
			As banjo bolt and/or with swiveling screw fitting
	Adjust	ment range	Adjustable response flow
Basic tv	pe, size	Type SB,	, SQ and SJ (without one-way orifice), size 0 to 5

Type DSJ ($Q_{max} = 20$ lpm, $p_{max} = 300$ bar) Flow control function in both directions e.g. for double acting cylinders



Function







General parameters and dimensions

Screw-in valveC SB, SQ





SJ

With housing...G



	Coding for response f	Coding for adjustment range of the set response flow from to [lpm] below						Ports Dimensions (BSPP) [mm]			m [g]
	1	3	5	7	9	90	G (Series)	L	L1 max	SW = a/f	
SB 0	11.6	1.62.5	2.54	46.3	6.310	1015	G 1/4 (A)	39	78	19	13
SJ 0 ¹⁾								24	-	-	35
SB 1	2.54	46.3	6.310	1016	1625	2535	G 3/8 (A)	43	82	22	23
SQ 1											
SB 2	1621	2128	2837	3750	5067 ²⁾	-	G 1/2 (A)	49	96	27	40
SQ 2											
SB 3	3750	5067	6790	90120	120150 ²⁾	-	G 3/4 (A)	61	106	32	80
SQ 3											
SB 4	80100	100125	125160	160200	200250	-	G 1 (A)	78	145	41	150
SB 5	170200	200236	236280	280335	335400	-	G 1 1/4 (A)	94	160	50	300
DSJ 1	1.021.0	1.021.0						39	78	19	30

Type SJ 0 without coding: adjust. range 0.25 ... 1.2 lpm
 Not for type SQ..

Associated technical data sheets:

- Lowering brake valves type SB, SQ: <u>D 6920</u>
- 2-way flow control valves type SJ: <u>D 7395</u>
- 2-way flow control valves type CSJ: <u>D 7736</u>
- Double-acting 2-way flow control valves type DSJ: <u>D 7825</u>

See also "Devices for special applications":

- Industrial trucks
- Screw-in valves and installation kits

2.4 Flow control valves type SE and SEH with electro-proportional actuation

The flow control valves type SE and SEH are used for continuous adjustment of the operating speed of connected hydraulic consumers regardless of pressure. They can be used as 2-way or 3-way flow control valves and are available with proportional electrical, directly actuated (type SE) or proportional electro-hydraulic, piloted (type SEH) control orifice adjustment (each available with normal position as open or closed). They help to achieve fully automated operating cycles with individually preselected acceleration and deceleration phases.

A piloted pressure-limiting valve and an electrically switchable circulation valve (3-way controller) or a bypass check valve and check valves in a bridge circuit for free selection of the flow direction (2-way controller) can be selected as additional elements.

Features and benefits:

- Electrical control of consumer operating speeds
- Automation of operating cycles

Intended applications:

- Construction machinery
- Machine tools
- General hydraulic systems



Nomen- clature:	2-way flow control valve 3-way flow control valve
Design:	Individual valve for pipe mounting or Screw-in valve
Adjustment:	Electro-proportional
p _{max} :	315 bar
Q _{max} :	0,1 120 lpm

Design and order coding example

SE 2-3	/30F	- P	- G24		
		S	olenoid v	voltage	Prop. solenoid 12 V DC, 24 V DC Controls via prop. amplifier or PLVC
		Design a	and port s	size 🔹	Pipe connection Manifold mounting (P)
	Flow [lpm	I] No	m. flow o	f the mete	ering orifice
		1	Deenergiz Deenergiz	zed open zed closed	(coding F
		0r	ifice steps	Q _{max} :3,	6, 10, 15, 22, 30, 36, 50, 70, 90, 120 lpm
Basic type,	size Ty	ype SE, ype SEH,	with non-p , with pilo	piloted me ted meter	etering orifice, size 3, 4 ing orifice, size 2 to 5
		Availa	ble as 2- a	and 3-way	flow control valve



Function

SE, SEH

2-way Pipe connection







No Z port with type SEH 3-2

Additional functions for flow control valves:

2-way flow control valve

- Version with bypass check valve
- Version with check valve in bridge circuit for free selection of the flow direction

2-way Manifold mounting valve



3-way Manifold mounting valve



3-way flow control valve

- Version with pressure-limiting valve
- Version with pressure-limiting valve and circulation valve (for pipe connection versions only)
- Version with compulsory closed position of the pressure compensator

when not actuated typeFO

• Version with automatic circulation type ... B 0.6

General parameters and dimensions

SEH

Version for pipe connection





SE

Manifold mounting valve



Basic type and size			Q _{max} [lpm] ¹⁾	p _{max} [bar]	Ports (BSPP) ²⁾	Dimensions [mm]			m _{max} [kg]
2-way	3-way					н	В	т	
SE 2-3	SE 3-3		0,3 50	315	G 1/2	110 120	80 91	50 60	2,2
SE 2-4	-	Directly actuated	0,6 70	315	G 3/4	120 130	85100	60 70	2,2
-	SE 3-4		0,6 90	315	G 3/4				
SEH 2-2	SEH 3-2	Hydraulically piloted	0,1 30	315	G 3/8	115	55 70	40	1,6 3,3
SEH 2-3 ³⁾	SEH 3-3		0,3 50	315	G 1/2	92,5	80 93	50 60	1,6 3,3
-	SEH 3-4		0,6 90	315	G 3/4	102,5	95 100	60 70	1,6 3,3
-	SEH 3-5		1,0 120	315	G 1	112,5	100	70	1,6 3,3

Different Q_{\max} available, see Design and order coding example: "Orifice steps" For pipe connection versions For manifold mounting versions only 1)

2) 3)



Circuit example

① SEHD 3-3/30 FP-X 24

- 2 TQ 4 P-A 5/2
- ③ EM 31 V-X24
- ④ EMP 31 S-X 24
- ⑤ MVH 6 C
- ⑥ EM 31 S-X24
- ⑦ SWPN 2-G-X24



Associated technical data sheets:

Proportional flow control valves type SE, SEH: <u>D 7557/1</u>

Similar products:

Flow control valves type SD etc.: Page 218

Proportional amplifier:

- Type EV1M (module): <u>Page 276</u>
- Type EV1G (module): <u>Page 276</u>

- Type EV22K2 (card version): Page 276
- Programmable logical valve control type PLVC: <u>Page 278</u>

See also section "Devices for special applications":

- Proportional valves

Flow dividers type TQ and TV 2.4

The flow dividers type TQ divide (collect) total flow entering (exiting) at port C. The distribution is independent of working pressure at ports A and B, and may be divided equally or unequally in predetermined portions.

Type TV flow dividers feature privilege division. A variable flow entering at port C is divided into a partial flow Q_A , which is kept constant, and a residual flow Q_B . As soon as one consumer'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 simulating flow via a pressure-limiting valve. These valves are used for applications where one pump is required to supply two unevenly loaded hydraulic consumers, which must be driven simultaneously and independently (type TQ) or if one consumer simply requires a constant flow (type TV).

Features and benefits:

Accurate flow division

Intended applications:

- Steering systems
- Synchronized cylinder movement



Nomen- clature:	Flow dividers with or without priority division
Design:	Individual valve for pipe mounting Manifold mounting
Adjustment:	Non-adjustable
p _{max} :	300 350 bar
Q _{max} :	7,5 200 lpm (nom. total flow)

Design and order coding example

TV3P TQ 32	- A	- 2,0 - 3		
		Coding Fl	ow indicator	
[Design	(A – ec	qual division ratio)	
Basic type,	size	PipeManif	connection (no coding) fold mounting (P)	
		Type TQ, Type TV,	size 2 to 5 flow divider with privilege	division, size 3

Function







TV.P





General parameters and dimensions

TQ...



TV 3..



TQ.P

т

Manifold mounting



TV 3P

Manifold mounting



	Q _{max} [lpm]	p _{max} [bar]	Ports (BSPP) ¹⁾			Dimensions[mm]			m [kg]
			A	В	С	Н	В	Т	
TQ 2	7.5 70	350	G 1/4, G 3/8	G 1/4, G 3/8	G 3/8	79	30	50	0.6
TQ 3	7.5 70	350	G 3/8, G 1/2	G 3/8, G 1/2	G 1/2	85	30	60	0.6 0.7
TQ 3P	7.5 70	350	-	-	-	79	30	50	0.7
TQ 4	80 120	350	G 1/2	G 1/2	G 3/4	110	40	60	1.5
TQ 4P	80 120	350	-	-	-	110	40	60	1.6
TQ 5	140 200	350	G 3/4	G 3/4	G 1	134	50	80	3.0
TQ 5P	140 200	350	-	-	-	134	50	80	3.1
TV 3	60	300	G 3/8	G 1/2	G 1/2	109	30	60	1.0
TV 3P	60	300	-	-	-	106	35	50	1.0

1) For pipe mounting versions only

Associated technical data sheets:

- Flow dividers type TQ: <u>D 7381</u>
- Flow dividers type TV: <u>D 7394</u>

2.4 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.

These values are preferentially used to limit flows when switching directional values (e.g. flow limitation to Qmax and avoidance of excessively rapid accumulator draining). The restrictor check values type BC and BE are designed as a hole or slot orifice and enable free flow in the direction $F \rightarrow B$ and throttle function in the opposite direction.

Type BC is spring loaded and can be screwed into normal threaded holes (point angle 118°).

Type EB orifice inserts can be used in the P gallery of manifold mounting valves, for example.

Features and benefits:

- Max. 700 bar
- Simple design and installation

Intended applications:

- General hydraulics
- Winch controls
- Hydraulic pilot systems



lomen- lature:	Orifice Restrictor check valve
)esign:	Orifice insert Screw-in valve Version with housing for in-line installation
) _{max} :	400 700 bar
2max:	0,5 120 lpm

C

Design and order coding example

BC1	- 0,8	G			
		Design	with housing	For pipe connection, t	type BC, BE (E; F, G)
	Orifice	Hole c	or slot type orifi	ce, diameter in mm	51 , (, , , ,
Basic ty	/pe, size	Type I	BC, size 1 to 3		
		Addit ■ Wi	ional versions th/without met	ic thread (type BC and E	BE)
Euro	ction				

Function





т

General parameters and dimensions





Associated technical data sheets:

- Restrictor check valves type BC: <u>D 6969 B</u>
- Restrictor check valves type BE: <u>D 7555 B</u>
- Orifice inserts type EB: <u>D 6465</u>

Similar products:

- Insert check valves type RK, RB, RC, RE, ER: Page 242
- Screw-in flow valves type BSE, QSE, MSE: D 7121
- Restrictor check valves type RD, ED, RDF: <u>Page 234</u>

See also section "Devices for special applications":

- Screw-in valves and installation kits

2.4 Throttles type Q, QR, QV, and FG

Throttles are a type of metering valve. The valve types Q, QR and QV are subdivided into five sizes and are used to limit the flow in accumulator and control circuits. They are designed as slot-type throttles (complete stroke) and are therefore impervious to micro-contaminants (no edge filter effect).

The precision throttle valves type FG are preferentially used for adjusting the switching time of directional valves, preventing pressure surges and damping oscillations. The throttle effect is achieved via the effective thread length.

The settings can only be adjusted using tools.

Features and benefits:

- Different installation options
- Simple design

Intended applications:

General hydraulic systems



Nomen- clature:	Throttle Restrictor check valves					
Design:	Cartridge Individual valve for pipe mounting Corner housing Banjo bolt Swivel fitting					
Adjustment:	Tool adjustable					
p _{max} :	300 400 bar					
Q _{max} :	0 80 lpm					

Design and order coding example





Function

FG, Q <u>A.∳. B</u>





General parameters and dimensions





	Q _{max} [lpm] ¹⁾	p _{max} [bar]	Dimensions	m [g]			
			H [mm]	G	SW = a/f	SW =a/f 1	
FG, FG1, FG2	0,15	300	30	M 8	SW 4	SW 13	15
Q20, QR20, QV20	12	400	32	M 8 x 1	SW 4	SW 13	15
Q30, QR30, QV30	25	400	36	M 10 x 1	SW 5	SW 17	25
Q40, QR40, QV40	50	400	41	M 12 x 1.5	SW 6	SW 19	40
Q50, QR50, QV50	90	400	46	M 14 x 1.5	SW 8	SW 22	55
Q 60, QR60, QV60	120	315	58	M 16 x 1.5	SW 10	SW 24	100

1) These figures apply for valves fully opened (observe red indicator) with a back pressure of approx. 50 bar (throttled direction of flow)

Associated technical data sheets:

- Throttles type Q, QR, QV: <u>D 7730</u>
- Precision throttles type FG: <u>D 7275</u>

Similar products:

- Throttles type CQ, CQR, CQV: <u>Page 236</u>
- Throttle and restrictor check valves type ED, RD and RDF: <u>Page 234</u>

 Restrictor check valves and orifice inserts type EB, BE, BC: <u>Page 230</u>

See also chapter "Equipment for special applications":

- Screw-in and insert valves

2.4 Throttles and restrictor check valves type ED, RD, and RDF

The throttles type ED, RD and RDF are metering valves and are used to influence the flow in single and double-acting consumers. The two smallest sizes are designed as a combination of a slot-type and annular gap throttle to improve adjustability. The larger sizes are pure annular gap throttles. With RD restrictor check valves, the check valve function is performed by a shim that responds to the smallest oil flow movement. With the restrictor check valves type RDF, a nozzle or orifice disc takes on the check valve function. The type ED is designed as a pure throttle.

Features and benefits:

- Sensitively adjustable
- Wear-resistant
- **Intended applications:**
- General hydraulic systems



Nomen- clature:	Throttle Restrictor check valves
Design:	Individual valve for pipe mounting Screw-in valve
Adjustment:	Manually adjustable (handle, adjusting knob) Tool adjustable
p _{max} :	500 bar
Q _{max} :	12130 lpm

Design and order coding example

RD 11 RDF 21	/1,0	- K	
		Adjusta	 bility Type ED and RD only Without labelling = manually (wing bolt/lock nut) K = tool adjustable (setting spindle/lock nut)
	Fixed thr	ottles	Diameter in mm, type RDF 0.4 - 0.6 (in increments of 0.1) 0.8 - 2.0 (in increments of 0.2) 2.5 - 5.5 (in increments of 0.5)
Basic type,	size 🔹	Type E Slot-ty	D, type RD, type RDF, size 1 to 5 ype throttles, available with or without built-in check valve

Function









General parameters and dimensions

ED.. and RD..



RDF..



1)	Q _{max} [lpm] ²⁾	p _{max} [bar]	Ports (BSPP)	Dimensions [mm]			m [g]	
				Н	В	SW = a/f		
ED 11	12	500	G 1/4	23.5	52	SW 24	180	
RD 11				23.5				
RDF 11/				-				
ED 21	30	500	G 3/8	24	52	SW 27	215	215
RD 21				24				
RDF 21/				-				
ED 31	60	500	G 1/2	32.5	62	SW 32	340	
RD 31				32.5				
RDF 31/				-				
ED 41	80	500	G 3/4	41	72	SW 41	655	
RD 41				41				
RDF 41/				-				
ED 51	130	500	G 1	46.5	82	SW 46	835	
RD 51				46.5				
RDF 51/				-				

The throttle diameter with type RDF canbe 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 direction of flow)

Associated technical data sheets:

Throttle and restrictor check valves type ED, RD and RDF: <u>D 7540</u>, <u>D 2570</u>

Similar products:

- Throttles type Q, QR, QV, FG: <u>Page 232</u>
- Restrictor check valves type CQ, CQR, CQV: <u>Page 236</u>
- Restrictor check valves type EB, BE, BC: <u>Page 230</u>

See also section "Devices for special applications":

- Devices up to 700 bar

2.4 Throttles and restrictor check valves type CQ, CQR, and CQV

The throttles type CQ, CQR and CQV are metering valves and are used to influence the flow in single and double-acting consumers. The throttles described here are designed as slot-type throttles and are therefore impervious to micro-contaminants (no edge filter effect). The check valve function of types CQR and CQV is performed by a shim that guarantees short response times. The double spindle seal enables leakage-free adjustment, even under pressure.

Features and benefits:

- Leak-free adjustment under pressure
- Operating pressure up to 700 bar

Intended applications:

Speed regulation in hydraulic lifting devices



Nomen- clature:	Throttle Restrictor check valves
Design:	Screw-in valve
Adjustment:	Tool adjustable Manually
p _{max} :	700 bar
Q _{max} :	50 lpm

Design and order coding example

CQV 2	- D	- 1/4		
		Single cor	nection blocks	For pipe connection (1/4, 3/8)Manifold mounting (in combination with type CQ and CQV only)
	Adjusta	ability in o	peration = \ = [=	Without labelling = tool adjustable D = Turn knob (with lock nut) D3 = Turn knob, diameter 35 mm (without lock nut)
Basic type,	size	Type CQ, Slot-type	type CQR, type C throttles, availa	QV, size 2 ble with or without built-in check valve

- Version with precision control range (size 22)
- Version with pressure compensator (flow control function)



Function

CQ 2, CQ 22 A _ _ _ _ B







General parameters and dimensions









	Q _{max} [lpm]	p _{max} [bar]
CQ 2 / CQ 22	50 / 20	700
CQR 2 / CQR 22		
CQV 2 / CQV 22		

Associated technical data sheets:

 Throttle and restrictor check valves type CQ, CQR, CQV: <u>D 7713</u>

Similar products:

- Throttle and restrictor check valves type ED, RD and RDF: <u>Page 234</u>
- Throttles type Q, QR, QV, FG: <u>Page 232</u>

See also section "Devices for special applications":

- Devices for up to 700 bar

2.4 Throttle and shut-off valves type AV, AVT, and CAV

The throttle and shut-off valves type AVT, AV and CAV (in various sizes) are metering valves and are designed as screw-in valves in the versions AV...E and CAV. They help to generate a pressure difference between the inlet and outlet side to regulate the speed of cylinders in accumulator circuits and the flow in control circuits, or to complete-ly shut off a consumer line (e.g. to safeguard a pressure gauge). With AV valves, the throttle effect is caused by an annular gap, which is created by a valve cone entering a valve seat hole (needle valve). CAV valves create the variably adjustable pressure difference by means of a slot (slot-type throttle, sensitively adjustable and impervious to micro-contaminants). Versions with an integrated check valve enable free flow in one direction.

Features and benefits:

- Various configurations
- Sensitive adjustment and complete shut off possible

Intended applications:

General hydraulic systems



Nomen- clature:	Throttle and shut-off valve with/without by-pass check valve
Design:	Individual valve for pipe mounting Screw-in valve
Adjustment:	Manually adjustable (handle, adjusting knob) Tool adjustable
p _{max} :	500 630 bar
Q _{max} :	50 100 lpm

Design and order coding example

AV 3AVT 10 CAV 1V	- K	- 1/4		
	Means o	Thread siz of adjustn	e V Ient	/ersion with connection block for pipe connection (type CAV) Tool adjustable Manually (adjustable)
Basic type, size	Туре Туре Туре	AV, size 2 AVT, size CAV, size	3 5 16 1, 2	;

Function

AV, AV.E, AVT, CAV \underline{A} , $\underline{4}$, \underline{B}







General parameters and dimensions











AV...E



	Q _{max} [lpm] ¹⁾	p _{max} [bar]	Connection size M	Dimensio [mm]	Dimensions [mm]						m [kg]
				Н	H1	H2	В	т	SW = a/f	SW= a/f 1	
AV 2	40	500	G 1/2 (BSPP)	145	-	-	45	30	-	-	0.6
AV 3	100	400	G 3/4 (BSPP)	198	-	-	60	40	-	-	1.7
AV 2E	40	500	M 28 x 1.5	-	115	25	-	-	SW 36	-	0.6
AV 3E	100	400	M 40 x 1.5	-	143	38	-	-	SW 46	-	1.0
AVT 6	12	630	6 mm	91	-	-	31	-	-	-	0.14
AVT 8	25	630	8 mm	94	-	-	32	-	-	-	0.18
AV 10	30	630	10 mm	94	-	-	34	-	-	-	0.23
AVT 12	50	630	12 mm	114	-	-	38	-	-	-	0.32
AVT 16	100	400	16 mm	123	-	-	43	-	-	-	0.44
CAV 1	30	500	M 16 x 1.5	-	42	19	-	-	SW 17	SW 22	0.05
CAV 2	50	500	M 20 x 1.5	-	51	21	-	-	SW 22	SW 24	0.07

1) This figures do apply with a back pressure of approx. 10 bar (throttled flow direction)

Т

Associated technical data sheets:

- Shut-off valves type AVT: <u>D 7690</u>
- Throttle and shut-off valves type AV: <u>D 4583</u>
- Throttle and shut-off valves type CAV: <u>D 7711</u>

Similar products:

- Throttle and restrictor check valves type ED, RD and RDF: <u>Page 234</u>
- Throttles type Q, QR, QV, FG: <u>Page 232</u>

See also section "Devices for special applications":

- Screw-in valves and installation kits
- Devices for up to 700 bar

Valves

2.5 Check valves

Check valves type RK/RB, RC, RE, and ER	242
Check valves type CRK and CRB	244
Check valves type B	246
Screw-in check valves with hydraulic release type CRH and	
RHC	248
Check valves with hydraulic release type HRP	250
Check valves with release type RH and DRH	252
Check valves and pre-fill valves type F	254
Line rupture safety valves type LB	256
Shuttle valves type WV and WVC	258



Check valves type RK/RB, RC, RE and ER



Check valves and pre-fill valves type F



Check valves

Туре	Design	p _{max}	Q _{max}
RK/RB, RC, RE, ER	 Check valve Insert valve Plug-in valve Version with housing for pipe connection 	400 700 bar	6 320 lpm
CRK, CRB	Check valve Screw-in valve	500 bar	30 80 lpm
В	Check valve Individual valve for pipe connection	500 bar	15 160 lpm

Releasable check valves

Туре	Design	Actuation	p _{max}	Q _{max}
CRH, RHC	Check valve with hydraulic releaseInsert valveScrew-in valve	- Hydraulic	500 700 bar	8 200 lpm
HRP	Check valve with hydraulic releaseManifold mounting valve	- Hydraulic - Electro-hydraulic	700 500 bar	20 400 lpm
RH, DRH	 Check valve with hydraulic release, twin check valve Individual valve for pipe connection Manifold mounting valve 	- Hydraulic	700 400 bar	15 160 lpm

Pre-fill valves

Туре	Design	Actuation	p _{max}	Q _{max}
F	Check valve with hydraulic release (pre-fill valve) Valve in wafer design	- Hydraulic	400 bar	100 7000 lpm

Line rupture safety valve, shuttle valves

Туре	Design	Adjustability	p _{max}	Q _{max}
LB	 Line rupture safety valve Insert valve Version with housing for pipe connection 	- Tool adjustable	700 bar	4 160 lpm
WV, WVC	 Shuttle valve Individual valve for pipe connection Insert valve Screw-in valve 		700 bar	6 150 lpm

Check valves

2.5 Check valves type RK/RB, RC, RE, and ER

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. RK/RB check valves are spring-loaded, sturdily designed and dirt-resistant ball seated valves.

The screw-in check valves type RC may be installed in both directions with the springloaded valve shim enabling rapid switching sequences. The check valve type RE is a shim-type check valve 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, for example.

The mounting hole for all screw-in check valves can be easily machined with a standard twist drill (point angle 118°).

The insert check valves type ER feature a spring-loaded, ball seated design and are primarily used in manifold-mounted versions of seated valves.

Features and benefits:

- Operating pressures up to 700 bar
- Easily machined mounting holes
- Sturdy

Intended applications:

- General hydraulic systems
- Hydraulic pre-loading



Nomen- clature:	Check valve
Design:	Screw-in valve Valve insert With housing for in-line installation
p _{max} :	400700 bar
Q _{max} :	6320 lpm

Design and order coding example

RC 2 - E					
Design	with housing For pip	e connection (E, F, G), type RK,	RB and RC		
Basic type, size	Screw-in check valve Type RK, RB, size 0 Type RC, size 1 3 Type RE, size 0 4 Type RE, ER (check va Additional versions: Type RK with incre Type ER, stainless Type RK, RB, RC ar	4 lve insert), size 0 to 4 ased open-up pressure (size 01 31) d RE with metric thread			
Function					
RK Ball seated valve	RB	ER	RC Shim type valves	RE	









General parameters and dimensions

RK..













	Q _{max} [lpm]	p _{max} [bar]	Ports (BSPP)	Dimensions [nm]	m [g]
RK O/RB O	10	700	G 1/8 A	7.2/7.9	SW 5	5
RK 1/RB 1	20	700	G 1/4 A	9/10.3	SW 7	5
RK 2/RB 2	50	700	G 3/8 A	11.2/11.7	SW 6	15
RK 3/RB 3	80	500	G 1/2 A	13.5/13.2	SW 8	15/20
RK 4/RB 4	120	500	G 3/4 A	17.5/17.5	SW 12	35/40
RK 6	320	300	G 1 1/4	55	-	135
RC 1	20	700	G 1/4 A	13	SW 4	6
RC 2	35	700	G 3/8 A	15	SW 5	13
RC 3	60	500	G 1/2 A	18	SW 8	24
RE O	12	500	G 1/8 A	5	SW 4	2
RE 1	25	500	G 1/4 A	б	SW 5	4
RE 2	40	500	G 3/8 A	7	SW 8	6
RE 3	70	450	G 1/2 A	7.5	SW 10	10
RE 4	120	400	G 3/4 A	9	SW 12	18
				L	D/D1	m[g]
ER O	6	500	G 1/8 A	5.6	6.1/4.6	0.5
ER 1	12	500	G 1/4 A	5.6	8.6/6.5	1
ER 2	30	500	G 3/8 A	8	14/10.5	5
ER 3	65	500	G 1/2 A	10	17/13	9
ER 4	120	400	G 3/4 A	17.5	28/21	40

Associated technical data sheets:

- Insert check valves type ER: <u>D 7325</u>
- Check valves type RE: <u>D 7555 R</u>
- Check valves type RC: <u>D 6969 R</u>
- Check valves type RK, RB: <u>D 7445</u>

Similar products:

- Check valves type CRK, CRB: <u>Page 244</u>
- Check valves type B: <u>Page 246</u>

Restrictor check valves type EB, BE, BC: <u>Page 230</u>

See also section "Devices for special applications":

- Screw-in valves and installation kits
- Devices for up to 700 bar

Check valves

2.5 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 mounting hole can be closed with a simple tapped plug or with a locking tapped plug if necessary.

- Features and benefits:
- Cartridge valves
- Intended applications:
- General hydraulics



Nomen- clature:	Check valve
Design:	Screw-in valve
p _{max} :	500 bar
Q _{max} :	30 80 lpm

Design and order coding example

CRK 2	- 1/4
1	ndividual connection block for pipe connection
Basic type	Check valves type CRK and CRB, size 1 to 3
	 With/without tapped plug

• With/without tapped blockage/plug combination



Function

CRK	CRB
↓ ^B	۲B
×.	Ŷ
Y_A	₹ _A

General parameters and dimensions

CRK, CRB





	Q _{max} [lpm]	p _{max} [bar]	Ports (BSPP)	Dimensions			m [g]
				H [mm]	SW = a/f 1	SW = a/f 2	
CRK 1 / CRB 1	30	500	M 16 x 1.5	31	SW 22	SW 8	70
CRK 2 / CRB 2	50		M 20 x 1.5	35	SW 24	SW 10	110
CRK 3	80		M 24 x 1.5	38	SW 30	SW 12	125

Associated technical data sheets:

Check valves type CRK, CRB: <u>D 7712</u>

Similar products:

Check valves type RK, RB, RC, RE, ER: <u>Page 242</u>

See also section "Devices for special applications":

- Screw-in valves and installation kits
- Devices for up to 700 bar

Check valves

Check valves type B 2.5

These check valves type B are available in three housing designs with internal and/or external thread, enabling in-line installation for any requirement.

Use as a foot valve for the suction pipes of pumps is possible due to the low opening pressures.

Features and benefits:

- Max. flow 160 lpm
- Pipe installation

Intended applications:

General hydraulics



Nomen- clature:	Check valve
Design:	Individual valve for in-line installation
p _{max} :	500 bar
Q _{max} :	15 160 lpm

Design and order coding example

B1-2

Basic type, with housing, size

Check valve type B, version with housing 1 to 3, size 1 to 7 Additional versions:

Open-up pressure 3 bar



B —∕O≁

General parameters and dimensions



Basic type	Size	Q _{max} [lpm]	p _{max} [bar]	Ports (BSF	PP)	Dimensions		m [kg]
				G	G1	L [mm]	SW = a/f	
B 1	-1	15	500	G 1/4	G 1/4 A	50 60	SW 19	0.11
B 2 B 3	-2	20		G 3/8	G 3/8 A	58 67	SW 24	0.16
	-3	30		G 1/2	G 1/2 A	60 66	SW 27	0.19
	-4	45		G 3/4	G 3/4 A	70 78	SW 36	0.36
	-5	75		G 1	G 1 A	94 114	SW 41	0.65
	-6	120		G 1 1/4	G 1 1/4 A	110 130	SW 55	1.3
	-7	160		G 1 1/2	G 1 1/2 A	115 136	SW 60	1.5

Associated technical data sheets:

Check valves type B: <u>D 1191</u>

Similar products:

 Check valves type RK, RB, RC, RE, ER: <u>Page 242</u> See also section "Devices for special applications"

- Devices for up to 700 bar

Check valves

2.5 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 and without pre-release (for high pressures and large consumer volumes) are designed as insert valves. The mounting hole (also sealing surface) is to be machined with a standard twist drill (point angle 118°). Different variants extend the range of applications.

The type CRH is a screw-in valve for very easily machined mounting holes.

Features and benefits:

- Cartridge valve
- Pressures up to 700 bar
- Flows up to 200 lpm
- Sturdy

Intended applications:

- Industrial hydraulics
- Construction machinery



Nomen- clature:	Check valve with hydraulic release
Design:	Valve insert Screw-in valve
Actuation:	Hydraulic
p _{max} :	500 700 bar
Q _{max} :	8 200 lpm

Design and order coding example

6011.0		
CRH 3	V	
	Functio	on Without pre-release (-)
		With pre-release (V)
Basic type,	size	Screw-in check valve with hydraulic release
		Type CRH, size 1 to 3 and
		Type RHC, size 1 to 6
		Additional versions:
		With increased release ratio (approx, 4.2 : 1)

- With sealed tapped journal and control piston
- Wth hydraulic relieve of the control piston (type RHCE)



Function





General parameters and dimensions









	Q _{max} [lpm]	p _{max} [bar]	Release ratio	Ports (BSPP)	Dimensions	m [g]		
					L [mm]	SW = a/f 1	SW = a/f 2	
CRH 1	30	500	2.6	M 16 x 1.5	47	SW 8	SW 22	60
CRH 2	50	500	2.6	M 20 x 1.5	53	SW 10	SW 24	90
CRH 3	80	500	2.5	M 24 x 1.5	61	SW 12	SW 30	150
RHC 1	15	700	2.6	M 16 x 1.5	32	SW 6	-	20
RHC 2	25	700	2.6	M 20 x 1.5	37.5	SW 8	-	40
RHC 3	55	700	2.5	M 24 x 1.5	47	SW 10	-	70
RHC 4	100	500	2.5	M 30 x 1.5	56	SW 12	-	140
RHC 5	150	500	2.8	M 36 x 1.5	67.5	SW 14	-	250
RHC 6	200	500	2.5	M 42 x 1.5	97	SW 19	-	500

Associated technical data sheets: Check valves with hydraulic release type:

- Type CRH: <u>D 7712</u>
- Type RHC: <u>D 7165</u>

Similar products:

- Type RHV: <u>D 3056</u>
- Type HRP: Page 250
- Type RH: <u>Page 252</u>

See also section "Devices for special applications":

- Screw-in valves and installation kits
- Devices for up to 700 bar

Check valves

2.5 Check valves with hydraulic release type HRP

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 extremely tolerant to residual pressure in the return duct (port B), as the rear side of the actuation piston is de-pressurised via a drain port. Another option allows opening of the check valve via the load pressure on the consumer side, controlled by a flange-mounted solenoid valve.

Features and benefits:

- Manifold mounting valve for max. pressure 700 bar
- Flows up to 400 lpm
- Electrically controlled
- With pre-release for smooth switching

Intended applications:

Industrial and mobile hydraulics



Nomen- clature:	Check valve with hydraulic release
Design:	Manifold mounting valve
Actuation:	Hydraulic Electro-hydraulic
p _{max} :	700 500 bar
Q _{max} :	20 400 lpm

Design and order coding example

HRP 4	۷	- B 0,4	- WH 1H B 0,4-G24			
		Optionally with directly mounted 3/2-way directional seated valve			For arbitrary open-up or for use as 2/2-way directional seated valve	
		Optionally	with orifice insert at cont	rol port Z	For preventing decompression	surges
	Functi	on With With	nout pre-release (-) n pre-release (V)			
Basic type,	size	Check va	alve with hydraulic release H	IRP, size 1 to	0 7	



Function

HRP





General parameters and dimensions



	Q _{max} [lpm]	p _{max} [bar]	Release ratio	Dimensions [mm]			m [kg]	
			p _A / p _Z	Н	В	L		
HRP 1	20	700	2.9	20	25	74.5	0.25	
HRP 2	35	700	3.9	25	30	78	0.4	
HRP 3	50	500	4.3	35	35	83	0.7	
HRP 4	80	500	3.8	35	50	103.5	1.2	
HRP 5	140	500	4.0	40	60	120.5	1.9	
HRP 7 V	400	500	3.0	63	100	190	8.0	

Associated technical data sheets:

Releasable check valves type HRP: <u>D 5116</u>

Similar products:

- Releasable check valves type RH: <u>Page 252</u>
- Releasable check valves type RHV: <u>D 3056</u>
- Releasable check valves type CRH, RHC: <u>Page 248</u>
- Releasable twin check valve type DRH: <u>Page 252</u>

See also section "Devices for special applications":

- Devices for up to 700 bar
Check valves

2.5 Check valves with release type RH and DRH

Check valves with hydraulic release are used to block one or both hydraulic consumer pipes or as a hydraulically actuated drain or circulation valve. The valves type RH and DRH are also available with pre-release for one or both sides of the connection to suppress decompression surges for circuits with high pressures and high consumer flows.

Features and benefits:

- Pressures up to 700 bar
- With pre-release for smooth switching

Intended applications:

- Blocking of leak-free hydraulic cylinders in connection with a directional spool valve control suffering from leaking oil
- Return flow relief if return oil flows that are greater than the permissible flow for the directional valve are experienced due to the surface ratio, when introducing a double-acting hydraulic cylinder
- Hydraulically actuated drain or circulation valve



Check valve with hydraulic release or releasable double check valve	Check valve with hydraulic release or twin check valve						
Design:	Individual valve for Pipe connection Manifold mounting						
Hydraulic	Hydraulic						
400700 bar	400700 bar						
15160 lpm	15160 lpm						

Design and order coding example

 RH 3
 V

 Function
 Without pre-release (-) With pre-release (V)

 Basic type, size
 Releasable check valve RH, size 1 to 5



- With safety valve preventing slow pressure rises
- With leakage port preventing unintended open-up when pressure migrated from the control side
- Manifold mounting version (type DRH3P)



Function

RH



General parameters and dimensions





	Q _{max} [lpm]	p _{max} [bar]	Release ratio p _{A(B)} /pz	Tapped ports (BSPP)		Dimer [mm]	m [kg]			
				A, B, C, D	Z	L	а	b	SW = a/f	
RH 1	15	700	2.7	G 1/4		84	31.5	27	SW 24	0.4
RH 2	35	700	3	G 3/8		90	32	28.5	SW 27	0.4
RH 3	55	500	2.4	G 1/2	G 1/4	100	36.5	31	SW 32	0.6
RH 4	100	500	2.4	G 3/4		126	45	35.5	SW 41	1.3
RH 5	160	500	3	G 1		143	52	38	SW 46	1.8
						L	В	Н	с	
DRH 1	16	500		G 1/4		70	45	20	8	0.5
DRH 2	30	500		G 3/8		89	60	30	10	1.2
DRH 3	60	500	2.5	G 1/2	-	115	60	30	13	1.6
DRH 4	90	400		G 3/4		150	70	40	15.5	2.9
DRH 5	140	400		G 1		195	80	50	17	5.5

Associated technical data sheets:

- Releasable check valves type RH: <u>D 6105</u>
- Releasable twin check valves type DRH: <u>D 6110</u>

Similar products:

- Type RHV: <u>D 3056</u>
- Type CRH and RHC: Page 244
- Type HRP: Page 250

See also section "Devices for special applications":

- Devices for up to 700 bar

Check valves

2.5 Check valves and pre-fill valves type F

Check valves and pre-fill valves type F are check valves. They are designed as springloaded disc seat valves. The check valves type F enable free flow in one direction and block flow in the opposite direction.

As a pre-fill valve (check valve with hydraulic release), they are used for example in top ram presses for draining and replenishing press cylinders during opening and closing in rapid traverse mode.

The smaller sizes may be optionally equipped with a pre-release device (decompression at high pressures via the valve) to prevent decompression surges.

Features and benefits:

- Wafer design
- Extremely large flows, up to 7000 lpm

Intended applications:

- Press control systems
- Injection moulding machines



Nomen- clature:	Check valve Check valve with hydraulic release (pre-fill valve)
Design:	Intermediate section between pipe flanges
Actuation:	Hydraulic
p _{max} :	400 bar
Q _{max} :	100 7000 lpm

Design and order coding example

F	2	5

Basic type, size Check valve type F, size 25 to 200

F80B-36	V					
	Additi	onal versions:	Without pre-release (-) With pre-release (V), size 25 to 80			
Basic type, si	ze	Pre-fill valves typ	e F, size 25 to 200			
		Additional funct	ions			
		 With holes in the mounting flange (B) 				
		 For fluids type 	HFA type F125-60-HFA			

Function



Pre-fill valve





General parameters and dimensions

Check valve





Basic type and size		Q _{max} [lpm]	p _{max} [bar]	Release ratio	Dimer [mm]	nsions			m [kg]		
Check valve	Pre-fill valve			p _A / p _Z	D	H1	H2	H3	Check valve	Pre-fill valve	
F 25	F 25-12	100	400	4.3	83	26	36	43	1	1.1	
F 32	F 32-16	160		3.6	93	27	45	55	1	1.2	
F 40	F 40-20	250		3.9	108	28	48.5	60	1.4	1.7	
F 50	F 50-25	400		4.2	128	29	59	72	2	2.4	
F 63	F 63(B)-30	630		4.2	143	33.5	69	83	2.8	3.4	
F 80	F 80(B)-36	1000		4.5	169	38.5	83	97.5	4.4	5.2	
F 100	F 100(B)-45	1600		4.3	212	44	97	118	9.9	11.7	
F 125	F 125(B)-60	2500		4.3	248	51	127	155	15.8	19.6	
F 160	F 160-76	4000		4.3	310	70	182	233	43	50	
F 200	F 200-100	7000	320	4.0	420	150	250	300	114	120	

Associated technical data sheets:

Check valves and pre-fill valves type F: <u>D 6960</u>

See also section "Devices for special applications":

- Press controls

Check valves

2.5 Line rupture safety valves type LB

The line rupture safety valves type LB are check valves. They are available as insert valves or with housing for pipe connection.

The line rupture safety valve, which is generally mounted directly on the consumer (cylinder)serves to block a consumer in the event of a break in a pressurised pipe, i.e. if the hydraulic counter pressure subsides. It therefore prevents an uncontrolled decline in the load. A flow in excess of the setpoint results in a shim that has been lifted off the valve seat with spring force being pressed onto the housing seat by the flow forces, and consequently the valve closes.

Two versions – one for completely stopping the load and one with an orifice hole for a slow decrease – enable this valve to be used for various requirements.

Features and benefits:

- Pressures up to 700 bar
- Intended applications:
- Industrial trucks
- Lifting devices



Nomen- clature:	Line rupture safety valve
Design:	Valve insert with housing for in-line installation
Adjustment:	Tool adjustable
p _{max} :	700 bar
Q _{max} :	4 160 lpm
Design: Adjustment: p _{max} : Q _{max} :	Valve insert with housing for in-line installation Tool adjustable 700 bar 4 160 lpm

Design and order coding example

LB 2	G	1,0	- 25	
	V	Vith/wi	Response flor ithout orifice	<pre>w [lpm] Response flow Q_A Orifice diameter 0.5 / 0.8 / 1.0 / 1.2 / 1.5 / 2 (dep. on type and size)</pre>
C	Design		Screw-in valve Design with he Fitting	e (C) ousing (F, G)
Basic type	, size	: Lin	ne rupture safe Design with n Design with U	ety valve type LB, size 2 to 4 netric thread JNF thread

Function

LB

Simplified Series With orifice Detailed







General parameters and dimensions

LB..C

Screw-in valve

LB 11(21)C







LB..G Valve with housing

LB...F





	Q _{max} [lpm]	p _{max} [bar]	Ports (BSPP)	Dimension [mm]	ns	m [g] ²⁾		
				L	L1	L2	SW = a/f	
LB 1 (C, G, F)	4 25	500	G 1/4 (A)	17.5	48	50	a/f 19	6 / 70
LB 11 C ¹⁾	4 25	700	G 1/4 (A)	17.5				6 / 70
LB 2 (C, G, F)	6.3 50	500	G 3/8 (A)	21	52	58	a/f 22	12 / 100
LB 21 C ¹⁾	6.3 45	700	G 3/8 (A)	25				12 / 100
LB 3 (C, G, F)	16 80	500	G 1/2 (A)	25	60	65	a/f 27	21 / 170
LB 4 (C, G, F)	25 160	500	G 3/4 (A)	30.5	72	78	a/f 36	45 / 375

The mounting thread is sealed additionally. Mass for screw-in valve versions with housing 1)

2)

Associated technical data sheets:

- Line rupture safety valves type LB: <u>D 6990</u>
- Line rupture safety valves type LB.E as a screw joint: Sk 6990 E

See also section "Devices for special applications"

- Industrial trucks
- Hydraulics for mobile applications
- Screw-in valves and installation kits

Check valves

2.5 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 for pipe connection is incorporated in a T-fitting. The WVC version is designed as an insert valve.

Features and benefits:

- Max. pressure 700 bar
- Insert and housing versions

Intended applications:

- For Load-Sensing systems
- Often in mobile hydraulics



Nomen- clature:	Shuttle valve
Design:	Individual valve for pipe mounting Valve insert Screw-in valve
p _{max} :	700 bar
Q _{max} :	6 150 lpm

Design and order coding example

WV 10 - S	
Desi	gn High pressure version (S)
	 Low pressure version (L)
Basic type, size	Type WV for pipe connection, size 6 to 18 Type WVC and WVH as cartridge valve, size 1



Function

WV, WVC, WVH

Inlet

 $\langle \phi \rangle$

Outlet

Inlet

General parameters and dimensions



	Q _{max} [lpm]	p _{max} [bar]	External pipe ∅ [mm]	Mounting thread	Dimensions [mm]			m [g]
					L	H	SW = a/f	
WV 6 - S	6		6		62	31	SW 17	120
WV 8 - S	15		8		64	32	SW 19	170
WV 10 - S	25		10		68	34	SW 22	225
WV 12 - S	40	315	12	-	76	38	SW 24	290
WV 14 - S	60		14		80	40	SW 27	320
WV 16 - S	100		16		86	43	SW 30	390
WV 18 - L	150		18		80	40	SW 32	340
WVC 1	6	315	-	M 10 x 1		16	SW 5	7
WVH 1	3	700	-	M 10 × 1		28.5	SW 14	10

Associated technical data sheets:

Shuttle valves type WV and WVC: <u>D 7016</u>

Similar products:

Shuttle valves type WVH: Sk 7962

See also section "Devices for special applications":

- Screw-in valves and installation kits

Hydraulic cylinders

Hydraulic clamps type HSE and HSA

262



Hydraulic clamps type HSE and HSA



Hydraulic cylinders

Туре	Nomenclature/Design	p _{max}	F _{max}
HSE, HSA	Hydraulic clamps	500 bar	60000 N
	Screw-in version		
	 Manifold mounting 		

Hydraulic cylinders

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.

Features and benefits

Compact

3

• Operating pressure up to 500 bar

Intended applications:

- Clamping systems
- Securing systems



Nomen- clature:	Hydraulic clamps
Design:	Screw-in version Manifold mounting
p _{max} :	500 bar
F _{max} :	60000 N

Design and order coding example

HSE 24	- 15			
Basic type,	Stroke	[mm]	Stroke H	Screw-in version type HSE
	piston d	diameter	[mm]	Manifold mounting version type HSA



Function

HSE, HSA



General parameters and dimensions

HSE ..

Hydraulic screw-in clamps



HSA ..

Manifold mounting hydraulic clamps





	Q _{max} [lpm]	Stroke [mm]	F _{max} [N]	Ports	Dimensions [mm]				m [kg]
			with 500 bar		Н	H1	SW = a/f	Α	
HSE 12	500	2 8	5500	M 20 x 1.5	20.5 32.5	-	SW 24	-	0.05 0.08
HSE 16		3 12	10000	M 24 x 1.5	26.5 41.5	-	SW 24	-	0.08 0.12
HSE 20		4 20	15000	M 30 x 1.5	28.5 56	-	SW 30	-	0.14 0.3
HSE 24		5 20	23000	M 36 x 1.5	34 65	-	SW 36	-	0.25 0.5
HSA 32		20	40000	-	-	71	-	60	1.6
HSA 40		25	60000	-	-	85	-	70	2.5

Associated technical data sheets:

• Hydraulic clamps type HSE and HSA: <u>D 4711</u>

See also section "Devices for special applications":

- Hydraulics for clamping

Hydraulic accessories

Pressure switches type DG	266
Hydraulic miniature accumulators type AC	268
Piston type accumulator type HPS	270
Hydraulic accessories	272



Pressure switches type DG and analogous pressure sensors



Туре	Nomenclature/Design	Capacity	p _{max}	Piston diameter
DG	 Spring-loaded piston-type pressure switch, electronic pressure switch Manifold mounting Screw-in version Version for pipe connection 		0 700 bar 0 1000 bar	
AC	Hydraulic accumulator Screw-in version	V ₀ : 0,013 2.8 dm ³	500 bar	
HPS	Piston-type accumulatorBasic type HPS	V ₀ : 0,4 80 dm ³	p _{operation} : 415 bar	80 250 mm
Hydraulic accessories	Reducing connector, connection fitting, screen filter, wire mesh filter, pressure gauge Screw-in version Version for pipe connection		350 700 bar	

Hydraulic accessories

4

Pressure switches type DG

Pressure switches close or open electrical contacts when under pressure. They are used to issue an electrical switching command or signal for further operations when a predefined pressure value is reached.

Different versions (with pressure setting on an adjusting knob, main and secondary switch, screw-on pressure switch) enable their use in a wide range of applications. A design-related difference (hysteresis) of 8... 20% is to be expected between the upper and lower switching point in piston-type pressure switches.

In contrast to this, the type DG5E and DG6 electronic pressure switches provide the option to select two independent pressure switching points and/or program or adjust the hysteresis.

Type DT is an analogouspressure sensor.

Features and benefits:

- Compact design
- Option of integration into the HAWE modular system
- Operating pressures up to 1000 bar

Intended applications:

- General hydraulic systems
- Machine tools



Nomen- clature:	Spring loaded piston type pressure switch Electronic pressure switch Pressure transducer
Design:	Screw-in version Manifold mounting Designed for pipe fittings
p _{max} :	0 1000 bar

Design and order coding example

DG 1	RF			
DG 35	V	-YS 8		
		Uudraulie een	naction -	With united to the second of the second of the second of the DC 2)
	'	Hydrautic con	nection	with various tapped journals or to be mounted at fittings (type DG 3)
				Combination with various fittings
1	Means (of adiustment	t, mounting	Manually adjustable (R) or Turn-knob (V, $H = with lock$) (type DG 3)
		· · · · , · · · · ·	, J	 Design with bozol for installation in control papels (E)
				Design with bezet for installation in control panels (1)
Basic type	Pres	sure switch ty	pe DG	
	Туре	e DG 1, 3, 8 (sj	pring loaded	piston type switch)
	Туре	e DG 5, DG 6 (E	Electronic pre	ssure switch with two switch points)
	0pe	rating voltage	12 V DC, 24 \	/ DC, 110 V AC, 230 V AC
	Anal	logous pressur	e transducer t	type DT
	Туре	e DT 11		
	Туре	e DT 2		
	51			
Functio	n			









General parameters and dimensions















(+)

	Brief description	Adjustable pressure p _{max} [bar] ¹⁾	Ports (BSPP)	m [kg]
DG 1 R	Adjustment via turn-knob at the dial	20 600	G 1/2 or G 1/4 A	1,3
DG 8	Version with two pressure switches Main switch: Adjustment via turn-knob at the dial Secondary switch: Adjustment via set screw	20 600 and 20 180	G 1/2 or G 1/4 A	1,35
DG 3	Compact design for manifold mounting Adjustment via set screw	4 700	G 1/4 or G 1/4 $A^{\rm 2)}$	0,3
DG 5 E	Electronic pressure switch with two switch points	0 600	G 1/4 A	0,25
DG 6		0 400	G 1/4 A or M 5	0.08
DT 11	Analogous pressure sensor	0 1000	G 1/4	0,08
DT 2		0 600	G 1/4	0,7

The max. operation pressure of 700 bar is not influenced by the max. set pressure For versions with adapter only 1)

2)

Associated technical data sheets:

- Pressure switches type DG: <u>D 5440</u>
- Electronic pressure switch type DG 5 E: <u>D 5440 E/1</u>
- Electronic pressure switch type DG 6: <u>D 5440 F</u>

Hydraulic accessories:

Fittings type X, X 84: Page 272

Similar products:

- Analogous pressure sensor type DT 11: <u>D 5440 T/2</u>
- Analogous pressure sensor type DT 2: <u>D 5440 T/1</u>

See also section "Devices for special applications":

- Hydraulics for clamping purposes _ Press controls _
- Devices for up to 700 bar _
- www.hawe.de | 2013 | 267

Hydraulic accessories

Hydraulic miniature accumulators type AC 4

The hydraulic accumulators type AC are available in two categories. The hydraulic miniature accumulators with a capacity of 0.013 dm³ and 0.040 dm³ are used for applications including clamping hydraulics for volume compensation in the event of temperature fluctuations, covering possible oil losses due to leakage or oscillation damping of functional parts activated by pressure difference.

The diaphragm accumulators with a capacity of up to 3.5 dm³ are primarily used as a source of pressure oil for supporting/increasing the pump delivery flow and storing pressure energy, in order toachieve an accumulator charging circuit, for example. Various fittings enable the integration of a hydraulic system in different installation positions and at different installation points.

Features and benefits:

- Compact design
- Option of integration into the HAWE modular system
- Operating pressures up to 500 bar

Intended applications:

- Clamping systems
- Jigs
- Accumulator charging systems



Nomen- clature:	Hydro-pneumatic accumulator
Design:	Screw-in version
p _{max} :	500 bar
V _{max} :	1,95 dm ³

Design and order coding example

AC 2001	/90	/3A		
		Connect	ion thread	(hydraulic side)
	Gas p	re-charge p	ressure [b	ar]
Basic type,	size	Hydraulic a	ccumulato	r type AC

AC 40 ACS 13	- 1/4 - 1/4	- 200 - 50	/110		
			Setting s	hut-off valve	[bar]
		Gas pre-	charge pre	ssure [bar]	
	Connecti	ion thread			

Basic type, nom. volume Hydraulic miniature accumulator type AC and type ACS with shut-off valve, nom. volume in cm³

Function

AC



General parameters and dimensions

AC(S) 13 - 1/4



AC 0725, AC 202, AC 322

AC 603, AC 1002, AC 1414, AC 2002, AC 2825









	V ₀ [dm³]	p _{max} [bar]	Max. gas filling pressure p₀[bar]	Ports (BSPP)	Dimensie [mm]	ons			m [kg]
					н	H1	H2	D	
Hydraulic miniature accumulator									
AC 13-1/4	0.013	500	250	G 1/4 A	see illust	ration			0.3
ACS 13-1/4	0.013	500	250	G 1/4 A	see illust	ration			0.3
AC 40-1/4	0.040	400	250	G 1/4 A	see illust	ration			0.65
Hydraulic accumulator									
AC 0725/1A	0.075	250	130	G 1/4 A	81	26.5	12	64	0.6
AC 202/3	0.16	250	130	G 3/8 A	102	26.5	-	74	0.8
AC 322/3A	0.32	210	140	G 1/2 A	101.5	25	12	92.5	1.4
AC 603/3	0.6	330	200	G 1/2	149	23	-	115	3.3
AC 1002/22	1.0	210	140	M 22 x 1,5	151	25	18	136	3.5
AC 1414/2A	1.4	140	120	G 3/8 A	162	25	18	147	4.2
AC 2002/4	1.95	250	140	G 3/4	229	25	-	155	7.5
AC 2825/2AW	2.8	250	130	G 3/8 A	246	26.5	18	167	8.2

Associated technical data sheets:

- Hydraulic miniature accumulators type AC: <u>D 7571</u>
- Diaphragm accumulator type AC: <u>D 7969</u>

Hydraulic accessories:

Fittings type X84: <u>Page 272</u>

Similar products:

- Piston type accumulator type HPS: <u>Page 270</u>
- See also section "Devices for special applications":
- Hydraulic clamping systems

Hydraulic accessories

Piston type accumulator type HPS

In many mobile and stationary applications, a modern hydraulic system includes reliable and powerful hydraulic accumulators. They are especially useful when energy is to be stored, pressure surges are to be damped, leakage is to be compensated or high flows are to be delivered in a short time. There is usually no faster or easier solution to do so than with apiston-type accumulator. The freely moving piston separates the compressible gas cushion and the hydraulic fluid. High-quality and thoroughly tested piston sealings guarantee a reliable separation of gas and oil even under extreme conditions.

To enable any arrangement of the piston-type accumulator, the accumulators are available with the appropriate mounting clips.

Features and benefits:

Compact design

4

Option of integration into the HAWE modular system

Intended applications:

- Accumulator charging systems
- Construction machinery
- Wind turbine systems



Basic type:	HPS
Nomenclature:	Piston accumulator
Operation pressure:	415 bar
Capacity:	0,1 - 80 dm ³
Internal piston diamater:	80 - 250 mm

Design and order coding example

HPS 11	- 250	- 160	- 0050	
		1	Nom. volume	e V ₀ [dm ³]
	1	Int. diame	ter [mm]	
	max. opera	ating pres	sure [bar]	Pressure ratings 250 bar, 350 bar, 415 bar
Basic type	Piston ty	vpe hydrau	lic accumulat	or type HPS

Function

HPS



General parameters and dimensions



øD



	Nom. volume Vo [dm³]	p _{max} [bar]	Ports (BSPP)	Dimensions [mm]	
				D	L
HPS 11 - 250 - 080	0.4 4.0	250	G 3/4	90	233 949
HPS 11 - 250 - 100	2.0 10.0		G 1	110	439 1458
HPS 11 - 250 - 160	5.0 30.0		G 1 1/2	180	436 1680
HPS 11 - 250 - 200	8.0 50.0		G 2	229	233 1840
HPS 11 - 250 - 250	10.0 80.0		G 2	275	465 1886
HPS 11 - 350 - 080	0.4 4.0	350	G 3/4	95	254 970
HPS 11 - 350 - 100	2.0 10.0		G 1	115	457 1475
HPS 11 - 350 - 160	5.0 30.0		G 1 1/2	185	458 1702
HPS 11 - 350 - 200	8.0 50.0		G 2	225	513 1849
HPS 11 - 350 - 250	10.0 80.0		G 2	280	491 1917
HPS 11 - 415 - 080	0.4 4.0	415	G 3/4	95	254 970
HPS 11 - 415 - 100	2.0 10.0		G 1	115	469 1488
HPS 11 - 415 - 160	5.0 30.0		G 1 1/2	185	458 1702
HPS 11 - 415 - 200	8.0 50.0		G 2	230	522 1859
HPS 11 - 415 - 250	10.0 80.0		G 2	290	491 1917

The data listed represent only a selection of the various differing versions

Associated technical data sheets:

Piston-type accumulator type HPS: <u>D 7969 HPS</u>

Similar products:

-

Diaphragm accumulator type AC: <u>Page 268</u>

Hydraulic accessories



Hydraulic accessories

Hydraulic systems use measuring instruments () for pressure monitoring, command devices for pressure-controlled switching (pressure switches) and hydraulic accumulators. Using the various fittings, these devices can be connected to the pressure pipes of HAWE hydraulic power packs as well as valves in a wide range of installation situations.

help to combine devices. Other accessories, such as screen and wire mesh filters protect hydraulic devices from larger, stray impurities that occasionally occur. These are available in two versions: as screen filters and wire mesh filters (wire mesh filters preferentially used in control circuits without a significant current flow).

Features and benefits:

- Compact design
- Option of integration into the HAWE modular system
- Operating pressures up to 700 bar

Intended applications:

General hydraulic systems



Nomencla-	Reducing connector	
ture:	Connection fitting	
	Screen filter	
	Wire mesh filter	
	Pressure gauge	
Destant	Course in coursion for since coursestion	
Design:	Screw-in version for pipe connection	
	250 700 hav	
P _{max} :	350 700 bar	

Designs

Reducing connectors (various dimensions)

- G g
- Internal thread external thread
- BSPP thread metric thread
- BSPP thread BSPP thread
- Metric thread metric thread
- Metric thread BSPP thread





Example: G 1/2A - M 16 x 1.5



Example: G 1/2 - G 1A

Fittings

- Connection fitting with tapped journal G 1/4
- Connection fitting with fastening nut and internal port G 1/4
- Connecting pieces for attaching the cutting ring for external pipe diameter 6 to 20 mm
- Straight screw-in fitting
- Swivel fitting
- L-fitting



Example: Straight fitting **type X... G**



Example: Elbow fitting **type X... V**



Example: Swivel fitting **type X... S**





Symbol:

Fitting combinations

Consisting of:

- Connecting pieces
- Straight screw-in fitting
- Swivel fitting
- L-connecting pieces
- Elbow fitting
- AVM 8 shut-off valve
- Locking element

Symbol: Connector Barrel tee fitting Straight male stud fitting



Example: X 84U - AC 40/100-9/400

Screen and wire mesh filters

- BSPP thread
- Metric thread
- Screw-in strainer type HFC (hole \emptyset 0.63 mm)
- Screw-in wire mesh filter disc type HFC.. F (filter fineness approx. 100 µm)
- Also available with housing



Example: X 84T

Example: HFE 3/8 Strainer with housing (hole \varnothing approx. Screw-in wire mesh filter disc 0.5 mm), with connection thread G 3/8(A)



Example: HFC 1/4 F for port G 1/4, filter fineness approx. 100 µm

Associated technical data sheets:

- Reducing connectors: <u>D 845</u>D 845
- Fittings type X: <u>D 7065</u>
- Fitting combination type X84: <u>D 7077</u>
- Screen and wire mesh filters: <u>D 7235</u>
- Shut-off valves type AVM 8: Page 238

See also chapter "Equipment for special applications":

- Clamping hydraulics

Electronics

Electronic accessory components	276
Type PLVC programmable logic valve control	278



Programmable logic valve controls type PLVC



Electronic accessory components

Туре	Nomenclature	Designs
Accessory component	 Plugs with no special feature (standard) With rectifier circuit, With clamp diode, With LED with economy circuit 	PlugsModules with screw terminalsCards with terminal strip
	Amplifier units for proportional solenoidsPower supply units	

Programmable logic valve controls

Туре	Nomenclature/Design
PLVC	Programmable logic valve control Modular system with Basic modules Extension modules CAN bus nodes Display Software
CAN-IO	CAN node Programmable

Electronics

5

Electronic accessory components

A range of electronic accessory components is available in various versions for the control of common on/off and proportional solenoids. These include electronic amplifiers in the form of modules and cards and versions integrated in the plug for single and twin solenoids, as well as for pressure switches. A power supply unit for 24V DC solenoid valves is also available. All of these components are tailored to HAWE solenoid valves.

Features and benefits:

- Compact design
- Functions tailored to HAWE products

Intended applications:

- For control of all types of proportional valves
- Plug for visual operation control, prolonging the service life of the solenoid etc.



(standard) With rectifier circuit

With LED with economy circuit

With clamp diode

Amplifier units for proportional solenoids Power supply units

Cards with terminal strip

ture: Design: Plugs Modules with screw terminals

Designs

Plug for solenoid valves (single and twin solenoid)

Brief description	Application
No special feature (standard)	For all applications with no special requirements
Version with LED	Visual operation control and EMC protection (note prolonged cut-off times)
Version with clamp diode	For optimum EMC protection (note prolonged cut-off times)
Version with economy circuit	Increased functional security and prolonged service life of the solenoids by reducing the voltage (pulse width modulation) after a defined period. Recommended for use in areas with high ambient temperatures and/or for application where the solenoids are permanently energised (e.g. safety circuits)
Version with rectifier circuit	Enables use of DC solenoids when a power supply of 110V AC, 230V AC is available

Plugs with no special feature (DC voltage supply) or the version with rectifier circuit for power supply of 110V AC, 230V AC are included as standard in the scope of delivery of the solenoid valve.



Proportional amplifier

Features:		Adjustable parameters:	
 Constant current control (regardless of the power supply and changes in resistance of the solenoid due to heating effects) Improved EMC properties Use in a broad temperature range 		 I_{max} and I_{min} setting Setting for ramp time up to 10 sec Reference voltage for potentiometric setpoint generator available Option to set dither amplitude and frequency 	
Туре	Brief description	Application	
EV 1 M EV 1 G EV 1 D	Module version (board only or built-in housing)	Suitable for installation in switch cabinets, secured with screw terminals	

Power supply units for solenoid valves

Туре	Brief description	Application
MNG	Power supply unit for input voltage 230V AC and output voltage 24V DC, max. power rating 5A	Power supply for solenoid-actuated hydraulic valves or electrical amplifiers for proportional solenoids

Associated technical data sheets:

Please check whether correct links are inserted

Plugs:

- Socket connectors (type overview): D 7163
- Economy circuits for WG 230 actuating solenoids: <u>Directional</u> seated valves: D 7831
- Economy circuit plug type MSE 28026 with adjustable economy voltage: D 7832
- Type MSD 4 P55 line connector with economy circuit for 24 VDC: Type PLVC 8: Page 278 D 7833

Electronic amplifiers:

- Type EV1M 2-12/24 and EV1M 2-24/48 electronic amplifier: <u>D 7831/1</u>
- Electronic amplifier type EV1D: D 7831 D
- Electronic amplifier type EV1G1-12/24: D 7837
- Electronic amplifier type EV22K2-12/24: D 7817/1

Power supply units:

Power supply unit type MNG 2,5-230/24 and MNG 5-230/24: D 7835

Further information:

- Possible combinations of valves and electronic accessories: P 7163
- Joysticks type EJ: D 7844

Programmable logic valve controls:

- Type PLVC 21: <u>Page 278</u>
- Type PLVC 41: Page 278

CAN node

Type CAN-IO 14: Page 278

Suitable products:

Lifting modules:

Type HMT etc.: Page 166

Prop. pressure valves:

- Type PM, PMZ: <u>Page 200</u>
- Type PMV, PDV: <u>Page 188</u>
- Type PDM: Page 202

- Prop. directional seated valves type EMP: Page 152
- Prop. directional spool valves type PSL, PSV: <u>Page 104</u>
- Prop. flow control valves type SE, SEH: Page 224

Electronic pressure sensors:

Type DT 11 and DT 2: Page 266

See also chapter "Equipment for special applications":

- Proportional valves

Electronics

5

Type PLVC programmable logic valve control

The type PLVC programmable logic valve control is intended for the actuation of complex hydraulic systems. Any movement sequences with pressure, speed and acceleration profiles can be implemented and saved in pre-defined limit areas. Analogue and digital components as well as components linked to CAN bus (e.g. valves, pressure sensors, joystick) can be used via cable or remotely to control tasks. This type of control can also be described as PLC with integrated prop. amplifiers.

High flexibility via:

- Modular systems with extension and enhancement modules (Basic and expansion module)
- Flexible programming
- Different interfaces (RS 232, CAN bus, Profibus)
- All output parameters can be customised
- Software function modules (PLC programs)

Intended applications:

- Construction machinery
- Crane systems
- Complex lifting devices
- Machines for forestry purposes
- Machine tools and press construction



Nomenclature: Programmable logic valve control

Version: Modular concept with

Basic modules

- Expansion modules
- CAN bus nodes
- DisplaySoftware

Basic types and general parameters

	PLVC 41	PLVC 21	PLVC 8	CAN-IO 14	
Number of inputs ¹⁾			·		
Digital	27 (3 / 24)	13 (5 / 8)	17 (10 / 7)	1	
Analogue	28 (4 / 24)	12 (4 / 8)	23 (11 / 12)	6 (10)	
Frequency	3 (3 / -)	3 (3 / -)	3 (3 / -)	-	
Emergency stop	х	х	X	-	
Number of outputs ¹⁾					
Digital	16 (- / 16)	16 (8 / 8)	13 (- / 13)	4	
Analogue (PWM)	16 (4 / 16)	4 (4 / -)	16 (16 / -)	4	
Analogue (0 10V)	1 (1/-)			-	
Relay	8 (3 / 8) 4 (- / 4)			-	
Auxiliary voltage	1 (5V DC)			-	
Interfaces					
RS 232	х	х	х	х	
CAN bus	х	x (- / x)	x (x / x)	Х	
Profibus		х		-	
Voltage supply (10 30V DC)	5A (10A)	5A	5A	10A	

1) Always max. number of inputs and outputs, figures in brackets apply to basic modules and expansion modules



Software function packs (examples):

- Position measurement
- CAN bus communication
- Position and volumetric flow control
- Fault detection
- Controller for closed control circuits

- Ganging
- Electronic volumetric flow distribution
- Stability
- Limit load control
- Pressure control

Furthermore, the system allows customers to use the aforementioned PLC programming to very quickly make individual adaptations using structured texts (ST).

29

Dimensions

PLVC 41









CAN-IO 14



Programmable logic valve control:

- Type PLVC 21: <u>D 7845-21</u>
- Type PLVC 41: <u>D 7845-41</u>
- Type PLVC 41: <u>D 7845-4</u>
 Type PLVC 8: <u>D 7845 M</u>
- Type CAN-IO 14: D 7845 IO

Prop. pressure valve:

- Including type HMT lifting modules: <u>Page 166</u>
- Type PSL, PSV prop. directional spool valves: <u>Page 104</u>
- Type SE, SEH prop. flow control valves: <u>Page 224</u>

- Type PM, PMZ: <u>Page 200</u>
- Type PMV, PDV: <u>Page 188</u>
- Type PDM: Page 202

See also chapter "Equipment for special applications":

- Industrial trucks
- Mobile hydraulics
- Prop. valve technology

Appendix

Pressure fluids – notes for selection	281
Devices for special applications	286
Formulas and units	295
Adresses of Offices and Representatives	302
Pamphlet index	310
Type index	314
Index	320



6 Pressure fluids – notes for selection

The performance of a hydraulic system depends to a large extent on the quality of the pressure fluid used. The pressure fluid should essentially be selected according to the operating conditions, such as

- Temperature (see viscosity classes)
- Device type (possible ban on certain pressure fluids due to undesired reactions with metals, seals etc.)
- Usage type (e.g. environmentally compatible pressure fluids)
- Surroundings (use of existing pressure fluids)

	The following viscosity ranges and temperature ranges apply to HAWE devices:
Temperature range:	Surrounding area: approx40+80°C (attention: +5+80°C for type LP air- driven pumps) Pressure fluid: -25+80°C Please observe viscosity range and any additional restrictions.
Permissible temperature during start:	down to -40°C (observe start-viscosity!), as long as the steady-state temperature is at least 20K higher for subsequent operation. Biologically degradable or fire inhibit- ing pressure fluids generally not over max. +60+70°C.
Viscosity range:	min. approx. 4 mm²/s, max. approx. 1500 mm²/s optimum service approx. 10500 mm²/

Mineral oils

Pressure fluid	Characteristics	Unusual features / restrictions
 Pressure fluids HLP (DIN 51524 part 2) 	Mineral oil with additives improving corrosion, oxidation and wear protection	Common hydraulic oil
 Pressure fluids HL (DIN 51524 part 1) 	Mineral oil without wear protecting additives	No wear protection additives therefore not suitable for gear pumps. HAWE-pumps type: Z, RZ, MPZ, HKZ Observe manufacturer's specifications for other devices!
 Pressure fluids HVLP (DIN 51524 part 3) 	Mineral oil with same additives as HLP, but with increased viscosity index for use in higher temperature ranges	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 !
 Undoped oil H e.g. lubricating oils (DIN 51517 part 1) white oil (e.g. USDA H1) 	Mineral oil without additives	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.
 Special fluids for aviation (MIL H-5606) for off-shore applications (NATO H 540) 	Mineral oils are based as a rule on naphtenic based oil with wide tempera- ture range	Seals made of fluor rubber FPM might be required, depending on pressure fluid. Consult the oil manufacturer!
 Other mineral oils Engine oils type HD (e.g. DIN 51511) Automatic transmission fluid type ATF(AQA Suffix A) Diesel fuel Test oil for diesel injection pumps 	Mineral oils which basically were developed for other application purposes.	More or less well suited pressure fluids. Observe whether it contains additives preventing corrosion and oxidation as well as material compatibility (especially with seals). Attention: increased leakage with directional spool valves. Consult the oil manufacturer!

Ecologically compatible pressure fluids VDMA 24568 and 24569

Pressure fluid	Characteristics	Unusual features / restrictions		
 Seed oil type HETG 	Fluids based on seed oils e.g. rape or sunflower with additives show only low temperature strength (< 6070°C)	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 (> 6070°C). Their use should be avoided !		
 Polyethyleneglycol HEPG PEG-Polyethylene (may be solved in water) PPG-Polypropylene (can't be solved in water) 	Fluids based on Polyethyleneglycol (PAG) Similar qualities i.e. service life, lubricating characteristics and pressure resistance, like mineral oil	 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 		
 Synthetical ester HEES (carbon acid ester, diester, polyester) 	Similar qualities i.e. service life, lubricating characteristics and pressure resistance, like mineral oil	No restrictions with regard to the operation behavior. Contact with PVC should be avoided.		

Fire inhibiting pressure fluids conforming DIN 51502

Pressure fluid	Characteristics	Unusual features / restrictions		
 HFA (pressurized water, emulsions) 	Emulsion, oil solved in water (water content > 80%) max. temp. range approx. 60°C	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 5060% (danger of cavitation) Min. oil content > 4%		
		 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 		
HFC	Glycol / water solution (water content < 35%) max. temp. range approx. 60°C	 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 		
 HFD HFDR phosphoric ester HFDS chlorinated hydrocarbon HFDT blend of HFDR and HFDS HFDU other composition 	Fluids without water content, similar qualities like mineral oil	 No restrictions with regard to the operation behavior, but it Requires seals out of FPM (FKM) (see also section "Seals") 		



Special fluids

Pressure fluid	Characteristics	Unusual features / restrictions
 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") No compact hydraulic power packs type HC, MP, FP, HK

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 VG68 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.

Due to manufacturer-related differences, the following benchmark figures are to be clarified and compared with the permissible viscosity ranges:

- Viscosity at 40°C
- Viscosity at the lowest (estimated or demanded) temperature
- Viscosity at the highest (estimated or demanded) temperature (to ensure sufficient service life of the seals not above 80°C!)

Temperature / viscosity curve



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):

Recommended purity of the pressure fluid		Recommended	Devices		
ISO 4406:1999	NAS 1638	SAE T 490	filter fineness		
21/18/1519/17/13	12 8	≥6	β ₁₆₂₅ ≥ 75	Radial piston and gear pumps, valves, cylinders (use in general mechanical engineering)	The purity degree of the pressure fluid is especially important for the repeatability accuracy with proportional valves. It should be noted that new pressure fluid "from the barrel" does not necessarily
20/17/1418/15/12	11 6	5 3	$\beta_{6\dots 16} \geq 75$	Prop. pressure and flow control valves	fulfil the highest cleanliness requirements.

Lower limits must be applied for pressure above 250 bar

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. Besides the properties of the pressure fluid itself (e.g. due to additives for high shear stability), the design of the hydraulic control system (e.g. tank size, steady-state temperature, number and type of throttling points) has a major influence on this.

The following points are to be noted:

 Service temperature in the tank < 80°C (mineral oils, pressure fluids with low water content) Avoid higher temperatures – Service life reduction – (+10K corresponds to half service life)

Circulation ratio of the pressure fluid
$$\frac{Q_{pump}[lpm]}{V_{circuit}[l]}$$
 (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!

Change of the pressure fluid

Mixing different kinds of pressure fluid sometimes can cause unintended chemical reactions such as sludging, gumming etc.

Therefore the relevant manufacturers should be consulted when switching between different pressure fluids.

In all cases, the whole hydraulic system must be rinsed thoroughly.

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 follow- ing materials as standard:

• NBR (acrylonitrile rubber, e.g. Bunan, Perbunan) or HNBR (hydrated NBR).

Some devices are available on request with seals made of:

- FPM FPM (also FKM, fluor rubber) e.g. for fluids type HFD
- The coding ...-PYD should be added to the coding for HAWE devices, e.g. WN1H-G24-PYD
- EPDM (ethylen propylen rubber) or SBR (styrene-butadiene rubber)
 - The coding ...-AT should be added to the coding for HAWE devices, e.g. WN1H-G24-AT (for brake fluid)



Storage of hydraulic components

The storage conditions for hydraulic components depend primarily on the seals used and the test bench oil with which the parts are moistened. The storability of rubber materials is generally influenced by the following factors:

Warmth, light, humidity, oxygen, ozone

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:

Ozone-producing equipment (electric motors, high-voltage equipment) among other things must not be present in the storage room. If seals are packaged in plastic bags, these should not contain any plasticisers and, if necessary, should be impermeable to UV light. Details on storage of elastomers are also available in the following standards: DIN 7716/BS3F68:1977, MIL-HDBK-695C, MIL-STD- 1523A, DIN 9088.

Hydraulic oils can be stored for an unlimited period in sealed containers supplied by the manufacturer, as no chemical reactions take place. The presence of atmospheric oxygen, dust and moisture can lead to more or less rapid oxidation and resinification, depending on the type of oil and its additives.

A dark room with virtually constant temperature and humidity is recommended for storage of hydraulic components. The parts should be kept in a plastic bag to protect them from dust and continuous air exchange. In addition, a functional test (emergency manual override, dry switching) should be carried out on the device at least once a year to ensure operation when required.

With safety-related components, a six-monthly functional test on site and a regular factory inspection including seal replacement every 2 years are recommended.

The risk of corrosion of hydraulic components that are stored as described above is low, as most external parts are coated with a protective layer (galvanised, gas-nitrated) and moistened with oil.

6 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 via our sales offices, representatives or directly from HAWE in Germany.

Devices intended for the following applications:

- Hydraulics for clamping
- Press control systems
- Industrial trucks
- Mobile hydraulics
- Systems for potentially explosive atmospheres, ATEX-compliant
- Use with HFA, emulsions or press 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)
- (TÜV, GL, automotive industig
 (TÜV, GL, automotive sector)

Devices for clamping at machine toll, jigs etc.

Nomenclature	Q _{max} [lpm]	p _{max} [bar]	Pamphlet	Page
Compact hydraulic power packs type NPC	1.36	750	D 7940	<u>12</u>
Compact hydraulic power packs type HC, HCW and HCG	12.9	700	D 7900, D 7900 G	<u>14</u>
Pumps complete with motor and hydraulic power packs type MP and \ensuremath{MPN}	14.8/108	700/150	D 7200, D 7200 H, D 7207	<u>22</u>
Compact hydraulic power packs type HK, HKF and HKL	12.9/16	700/150	D 7600-4, D 7600-3, D 7600-3L, D 7600-2	<u>26</u>
Compact hydraulic power packs type KA and KAW	6.2/10.3	700/150	D 8010	<u>18</u>
Connection blocks some with return or pressurized filter type A, B and C, (for hydraulic power packs type HC, MP, MPN, FP, HK, KA)	18	700	D 6905 A/1, D 6905 B, D 6905 C, D 6905 TÜV	<u>32</u>
Two stage connection block type NA		700/120	D 6905 A/1	<u>32</u>
Solenoid actuated directional spool valve type SW, SWR, SWS, SWP and NSWP	25	315	D 7450, D 7451, D 7451 N, D 7951	<u>88</u>
Directional seated valves with different actuations type G, WG, H, P, K, T, F and D	120	700	D 7300	<u>124</u>
Directional seated valves with different actuations type of NG, NWG, NH, NP, NK, NT, NF and ND (connection hole pattern NG 6)	12	500	D 7300 N	<u>124</u>
Directional seated valve banks type VB	120	700	D 7302	<u>130</u>
Directional seated valves type WH and WN	60	450	D 7470 A/1	<u>136</u>
Valve banks type BWH and BWN	60	450	D 7470 B/1	<u>138</u>
Directional seated valves type VZP	15	450	D 7785 A	<u>144</u>
Valve banks type BVZP	15	450	D 7785 B	<u>146</u>
Valve banks type BA	20	400	D 7788	<u>34</u>
Valve banks type BVH	20	400	D 7788 BV	<u>40</u>
Intermediate plates NG 6, type NZP	20	400	D 7788 Z	<u>34</u>
$2/2\mathchar`-$, $3/2\mathchar`-$ and $4/3\mathchar`-$ way directional seated valves type BVG, BVP, NBVP	50	400	D 7400, D 7765, D 7765 N	<u>156</u>
Directional seated valves type VP	20	400	D 7915	<u>160</u>
4/3- and 3/3-way directional seated valves type VH, VHR, and VHP $$	25	700	D 7647	<u>170</u>
Directly controlled pressure valves type MV, MVS, MVE, MVP, SV, SVC, MVCS, DMV and DMVN, assembly kits type MVF, MVH etc.	160	700	D 7000/1, D 7000 E/1	<u>178</u>
Pressure limiting valve type CMV(Z) and CSV(Z), for mounting in simple tapped holes	60	500	D 7710 MV	182



Nomenclature	Q _{max} [lpm]	p _{max} [bar]	Pamphlet	Page
Pressure limiting valves with unit approval type CMVX, for mounting in simple, tapped holes	28	500	D 7710 TÜV	<u>182</u>
Pressure reducing valves type CDK and CLK, for mounting in simple, tapped holes	15	500	D 7745, D 7745 L	<u>196</u>
Pressure reducing valves with tracked pressure switch type DK	15	400	D 7941	<u>196</u>
Proppressure limiting valves type NPMVP	16	700	D 7485 N	<u>188</u>
Idle circulation valves type CNE, for mounting in simple, tapped holes	30	75	D 7710 NE	<u>204</u>
Switch-off valves type LV	25	350	D 7529	<u>208</u>
Fine throttle type FG	< 1	300	D 7275	232
Slot type throttle type Q, QR, and QV	80	400	D 7730	232
Slot type throttle type CQ, CQR and CQV, for mounting in simple, tapped holes	50	700	D 7713	236
Prop. throttle type PB	20	300	D 7557/1	224
Hydraulic clamps type HSE and HSA		800	D 4711	262
Electro-hydraulic pressure switches type DG		1000	D 5440, D 5440 E/1, D 5440 F	<u>266</u>
Pressure sensor type DT11 and DT2		500	D 5440 T/1, D 5440 T/2	266
Hydraulic miniature accumulators type AC		330	D 7571	<u>268</u>
Hydraulic miniature accumulators type AC			D 7969	268
Fittings type X 84			D 7077	272
Device connectors with LED and clamp diode etc. type MSD, SVS, MSE and MSUD			D 7163	276
Economy circuit type MSD4 P53 and MSD4 P63 for solenoid valves with actuation solenoids type WG 230/115, 50/60 Hz			D 7813	276
Economy circuit type MSE 28026			D 7832	276
Economy circuit type MSD 4 P55 for solenoid valves with actuation solenoids type G 24 V DC			D 7833	276
Mains supply type MNG			D 7835	276
Programmable logical valve control type PLVC			D 7845-2, D 7845-4, D 7845 HMI, D 7845 M	278
CAN node type CAN-IO 14			D 7845 IO	278
Hydraulics for clamping especially for chucks of lathes or other consumers with design related leakage

Nomenclature	Q _{max} [lpm]	p _{max} [bar]	Pamphlet	Page
Compact hydraulic power packs type HK, HKF and HKL	12.9/16	700/150	D 7600-4, D 7600-3, D 7600-3L, D 7600-2	<u>26</u>
Connection blocks some with reflow or pressurized filter type A		700	D 6905 A/1	<u>32</u>
Valve banks type BA	25	500	D 7788	<u>34</u>
Intermediate plates NG 6, type NZP	20	400	D 7788 Z	<u>34</u>
Solenoid actuated directional spool valve type SWP and NSWP	25	315	D 7450, D 7451, D 7451 N	<u>84</u>
Clamping modules type NSMD	25	100	D 7787	<u>116</u>
2/2- , 3/2- and 4/3-way directional seated valves type NBVP	20	400	D 7765 N	<u>156</u>

Press controls (top or bottom acting ram presses, or presses for laboratories, injection molds)

Nomenclature	Q _{max} [lpm]	p _{max} [bar]	Pamphlet	Page
Two stage connection block type NA		700/120	D 6905 A/1	<u>32</u>
Pumps complete with motor and hydraulic power packs type MP, MPW, and MPN	14.8/108	700/150	D 7200, D 7200 H, D 7207	<u>22</u>
Hydraulic pumps type R and RG	91.2	700	D 6010, D 6010 H, D 6010 D, D 6010 DB, D 6010 S	<u>46</u>
InLine variable displacement axial piston pump type V30D and V30E	365	350 (420)	D 7960, D 7960 E	<u>50</u>
Hydraulic pumps type RZ	91.2/135	700/150	D 6910, D 6910 H	<u>62</u>
Airdriven hydraulic pumps type LP	12	1500	D 7280, D 7280 H	<u>68</u>
Hand pumps type H, HD, HE, and DH		600	D 7147/1	<u>74</u>
Directional seated valves with different actuations type G, WG, H, P, K, T, F and D	120	700	D 7300, D 7300 Ex, D 7300 H	<u>124</u>
Directional seated valves with different actuations type of NG, NWG, NH, NP, NK, NT, NF and ND (connection hole pattern NG 6)	12	500	D 7300 N	<u>124</u>
Valve banks type VB	120	700	D 7302	<u>130</u>
Lift monitored seated valves	120	400	D 7300 H	<u>124</u>
Switch units type CR	20/160	500/60	D 7150	<u>164</u>
Directly controlled pressure valves type MV, MVS, MVE, MVP, SV, SVC, MVCS, DMV and DMVN, ssembly kits type MVF, MVH etc., multiple pressure limiting valves	160	700	D 7000/1, D 7000 E/1, D 7000 M, D 7000 TÜV	<u>178</u>
Piloted pressure valve type DV, DVE, and DF	120	420	D 4350	<u>184</u>
Piloted pressure valve with check valve type AL, AE, and AS	120	350	D 6170	<u>184</u>
Prop. pressure limiting valve type PMV	120	700	D 7485/1	<u>188</u>
Prop. pressure valves type PDV	120	350	D 7486	<u>188</u>
Shut-off valve type LV	25	350	D 7529	208
Idle circulation valves type CNE, for mounting in simple, tapped holes	30	450	D 7710 NE	<u>204</u>
Pressure reducing valve with tracked pressure switch type DK	15	400	D 7941	<u>196</u>
Two stage valves type NE	25/180	700/60	D 7161	206
Slot type throttle type CQ, CQR, and CQV, for mounting in simple, tapped holes	50	50	D 7713	<u>236</u>
Blocking valves with pre-release type RHV	200	500	D 3056	248
Check valves and pre-fill valves type F	4000	400	D 6960	254
Electro-hydraulic pressure switches type DG		800	D 5440, D 5440 E/1, D 5440 F	<u>266</u>



Nomenclature	Q _{max} [lpm]	p _{max} [bar]	Pamphlet	Page
Hydraulic miniature accumulators type AC		330	D 7969	<u>268</u>

Devices for industrial trucks and lifting equipment (e.g. stackers, lifting platforms etc.)

Nomenclature	Q _{max} [lpm]	p _{max} [bar]	Pamphlet	Page
Solenoid actuated directional spool valve type SW, SWR, SWP and SWS	25	315	D 7450, D 7451, D 7951	<u>84</u>
Directional spool valves type DL	90	315	D 7260	<u>98</u>
Proportional directional valves type HMPL and HMPV	160	420	D 7700 H	<u>104</u>
2/2-way directional seated valves type EM and EMP	160	450	D 7490/1	<u>152</u>
Lifting/lowering valves type HSV and HZV	120	315	D 7032	<u>162</u>
Lifting modules type HMB, HMC, and HST	90	315	D 7650, Sk 7650 B2, Sk 7650 B33, Sk 7650 HST	<u>166</u>
Lifting modules type HMT, HSN, HMS, HMF, HMR and HSW	90/100	315	Sk 7758 HMT etc.	<u>166</u>
Directly controlled pressure valves type MV, MVS, SV, SVC, MVCS, DMV and DMVN, assembly kits type MVF, MVH etc., multiple pressure limiting valves	160	700	D 7000/1, D 7000 E/1, D 7000 M	<u>178</u>
Pre-loaded check valves type VR	120	300/15	D 7340	<u>186</u>
Load-holding valves type LHK and LHT	250	400	D 7100, D 7918	212
2-way flow control valves (drop-rate braking valves) type SB	400	315	D 6920	222
2-way flow control valves type DSJ	25	315	D 7825	222
Emergency drain valve type BR		400	D 7854	
Line rupture safety valves type LB	160	500	D 6990	256
Prop. amplifiers type EV22K			D 7817, D 7817/1	276
Prop. amplifiers type EV1M			D 7831/1	276
Prop. amplifiers type EV1D			D 7831 D	276
Prop. amplifiers type EV1G			D 7837	276
Programmable logical valve control type PLVC			D 7845-2, D 7845-4, D 7845 HMI, D 7845 M	<u>278</u>
CAN node type CAN-IO 14			D 7845 IO	278

Devices for mobile applications (e.g. crane controls, ship building)

Nomenclature	Q _{max} [lpm]	p _{max} [bar]	Pamphlet	Page
InLine variable displacement axial piston pump type V30D and V30E	365	350/420	D 7960, D 7960 E	<u>50</u>
InLine variable displacement axial piston pump type V60N	240	350/420	D 7960 N	<u>54</u>
Variable displacement axial piston pumps type V40M	65	250/320	D 7961	<u>58</u>
Air driven hydraulic pumps type LP	12	1500	D 7280, D 7280 H	<u>68</u>
Hand pumps type H, HD, HE and DH		600	D 7147/1	<u>74</u>
Individual directional spool valves type SG and SP	100	400	D 5650/1	<u>80</u>
Directional spool valves type DL and DLS	90	315	D 7260	<u>98</u>
Prop. directional spool valves type PSL and PSV (valve bank via directly attached valve sections)	210	420	D 7700-2, D 7700-3, D 7700-5	<u>104</u>
Prop. directional spool valves type PSLF and PSVF (valve bank via manifold mounting valve sections)	500	420	D 7700-F	<u>110</u>
Directly controlled pressure valves type MV, MVS, MVE, MVP, SV, SVC, MVCS, DMV and DMVN, assembly kits type MVF, MVH etc., multiple pressure limiting valves	160	700	D 7000/1, D 7000 E/1, D 7000 M	<u>178</u>

Nomenclature	Q _{max} [lpm]	p _{max} [bar]	Pamphlet	Page
Pre-loaded check valves type VR	120	300/15	D 7340	<u>186</u>
Load-holding valves type LHK	100	400	D 7100	212
Load-holding valves type LHT	250	400	D 7918	212
Load-holding valves type LHDV	80	420	D 7770	212
Flow control valves type SD, SF, SK, SKR and SU	130	300	D 6233	<u>218</u>
2-way flow control valves (drop-rate braking valves) type SB and SQ	400	315	D 6920	222
2-way flow control valves type SJ	15	315	D 7395	222
Flow divider type TQ	200	350	D 7381	<u>228</u>
Flow divider with priority division type TV	60	300	D 7394	228
Pressure sensor type DT		1000	D 5440 T, D 5440 T/1	<u>266</u>
Prop. amplifiers type EV22K			D 7817, D 7817/1	276
Prop. amplifiers type EV1M			D 7831/1	276
Prop. amplifiers type EV1D			D 7831 D	276
Prop. amplifiers type EV1G			D 7837	<u>276</u>
Plugs type MSD, SVS, MSE, MSUD with LED and clamp diode etc.			D 7163	<u>276</u>
Programmable logical valve control type PLVC			D 7845-2, D 7845-4, D 7845 HMI, D 7845 M	<u>278</u>
CAN node type CAN-IO 14			D 7845 IO	<u>278</u>

Devices for explosion hazardous areas (ATEX-conform)

Nomenclature	Q _{max} [lpm]	p _{max} [bar]	Pamphlet	Page
Hydraulic pumps and power packs type R and RG	91.2	700	D 6010, D 6010 H, D 6010 D, D 6010 DB, D 6010 S	<u>46</u>
Hydraulic power packs type Z	135	150	D 6820	<u>46</u>
Dual stage pumps and power packs type RZ	91.2/135	700/150	D 6910, D 6910 H	<u>62</u>
Airdriven hydraulic pumps type LP	12	1500	D 7280, D 7280 H	<u>68</u>
Solenoid actuated directional spool valve type SW, SWR, SWS, SWP and NSWP	25	315	D 7450, D 7451, D 7451 N, D 7951	<u>84</u>
Directional spool valve type HSRL 3	80	400	Sk 7493 RL	<u>94</u>
Prop. directional spool valves type PSL and PSV (valve bank via directly attached valve sections)	210	420	D 7700-2, D 7700-3, D 7700-5	<u>104</u>
Prop. directional spool valves type PSLF and PSVF (valve bank via manifold mounting valve sections)	500	420	D 7700-F	<u>110</u>
Directional seated (size 1) type G and NG	12	700	D 7300, D 7300 N	<u>124</u>
Valve banks type VB, pneumatically actuated	12	700	D 7302	130
2/2- and $3/2-way$ directional seated valves type BVG, BVP and NBVP	20	400	D 7765, D 7765 N	<u>156</u>
2/2-, 3/2-, 4/2-way directional seated valves type VP	20	400	D 7915	<u>160</u>
Lifting/lowering valves type HSV 21(22)	30	315	D 7032	<u>162</u>
Pressure switch type DG 3		700	D 5440	266
Prop. pressure limiting valves type PMV and PMVP	16	700	Sk 7485 863	<u>188</u>
Prop. pressure reducing valves type PDMP	20	320	Sk 7584 350	202

All pure mechanical devices, i.e. also directional valves with hydraulic, pneumatic, or mechanical actuation can be supplied conforming ATEX.



Proportional valves				
Nomenclature	Q _{max} [lpm]	p _{max} [bar]	Pamphlet	Page
Connection blocks type AP	16	700	D 6905 A/1	<u>32</u>
Solenoid actuated directional spool valve type SWS	25	315	D 7951	<u>88</u>
Prop. directional spool valves type PSL and PSV (valve bank via directly attached valve sections)	210	420	D 7700-2, D 7700-3, D 7700-5	<u>104</u>
Prop. directional spool valves type PSLF and PSVF (valve bank via manifold mounting valve sections)	500	420	D 7700-F, D 7700-7F	<u>110</u>
Valve banks type BVZP1FEH	15	450	D 7785 B	<u>146</u>
$2/2\mbox{-way}$ directional seated valve with prop. throttle function type \mbox{EMP}	60	400	D 7490/1, D 7490/1E	<u>152</u>
Prop. pressure limiting valve type PMV	120	700	D 7485/1	<u>188</u>
Prop. pressure valves type PDV	120	350	D 7486	<u>188</u>
Prop. pressure reducing valves type PDM	120	400/350	D 7486, D 7584/1	<u>202</u>
Prop. pressure valves type PDVE	120	350	D 7486	<u>188</u>
Prop. pressure reducing valves type PM and PMZ	< 2	40/19	D 7625	<u>200</u>
Prop. flow control valves type SE and SEH	90	300	D 7557/1	<u>224</u>
Prop. throttle type PB	20	300	D 7557/1	<u>224</u>
Pressure sensor type DT11 and DT2		1000	D 5440 T/1, D 5440 T/2	<u>266</u>
Prop. amplifiers type EV22K			D 7817, D 7817/1	<u>276</u>
Prop. amplifiers type EV1M			D 7831/1	<u>276</u>
Prop. amplifiers type EV1D			D 7831 D	276
Prop. amplifiers type EV1G			D 7837	<u>276</u>
Programmable logical valve control type PLVC			D 7845-2, D 7845-4, D 7845 HMI, D 7845 M	<u>278</u>
CAN node type CAN-IO 14			D 7845 IO	<u>278</u>

Devices for HFA, emulsions and pressurized water

Nomenclature	Q _{max} [lpm]	p _{max} [bar]	Pamphlet	Page
Hydraulic pumps type RHFA, RGHFA	91.2	700	D 6010 ff	<u>46</u>
Directional seated valves with different actuations type G, WG, H, P, K, T, F and D (version for HFA)	120	500	D 7300, D 7300 Ex, D 7300 N	<u>124</u>
Valve banks type VB (version for HFA)	120	500	D 7302	<u>130</u>

Devices for operating pressure of 500 ... 700 bar

Nomenclature	Q _{max} [lpm]	p _{max} [bar]	Pamphlet	Page
Compact hydraulic power packs type NPC	1.36	750	D 7940	<u>12</u>
Compact hydraulic power packs type HC, HCG and HCW	12.9	700	D 7900, D 7900 G	<u>14</u>
Pumps complete with motor and hydraulic power packs type MP, MPW and MPN	14.8/108	700/150	D 7200, D 7200 H, D 7207	<u>22</u>
Pumps complete with motor and hydraulic power packs type HK, HKF and HKL	12.9/16	700/150	D 7600-4, D 7600-3, D 7600-3L, D 7600-2	<u>26</u>
Compact hydraulic power packs type KA and KAW	6.2/10.3	700/150	D 8010	<u>18</u>
Connection blocks some with return or pressurized filter type A, B, C (for hydraulic power packs type HC, MP, FP and HK)			D 6905 A/1, D 6905 B, D 6905 C	<u>32</u>
Two stage connection block type NA		700/120	D 6905 A/1	<u>32</u>

Nomenclature	Q _{max} [lpm]	p _{max} [bar]	Pamphlet	Page
Hydraulic pumps type R and RG	91.2	700	D 6010, D 6010 H, D 6010 D, D 6010 DB, D 6010 S	<u>46</u>
Hydraulic power packs type R with DC-motor	approx. 19	700	D 6010 G	<u>46</u>
Dual stage pumps type RZ	91.2/135	700/150	D 6910, D 6910 H	<u>62</u>
Dual stage pumps type RF (with 2-hole SAE flange suited for direct mounting of an additional pump)	30.4/	700/	D 7410	<u>62</u>
Airdriven hydraulic pumps type LP	12	1500	D 7280, D 7280 H	<u>68</u>
Hand pumps type HE		600	D 7147/1	<u>74</u>
Directional seated valves with different actuations type G, WG, H, P, K, T, F and D	25	700	D 7300, D 7300 Ex	<u>124</u>
Directional seated valves with different actuations type of NG, NWG, NH, NP, NK, NT, NF and ND (connection hole pattern NG 6)	12	500	D 7300 N	<u>124</u>
Directional seated valve banks type VB	25	700	D 7302	<u>130</u>
Switch units type CR	20/160	500/60	D 7150	<u>164</u>
4/3- and 3/3-way directional seated valves type VH, VHR and VHP	25	700	D 7647	<u>170</u>
Single and double acting shut-off valves type DA	150	500	D 1741	<u>172</u>
Single and double acting shut-off valves type MVG, MVE and MVP	8	700	D 3726	<u>178</u>
Directly controlled pressure valves type MV, MVS, MVE, MVP, SV, SVC, MVCS, DMV and DMVN, assembly kits type MVF, MVH etc.	70	700	D 7000/1, D 7000 E/1	<u>178</u>
Pressure limiting valve for manifold mounting type SVP	80	700	D 7722	<u>178</u>
Pressure limiting valve type CMV and CSV, for mounting in simple, tapped holes	60	500	D 7710 MV	<u>182</u>
Pressure limiting valve with unit approval type CMVX, for mounting in simple, tapped holes	28	500	D 7710 TÜV	<u>182</u>
Prop. pressure limiting valve type PMV	120	700	D 7485/1	<u>188</u>
Pressure reducing valve type CDK and CLK, for mounting in simple, tapped holes	15	500	D 7745, D 7745 L	<u>196</u>
Dual stage valve type NE	25/180	700/80	D 7161	<u>206</u>
Idle circulation valves type CNE, for mounting in simple, tapped holes	30	500/450	D 7710 NE	<u>204</u>
Pressure dependent shut-off valves type DSV	60	600	D 3990	<u>210</u>
Pressure dependent shut-off valves type CDSV, for mounting in simple, tapped holes	10	600	D 7876	210
By-pass check valves type BC	60	700	D 6969 B	<u>230</u>
Restrictor check valves and check valves type BE	120	500	D 7555 B	<u>230</u>
Throttle and shut-off valves type AV	100	500	D 4583	<u>238</u>
Shut-off valves type AVT and AVM	80	630	D 7690	<u>238</u>
Throttle and shut-off valves type CAV, for mounting in simple, tapped holes	50	500	D 7711	<u>238</u>
Slot type throttle type CQ, CQR, and CQV, for mounting in simple, tapped holes	50	700	D 7713	<u>236</u>
Check valves type RC	60	700	D 6969 R	<u>242</u>
Check valves inserts type ER and EK	120	500	D 7325	<u>242</u>
Check valves inserts type RK and RB	120	700	D 7445	242
Check valves inserts type RE	120	500	D 7555 R	<u>242</u>
Blocking valves type CRK, CRB, for mounting in simple, tapped holes	80	500	D 7712	<u>244</u>
Check valves with pre-release type RHV	200	500	D 3056	<u>252</u>



Nomenclature	Q _{max} [lpm]	p _{max} [bar]	Pamphlet	Page
Check valves type B	160	500	D 1191	<u>246</u>
Check valve inserts with hydraulic release type RHC and RHCE	200	500	D 7165	248
Check valves type CRH, for mounting in simple, tapped holes	55	500	D 7712	248
Check valves with hydraulic release type HRP	140	700	D 5116	<u>250</u>
Check valves with hydraulic release type RH	160	700	D 6105	<u>252</u>
Twin check valves with release type DRH	140	500	D 6110	<u>252</u>
Line rupture safety valves type LB	160	700	D 6990	<u>256</u>
Shuttle valves type WVH	3	700	D 7016, Sk 7962	<u>258</u>
Hydraulic clamps type HSE and HSA		500	D 4711	262
Electro-hydraulic pressure switches type DG and DG5E		800	D 5440, D 5440 E/1	266
Pressure sensor type DT11 and DT2		1000	D 5440 T/1, D 5440 T/2	266
Hydraulic miniature accumulators type AC		500	D 7571	<u>268</u>

Screw-in valves and installation kits

Nomenclature	Q _{max} [lpm]	p _{max} [bar]	Pamphlet	Page
Solenoid actuated 2/2-way directional seated cartridge valves type EM and EMP	160	450	D 7490/1	<u>152</u>
Solenoid actuated 2/2-, 3/2-way directional seated valve type BVE	60	400	D 7921	<u>156</u>
Miniature pressure limiting and sequence valves type MVE	8	700	D 3726	<u>178</u>
Directly controlled pressure valves type MVE, assembly kits type MV.	160	700	D 7000/1, D 7000 E/1	<u>178</u>
Pressure limiting valve type CMV and CSV, for mounting in simple, tapped holes	60	500	D 7710 MV	<u>182</u>
Pressure limiting valves type CMVX with unit approval, for mounting in simple, tapped holes	28	500	D 7710 TÜV	<u>182</u>
Miniature pressure reducing valves type ADC, AM, ADM and ADME	8	300/100	D 7458	<u>190</u>
Pressure reducing valves type CDK and CLK, for mounting in simple, tapped holes	15	500	D 7745, D 7745 L	<u>196</u>
Prop. pressure reducing valves type PM	< 2	40/19	D 7625	<u>200</u>
Idle circulation valves type CNE, for mounting in simple, tapped holes	30	500/450	D 7710 NE	<u>204</u>
Pressure dependent shut-off valves type CDSV, for mounting in simple, tapped holes	10	600	D 7876	210
Load-holding valves type LHKE and LHTE	120	420	D 7100, D 7918	<u>212</u>
2-way flow control valves (drop-rate braking valves) type SB and SQ $% \left(\mathcal{S}^{2}\right) =\left(\mathcal{S}^{2}\right) \left(\mathcal{S}^{2}\right)$	400	315	D 6920	222
2-way flow control valves type SJ	15	315	D 7395	222
2-way flow control valves type SJ	25	315	D 7825	222
2-way flow control valves type CSJ	10	315	D 7736	222
Screw-in flow valves type BSE, QSE, and MSE	26	315	D 7125	<u>230</u>
Orifice inserts type EB	120	500	D 6465	<u>230</u>
By-pass check valves type BC	60	700	D 6969 B	<u>230</u>
By-pass check valves type BE	120	500	D 7555 B	<u>230</u>
Throttle type FG	< 1	300	D 7275	<u>232</u>
Slot type throttle type Q, QR, and QV	80	400	D 7730	232
Slot type throttle type CQ, CQR, and CQV, for mounting in simple, tapped holes	50	700	D 7713	236

Nomenclature	Q _{max} [lpm]	p _{max} [bar]	Pamphlet	Page
Throttle and shut-off valves type AV.E	100	500	D 4583	<u>238</u>
Throttle and shut-off valves type CAV, for mounting in simple, tapped holes	50	500	D 7711	238
Check valves type RC	60	700	D 6969 R	242
Check valves inserts type ER and EK	120	500	D 7325	242
Check valves inserts type RK and RB	120	700	D 7445	242
Check valves inserts type RE	120	500	D 7555 R	242
Check valves type CRK, CRB, for mounting in simple, tapped holes	80	500	D 7712	244
Screw-in check valves with hydraulic release type RHC and RHCE	200	500	D 7165	248
Check valves with hydraulic release type CRH, for mounting in simple, tapped holes	55	500	D 7712	<u>248</u>
Line rupture safety valves type LB	160	500	D 6990	256
Shuttle valves type WVC and WVH	6	700	D 7016, Sk 7962	<u>258</u>
Hydraulic clamps type HSE		500	D 4711	262
Electro-hydraulic pressure switches type DG		800	D 5440, D 5440 E/1, D 5440 F	<u>266</u>
Pressure sensors type DT11 and DT2		1000	D 5440 T/1, D 5440 T/2	266
Hydraulic miniature accumulators type AC		500	D 7571	<u>268</u>
Hydraulic miniature accumulators type AC		330	D 7969	268

Devices with unit approval (TÜV-CE), specimen approval (German Lloyd), or for automotive industry

Nomenclature	Q _{max} [lpm]	p _{max} [bar]	Pamphlet	Page
Unit approved TÜV-CE marked units acc. to"Pressurized equipment guideline" Pressure limiting valve with unit approval in connection blocks type AX, ASX, AVX, and APX			D 6905 TÜV	<u>32</u>
Pressure limiting valves with unit approval type MV.X	100	450	D 7000 TÜV	<u>178</u>
Pressure limiting valves with unit approval type CMVX, for mounting in simple, tapped holes	28	500	D 7710 TÜV	<u>182</u>

Devices utilized by the automotive industry

		Chapter
BMW	Hydraulic power packs (tank < 40 l)	1.1, 1.2, 1.3, 1.4
	Radial piston pumps	1.2, 1.3
	Seated valves	2.2
MERCEDES-BENZ	Hydraulic power packs for high pressure	1.1, 1.2, 1.3, 1.4, 1.5
	Seated valves (NG 6)	2.2
	Check valves with release (type RH, DRH)	2.5
	Clamps (type HSA, HSE)	3
	Hydraulic power packs < 63 l-tank (type HC, MP, HK) Hydraulic power packs	1.1, 1.2
FIAT	Hydraulic power packs	1.1, 1.2, 1.3, 1.4
	Radial piston pumps	1.2, 1.3
OPEL	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



		Chapter
FORD	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
PEUGEOT, CITROEN	Seated valves	2.2
	Hydraulic power packs	1.1

HAWE Hydraulik is listed with Dun & Bradstreet (D&B) under D-U-N-S [®] (Data Universal Numbering System) number 316724384.

6 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 important condition for this is the definition or specification of relevant consumer variables, such as the loads (load forces, load torques or turning torques), motion functions (travel, speeds, rotational speeds, timing) etc.

The following formulas and tables are intended to serve as guideline only and should help with the planning of your hydraulic system. Other factors that have an influence on the choice of hydraulic systems and components include noise emission values and thermal budget considerations.

The following formulae and tables are non-binding and are intended to make producing the rough design for a hydraulic system easier.

Equipment	Formulas and description				
General information	Basic equations (static, without any loss)				
	$Q = \frac{V}{t}$ $V = A \cdot s$ $F = p \cdot A$ $p = \frac{F}{A}$ $Q = A \cdot v$ $M = \frac{V \cdot p}{2 \pi}$ $v = \frac{s}{t}$	force volum A: Q: v: V: torque s: M:	Force ePressure Area Flow Speed Volume Time Travel (stroke) Torque		
Equipment	Formulas and description			Symbol	
Hydraulic cylinders Single acting 	$\begin{split} &A[mm^{2}] = \frac{\pi}{4} d^{2}[mm] \\ &v\left[\frac{m}{s}\right] = \frac{s[mm]}{1000t[s]} \\ &F_{s}[N] = -0, 1 \cdot p_{B}[bar] \cdot A[mm^{2}] \\ &p_{B}[bar] = \frac{-10F_{S}[N]}{A_{1}[mm^{2}]} \\ &Q_{in}[lpm] = 0.06 \cdot A[mm^{2}] \cdot v\left[\frac{m}{s}\right] \end{split}$	d: A: F₅: pB: v: Qin: s: t:	piston diameter [mm] piston area [mm ²] force [N] operating pressure [bar] Piston speed $\left[\frac{m}{s}\right]$ inflow [lpm] stroke [mm] time [S]	P_{B} V F_{S} F_{S}	
Double acting	Extending Basic equations (balance of forces): $A_{1} = \frac{\pi}{4} d_{1}^{2} \approx 0.78 d_{1}^{2}$ $A_{3} = \frac{\pi}{4} (d_{1}^{2} - d_{1}^{2})$ $p_{1} \cdot A_{1} = p_{3} \cdot A_{3} - F$ $p_{1} = \frac{1}{A_{1}} (p_{3} \cdot A_{3} - F)$ $Q_{zu} = A_{1} \cdot v$ $Q_{ab} = A_{3} \cdot v$	Simpl p ₁ [ba F[N]= p ₃ is t valves Attent	ified: $r] = \frac{p_{3}[bar] \cdot A_{3}[mm^{2}] - 10F[N]}{A_{1}[mm^{2}]}$ $= \frac{-p_{1}[bar] \cdot A_{1}[mm^{2}] + p_{3}[bar] \cdot A_{3}[mm^{2}]}{10}$ the result of back pressure from pipes and s for Q _{out} tion: note possible pressure intensification!	d1A1 Qin Qout	
	Retracting Basic equations (balance of forces): $p_1 \cdot A_1 = p_3 \cdot A_3 + F$ $p_3 = \frac{1}{A_3} (p_1 \cdot A_1 - F)$	Simpl [:] p ₃ [ba	ified: p ₁ [bar]·A ₁ [mm ²]-10F[N] ar]=		

Equipment	Formulas and description	Formulas and description		
	$Q_{zu} = A_3 \cdot v$ $Q_{ab} = A_1 \cdot v$	P ₁ [bar]:A ₁ [mm ²]-P ₃ [bar]:A ₃ [mm ²] F[N]= 10 p ₁ result of back pressure from pipes and valves for Q _{out}	Qout Qin	
	A ₁ : piston area $[mm^2]$ A ₃ : rod side area $[mm^2]$ d ₁ : piston \emptyset $[mm]$ d ₂ : rod \emptyset $[mm]$ F: force $[N]$	Q _{in} : inflow [lpm] Q _{out} : outflow [lpm] p ₁ : pressure, piston side [bar] p ₃ : pressure, rod side [bar] s: stroke, travel [mm]		



Equipment	Formulas and description			Symbol
Hydraulic pumps /	Basic equations:	Δ <i>p</i> = <i>p</i> ₁ - <i>p</i> ₀ ¹⁾	Simplified:	Hydraulic pump
hydraulic motors	Geometric volume per revolution (piston pumps):	V=A·h	V[cm ³]≈ ^{A[mm²]·h[mm]} 1000	Q _{in} p
	Flow:	Q=V∙n	$Q[lpm] \approx \frac{V[cm^3] \cdot n[min^{-1}]}{1000}$	
	Middle torque:	$M = \frac{V \cdot \Delta p}{2\pi}$	<i>M</i> [<i>Nm</i>]≈ $\frac{V[cm^3] \cdot \Delta p[bar]}{62}$	Hydraulic motor
	Power:	$P_{hydr} = \Delta p \cdot Q$	P _{hyd} [kW]≈ <u>Δp[bar]·Q[lpm]</u> 612	P1 P0
	Power consumption (pump):	$P_{mech} = \frac{\Delta p \cdot Q}{\eta_T} = \frac{M \cdot 2 \pi n}{\eta_T}^{2}$	$P_{drive}[kW] \approx \frac{\Delta \rho[bar] \cdot Q[lpm]}{500}$	
	Power rating (motor):	$P_{max} = \Delta p \cdot Q \cdot \eta_T = M \cdot 2 \pi n \cdot \eta_T^{2}$	$P_{\text{out}}[kW] \approx \frac{\Delta p[\text{bar}] \cdot Q[lpm]}{740}$ $\approx \frac{M[Nm] \cdot n[min^{-1}]}{12000}$	
	V: displacement $[cm^3]$ A: effective piston area h: double stroke $[mm]$ n: rev. rating $[rpm]$ M: middle torque $[Nm]$ p: pressure $[bar]$ Δp : effective pressure $[I$ Q: flow $[lpm]$ P _{hydr} : hydraulic performa P _{mech} : mechanical perfor η_T : total efficiency (incolosses)	[mm²] bar] nce [kW] mance [kW] luding volumetric and mechanical	Guideline: A power rating of 1 kW for the drive is necessary to achieve a delivery flow of $Q = 1$ lpm with operating pressure $p = 500$ bar!	

 $^{1)}$ p_o result of back pressure from pipes and valves $^{2)}$ incl. degree of efficiency $\eta_T {\approx}~0.82$

Equipment	Formulas and description		Symbol
Valves Directional valves Pressure valves Metering valves Check valves	Losses of pressure by streaming fluid The pressure loss in hydraulic systems consist ■ Back pressure of valves ■ Back pressure of pipes ■ Back pressure due to geometric shape (elb Pressure losses Δp in the valves that are caus Δp-Q characteristics of the relevant documen design, a performance loss of approx. 20 30 expected.	ts of: bows etc.) sed by the flow of fluid can be found in the tation. For the purposes of an initial rough 0% in the overall control system can generally be	Examples: Directional valve A Pressure limiting valve A Flow control valve A Releasable check valve A B B B B B B B C C C C C C C C C C
Equipment	Formulas and description		Symbol
Orifices (ideally, sharp edged) e.g. orifice inserts type EB; by- pass check valves type BC, BE	Basic equation: $Q \approx \alpha \cdot \frac{\pi}{4} d^2 \cdot \sqrt{\frac{2 \Delta p}{p}}$ Q: flow [lpm] Δp : back pressure between A and B [bar] d: orifice diameter [mm]	Simplified: $Q \approx 0.55d^2[mm] \cdot \sqrt{\Delta p[bar]}$ $d \approx 1.35 \cdot \sqrt{\frac{Q[lpmin]}{\sqrt{\Delta p[bar]}}}$	

Equipment	Formulas and description	Symbol	
	ρ: density (approx. 0.9 g/cm³) α: flow coefficient (approx. 0.78)	$\Delta p \approx \left(\frac{1.82 \cdot Q[lpm]}{d^2[mm]}\right)^2$	
Equipment	Formulas and description		Symbol
Pipes / hoses	The diameter of pipes and/or hoses should be minimized. Basic equations: $\operatorname{Re}=\frac{v \cdot d}{v} \lambda_R = \frac{64}{\operatorname{Re}} \Delta p = \lambda$		
	λR: pipe back pressure coefficientΔp: back pressure [bar]l: pipe length [m]d: pipe diameter [mm] v : cinematic viscosity [mm²/s]Q: flow [lpm]Re: Reynolds No. (< 2300)	Simplified: $Q[l/min] \le 0,108 \cdot d[mm] \cdot v \left[\frac{mm^2}{s}\right]$ $d[mm] \ge \frac{9.2 \cdot Q[lpm]}{v \left[\frac{mm^2}{s}\right]}$ $\frac{\Delta p}{l} \left[\frac{bar}{m}\right] \approx \frac{6,1 \cdot v \left[\frac{mm^2}{s}\right] \cdot Q\left[\frac{l}{min}\right]}{d^4[mm]}$	
Equipment	Formulas and description		Symbol
Back pressure due togeometric shape	Basic equations: $\Delta p = \varsigma \cdot \frac{p}{2} v^2 v = \frac{Q}{A} = \frac{4Q}{\pi d^2}$		
(elbows etc.)	90° elbow	ξ = 0,15	
	straight pipe fitting	$\xi = 0,5$	
	elbow fitting	ξ = 1,0	
	Simplified: $\Delta p[bar]=2,2\cdot\xi \cdot \frac{Q^2[lpm]}{d^4[mm]}$ $\Delta p: \text{ back pressure [bar]}$ $\xi: \text{ back pressure coefficient}$ $v: \text{ cinematic viscosity [mm^2/s]}$ $d: \text{ pipe diameter [mm]}$		
	p: density (approx. 0.9 g/cm ²)		
Equipment	Formulas and description		Symbol
Leakage losses (by concentric (e = 0) and eccentric gaps)	Basic equation: $Q_{L} = \frac{\pi \cdot d \cdot \Delta r^{3}}{12 \cdot v \cdot p} \cdot \frac{\Delta p}{l} (1 \ 1, 5 \cdot \epsilon^{2})$	Simplified: $Q_L = 1848 \cdot \frac{d \cdot \Delta r^3}{V} \cdot \frac{\Delta p}{l} (1 \ 1, 5 \cdot \epsilon^2) \epsilon = \frac{e}{\Delta r}$	
	e: eccentricity [mm] Δr: gap [mm] Δp: Pressure difference [bar] d: diameter [mm] V: cinematic viscosity [mm²/s] l: gap length [mm] ρ: density (approx. 0.9 g/cm³)		



Sym	bol	

Equipment	Formulas and description		Symbol	
Volumetric losses (due to pressure increase)	Basic equation: $\Delta V = \beta_p \cdot V_o \cdot \Delta p$ with $\Delta p = p_2 - p_1$		F=∆p·A	
	<pre>p1: pressure, start [bar] p2: pressure, end [bar] V0: initial volume [l] Δ: θ volume alternation [l] βP: compressibility</pre>	Simplified: $\Delta V=0, 7\cdot 10^{-4} \cdot V_o \cdot \Delta p$ $\left(\text{with } \beta_p \approx 0.7 \cdot 10^{-4} \frac{1}{\text{bar}}\right)$		
Volumetric losses (due to temperature rise)	Basic equation: $\Delta V = \beta_T \cdot V_O \cdot \Delta \vartheta$ mit $\Delta \vartheta = \vartheta_2 - \vartheta_1$			
	ϑ_1 : temperature, start [°C] ϑ_2 : temperature, end [°C] $\Delta \vartheta$: temperature, difference [K] V_0 : initial volume [l] ΔV : volume alternation [l] β_T : expansion coefficient	Simplified: $\Delta V = 0, 7 \cdot 10^{-3} \cdot V_o \cdot \Delta \vartheta$ $\left(\text{mit } \beta_T \approx 0, 7 \cdot 10^{-3} \frac{1}{K} \right)$		
Pressure increase caused by tempera-		$\Delta V = 0, 7 \cdot 10^{-4} \cdot \Delta p = 0, 7 \cdot 10^{-3} \cdot \Delta \vartheta$ i.e. $\Delta \vartheta \approx 1 K \Leftrightarrow \Delta p \approx 10 bar$		
ture rise (without volumetric compensation)	Note: A temperature rise of trapped oil volume will cause a pressure increase! (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 description		Symbol	
Hydraulic accumula- tors Pressure alternations,	Hydraulic accumulators are intended for the supply of pressurized fluid during sudden demands (quick, adiabatic pressure alternations), compensation of leakage losses or to dampen oscillations (slow, isotherm pressure alternations).		\bigcirc	
isotherm (slow) adiabatic (guick)	Basic equations:	p ₁ =1, 1p ₀	\downarrow	
	isotherm (slow)	$\Delta V = V_{1} \left(1 - \frac{p_{1}}{p_{2}} \right)$		
	adiabatic (quick)	$\Delta V = V_{\mathrm{T}} \left(1 - \left(\frac{p_1}{p_2} \right)^{0,71} \right)$		
	 p_o: filling pressure for the gas [bar] p₁: lower operating pressure [bar] p₂: upper operating pressure [bar] V₁: initial volume [l] ΔV: volume alternation [l] 			
Equipment	Formulas and description			
Cavitation	Approx. 9 % (volumetric) air are solved in oil during atmospheric pressure below 0,2 bar. The process of pumps and cylinders as well as at will show increased wear.	at atmospheric pressure. There is the danger of hese situations can occur, accompanied by sudde extreme throttle sections. The hydraulic compone	bubble cavitation n noise, during suction ents where this occurs	

Equipment	Formulas and description		
Thermal level Dissipation power and oil temperature	The hydraulic power losses in a hydraulic system result in a temperature rise of the fluid and the equipment which is partly radiated to the surroundings via the surface of the system. They roughly amount 20 - 30% of the induced performance. The induced and the radiated heat will balance at some point after the warm-up of the system.		
	Basic equations: P _V =0,3·P _{hydr} ϑ _{Ölmax} ≈ϑ _{Umg} +C· <u>P_v</u>		
	Surface with unhindered circulation c \approx 75 Surface with bad circulation c \approx 120 with fan (v \approx 2 m/s) c \approx 40 Oil/water radiator c \approx 5	Simplified: $\vartheta_{\ddot{O}Imax} \approx \vartheta_{Umg} C \cdot \frac{0, 3 \cdot P_{hydr}[kW]}{A[m^2]}$	
	 P_v: performance loss, transformed in heat [kW] P_{hydr}: hydraulic performance [kW] 𝔅 oilmax: max. fluid temperature [°C] 𝔅 amb: ambient temperature [°C] A: surface of the system (tank, pipes etc.) [m²] 		



Conversion table

Nomenclature	Codings	Unit	~	Factor X	Unit
Pressure	р	$1\frac{N}{mm^2}$	~	10	bar
		1 MPa	~	10	bar
		1 kgf 1 cm ²	~	1	bar
		1 psi	~	0.07	bar
Force	F	$1\frac{kg \cdot m}{s^2}$	=	1	Ν
		1 lbf	~	4.45	Ν
Length, travel, stroke	l, s, h	1 in	~	25.4	mm
		1 ft	~	304.8	mm
Torque	Μ	$1\frac{kg \cdot m^2}{s^2}$	=	1	Nm
Performance	Р	1 PS, 1 hp	~	0.74	kW
Area	A	1 ft²	~	92903	mm²
		1 in ²	~	645.16	mm²
Volume	V	1 ft ³	~	28.92	L
		1 in ³	*	1.64 · 10 ⁻²	l
		1 UK gal	~	4.55	L
		1 US gal	~	3.79	L
Temperature	Т, Ә	5 (°F-32)/9	~	1	°C
Mass	m	1 lb	~	0.45	kg
Cinematic viscosity	V	1 cST	=	1	<u>mm²</u> s

Adresses of Offices and Representatives

Germany

Headquarter

HAWE Hydraulik SE Streitfeldstr. 25 D-81673 München PO Box 800805 D-81608 München Tel. +49 89 37 91 00-0 Fax: +49 89 37 91 00-12 69 e-mail: info@hawe.de www.hawe.de

Office Filderstadt

Felix-Wankel-Str. 41 D-70794 Filderstadt Tel. +49 71 1 90 09 5 -0, -20 Fax: +49 711 90 09 5 -23, -50 e-mail: vertrieb-filderstadt@hawe.de

Office Norderstedt

Werkstraße 6 D-22844 Norderstedt Tel. +49 40 53 53 48-0 Fax: +49 40 53 53 48-48 e-mail: vertrieb-norderstedt@hawe.de

Office Kassel

Frankfurter Str. 229 b D-34134 Kassel Tel. +49 56 14 75 97-0 Fax: +49 56 14 75 97-77 e-mail: vertrieb-kassel@hawe.de

Office Hennef

Bonner Str. 12 d D-53773 Hennef Tel. +49 22 42 9223-0 Fax: +49 22 42 92 23-23 e-mail: vertrieb-hennef@hawe.de

Office Freising

Kulturstr. 44 D-81653 Freising Tel. +081 61 86 93 80 Fax: +49 81 61 86 93 88 e-mail: vertrieb-freising@hawe.de



International

For countries not listed: HAWE Hydraulik SE Mr. Werner Windstetter Streitfeldstraße 25 D-81673 München Tel. +49 89 37 91 00-0, -12 81 Fax: +49 89 37 91 00-12 69, -12 49 e-mail: info@hawe.de, w.windstetter@hawe.de www.hawe.de

Egypt

Egyptian Hydraulic Engineering Mr. Sameh Zeyada 22 Saudi Buildings Al - Sawah 11281 Cairo, Egypt Tel. +20 224 5018-90 Fax: +20 224 5018-92 e-mail: s.zeyada@ehehydraulic.com www.ehehydraulic.com

Angola

ZANANCHO HIDRÁULIC de ANGOLA Mr. Filipe Armada Estrada Direita do Zango, Polo Indústrial de Viana / Zona Nova Viana, Angola Tel. +244 222 200 26 54 Fax: +244 222 012 059 e-mail: geral@zananchohidraulico.com www.zanancho.pt

Argentina

FLUTECNO, S.R.L. Mr. Juan Emina Avda. Belgrano, 615, 1º Of. G, C1092AAG Buenos Aires Argentina Tel. +54 11 43435168 Fax: +54 11 43421083 e-mail: ventas@flutecno.com.ar www.flutecno.com.ar

Australia

Hawe Hydraulics Australia PTY Ltd Mr. Herbert Hirning 5/ 83-85 Montague Street North Wollongong NSW 2500 P0 Box 618 Fairymeadow 2520 Tel. +61 242 257 222 Fax: +61 242 297 622 e-mail: hhirning@hawe.com.au

Belgium

Doedijns Hydraulics N.V. België Mr. Jelle Beuker Langveld Park 10, P. Basteleusstraat 2 B-1600 Sint-Pieters-Leeuw Tel. +32 23 617 401 Fax: +32 23 617 405 e-mail: jelle.beuker@doedijns.com www.doedijns.com

Bosnia-Herzigowina

see HAWE Hidravlika d.o.o. / Slowenien / Slovenia

Brazil

HIDRACOMP, LTDA Mr. Lélio Ferrari Rua Dr.Edgard Magalhaes Noronha, 704 BR-03480-000 Vila Nova York, Sao Paulo Tel. +55 11 6721-1113 Fax: +55 11 6721-9302 e-mail: hidracomp@hidracomp.com.br www.hidracomp.com.br

Bulgaria

Eurofluid Hydraulik Bulgaria OOD Mr. Alexander Erschov Vojeli Str. 3 BG-6100 Kazanlak Tel. +359 431 634 77, +359 431 621 73 Fax: +359 431 644 74 e-mail: eu-fluid@spnetkz.com

Bolivia

see FLUTECNO, S.R.L. / Argentinien / Argentina

Chile GUPO MARCO SpA. Mr. Rodolfo Cerda Los Gobelinos 2584, Renca, Santiago Chile Tel. +56 2 782 4400 Fax: +56 646 4623 e-mail: rcerda@marco.cl www.marco.cl

China

HAWE Oil-Hydraulic Technology (Shanghai) Co., Ltd. Ms. Wang Xiaodan 155 Jindian Road 201206 PuDong / Shanghai, P.R. China Tel. +86 21 589 996 78 Fax: +86 21 505 508 36 e-mail: info@hawe.com.cn www.hawe.de

HAWE Beijing Representive Office

Mrs. Yan Lu Unit 1908 Landmark Tower 1, 8 North Dong San Huan Road Beijing 100004, P.R. China Tel. +86 10 65 90 71 73 Fax: +86 10 65 90 64 17 e-mail: info@hawe.com.cn www.hawe.de

Denmark

Fritz Schur Teknik AS Mr. Jørgensen Sydmarken 46 DK-2860 Søborg Tel. +45 70 20 1616 Fax: +45 70 20 1615 e-mail: mail@fst.dk www.fst.dk

Ecuador

Marco Ecuador Mr. Jorge Sánchez Av. Juan Tanca Marengo Km 0.5, No. 305 Guayaquil Tel. +59 3 4229 2763 e-mail jsanchez@marco.com.ec www.marco.com.ec

Finland

HAWE Finland Oy Mr. Mikko Vainio Kellonsoittajantie 2 FIN-02770 Espoo Tel. +358 10 82126-00 Fax: +358 10 82126-10 e-mail: info.finland@hawe.fi www.hawe.fi

France

HAWE-Otelec S.A.S. Mr. Jean-Marc Appéré 13, rue des Pyrénées, ZAC du Bois Chaland, CE 5611 Lisses F-91056 Evry Cedex Tel. +33 169 471 010 Fax: +33 160 792 048 e-mail: hawe-otelec@hawe-otelec.fr

French Guyana

see FLUTECNO, S.R.L. / Argentinien / Argentina

Greece

G. & J. Pangakis SA Mr. Iannis Pangakis 63-65 Akominatou Str. GR-10438 Athen Tel. +30 188 107 50 Fax: +30 188 186 59 e-mail: info@pangakis.gr

Great Britain

Koppen & Lethem Ltd. Mr. Allan Woodhead 3 Glenholm Park, Northern Rd. Industrial Estate, Newark GB-Nottinghamshire NG24 2EG Tel. +44 163 667 679 4 Fax: +44 163 667 105 5 e-mail: sales@koppen-lethem.co.uk www.koppen-lethem.co.uk

Guyana

see FLUTECNO, S.R.L. / Argentinien / Argentina

Hong Kong

Melchers (H.K.) Ltd., Industrial Materials Dept. Mr. Benjamin Becker 1210 Shun Tak Centre West Tower, 168-200 Connaught Road Central, Hong Kong Tel. +85 22 58 91 54-4 Fax: +85 22 55 96 55-2 e-mail: bbecker@melchers.com.hk

HYDRAULIK

India

HAWE Hydraulics Pvt. Ltd. Mr. Lokesh Bopanna No. 68, Industrial Suburb 2nd Stage, Yeshwanthpur Bangalore 560 022, India Tel. +91 80 419 520 00 Fax: +91 80 419 520 01 e-mail: contactus@haweindia.com

Indonesia

see

Flo-Line Hydraulics Pte Ltd. / Singapore / Singapore

Israel

LYA Hydraulics & Pneumatics Ltd. Mr. Yossi Shapira 9 Lev Pesach St. North Industrial Zone IL-71293 Lod, Israel Tel. +97 27 32 57 00 00 Fax: +97 27 32 57 00 99 e-mail: yossi@lya.co.il www.lya.co.il

Italy

HAWE-Italiana S.r.l. Mr. Udo Wolter Via C. Cantù, 8 I-20092 Cinisello Balsamo (Milano) Tel. +39 02 399 75-100 Fax: +39 02 399 75-101 e-mail: info@haweit.com

Japan

HAWE Japan Ltd. Mr. Takao Yasuda 2-2, Yoshimoto-cho, Nakagawa-ku J-Nagoya, Aichi, 454-0825, Japan Tel. +81 52 365-1655 Fax: +81 52 365-1656 e-mail: info@hawe.co.jp www.hawe.de

Canada

HAWE North America, Inc. Mrs. Dani Boon 9009-K Perimeter Woods Drive Charlotte, NC 28216 Tel. +1 (704) 509-1599 Fax: +1 (704) 509-6302 e-mail: sales@hawehydraulics.com www.hawehydraulics.com Colombia MASTERFLU International S.A.C. Ms. Diana Gomez Av. Sáenz Pena 1439, Callao 1 Peru Tel: +57 4 311 2682 Fax: +57 4 366 5005 e-mail: d.gomez@masterflu.co www.masterflu.co

Korea

HAWE Korea Co., Ltd. Mr. WonSam Cho 27, 1-gil, 4-sandan, Seobuk-gu, Cheon-an, Chungnam 331-814, South Korea Tel. +82 41 585-3800 Fax: +82 41 585-3801 e-mail: info@hawe.kr www.hawe.kr

Croatia

see HAWE Hidravlika d.o.o. / Slowenien / Slovenia

Malaysia

Hydra-Line Hydraulics SDN. BHD. Mr. Andy H. S. Khoo Lot 56, Jalan Tago 2, Taman Perindustrian Tago, Sri Damansara 52200 Kuala Lumpur, Malaysia Tel. +60 363 710 00 Fax: +60 362 751 000 e-mail: info@hydra-line.com www.hydra-line.com

Macedonia

see HAWE Hidravlika d.o.o. / Slowenien / Slovenia

Mexico

see HAWE North America, Inc. / USA / USA

Netherlands

Doedijns Hydraulics B.V. Mr. Jelle Beuker P.O.Box 179 NL-2740 AD Waddinxveen Tel. +31 182 302 888 Fax: +31 182 302 777 e-mail: jelle.beuker@doedijns.com www.doedijns.com

Norway

PMC Servi AS Mr. Børre Kleven Haugenveien 10, P.O. Box 3230 N-1402 Ski Tel. +47 64 979 797 Fax: +47 64 979 899 e-mail: post@pmcservi.no www.pmcservi.no

Austria

HAWE Österreich GmbH Mr. Andreas Schöller Keltenstraße 5 A-3100 St. Pölten Tel. +43 274 224 577 Fax: +43 274 224 588 e-mail: office@hawe.at www.hawe.at

Paraguay

see FLUTECNO, S.R.L. / Argentinien / Argentina

Peru

Marco Peruana S.A. Mr. Helmut Castro Aquino Av. Sáenz Pena 1439, Callao 1 Peru Tel: +51 1 201 3800 Fax: +51 146 594 97 e-mail: hcastro@marco.com.pe www.marco.com.pe

Poland

Rockfin Distribution & Logistics Sp. z.o.o. Mrs. Beata Block, Mr. Marcin Liss Nowy Tuchom 10 PL-80-209 Chwaszczyno Tel. +48 58 671 51 61 Fax: +48 58 671 51 64 e-mail: handlowy@rockfin.com.pl www.rockfin.dl.pl

Portugal

ZANANCHO-HIDRÁULICO Lda. Mr. Jorge Valente Estrada Mata da Torre, 352 A-B-C Edificio Valente-Tires PT-2785-291 São Domingos Rana, Lisboa Tel. +35 121 444 037 4 Fax: +35 121 444 326 5 e-mail: jorge.valente@zanancho.pt www.zanancho.pt

Romania

FLUPEC S.R.L. Engineering & Trading Mr. Daniel Vasile, Mr. Adrian Mihu Str. Zidului Nr. 3 RO-550324 Sibiu Tel. +40 269 206 138 Fax: +40 269 210 700 e-mail: office@flupec.ro www.flupec.ro

Russia

InterPromTechnika Mr. Artur Ivanov Ulitsa Savushkina 83/3 197374 St. Petersburg Tel. +7 812 318 02 92 Fax: +7 812 318 02 92 e-mail: info@interpromtechnika.ru www.interpromtechnika.ru

Saudi Arabia

Dalil Al Souk Est. Mr. Eng. Omar S. Alessa P.O. Box 5874 Riyadh 11432 Saudi Arabia Tel. +96 61 44 64 14-5 Fax: +96 61 44 64 18-9 e-mail: o.alessa@dalilalsouk.com www.dalilalsouk.com

Sweden

PMC Hydraulics AB Mr. Mikael Brunell Askims Verkstadsväg 15 Box 1013, S-436 21 Askim Tel. +46 31 289 840 Fax: +46 31 286 401 e-mail: info@pmchydraulics.se www.pmchydraulics.se



Switzerland HAWE-HYDRATEC AG Mr. Carlo Fornasier, Mr. Kurt Hess Langackerstrasse 35 CH-6330 Cham Tel. +41 417 474 000 Fax: +41 417 474 010 e-mail: info@hawe-hydratec.ch www.hawe-hydratec.ch

Serbia / Montenegro

see HAWE Hidravlika d.o.o. / Slowenien / Slovenia

Singapore

HAWE Hydraulik Singapore Pte. Ltd. Mr. Chee Hoong Chan 25 International Business Park, #01-59/60, German Centre Singapore 609916, Singapore Tel. +65 656 283 61 Fax: +65 656 283 60 e-mail: chan.ch@hawe.com.sg www.hawe.de

Slovakia Republic

Eurofluid Hydraulik SR s.r.o. Mr. Andrej Galád Racianska 71 (Areal VUZ) SK-852 02 Bratislava 02 Tel. +42 12 49 10 22 66 Fax: +42 12 44 25 90 82 e-mail: eurofluid@eurofluid.sk www.eurofluid.sk

Slovenia

HAWE Hidravlika d.o.o. Mr. Kristian Les Petrovče 225 SI-3301 Petrovče Tel. +386 371 348 80 Fax: +386 371 348 88 e-mail: office@hawe.si www.hawe.de Spain HAWE Hidráulica, S.L.U. Mr. Antonio Polo Polig. Ind. Almeda, c/. del Progrés, 139-141 E-08940 Cornella de Llobregat, Barcelona, Spain Tel. +34 934 751 370 Fax: +34 934 751 371 e-mail: hawe.hidraulica@hawe.es www.hawe.de

Suriname

see FLUTECNO, S.R.L. / Argentinien / Argentina

South Africa

WALCH Engineering Co. (PTY) Ltd. Mr. Gerhard Walch 6, Field Road, Lilianton, Boksburg North SA-Witfield 1467, TVL Tel. +27 118 261 411 Fax: +27 118 266 129 e-mail: walch@mweb.co.za

Taiwan

S.G.D. Engineering Co., LTD Mr. Wan-Chin Yin, Mr. K. P. Chen 9F No. 1 - 27 Kuoh Jiann Rd., Chyan Jenn Dist. Kaohsiung City 806, Taiwan R.O.C. Tel. +886 781 593 55 Fax: +886 781 593 77 e-mail: kpchen@sgdeng.com.tw www.sgdeng.com.tw

Thailand

Aerofluid Co. Ltd. Mr. Kritsda 169/4 - 169/5 Moo 1, Rangsit-Nakhonnayok rd., Lampakkud Thanyaburi 12110 Patumthanee, Thailand Tel. +66 257 729 99 Fax: +66 257 727 00 e-mail: kritsda@aerofluid.com www.aerofluid.com

Czech Republic

Eurofluid-Hydraulik CR, s.r.o. Mr. Martin Hvézda Chrášťany 9 CZ-270 01 Knezeves u Rakovníka Tel. +42 031 358 262 0, +42 031 353 101 6, +42 031 358 261 5, +42 031 353 101 7 Fax: +42 031 358 261 6 e-mail: info@eurofluid.cz www.eurofluid.cz

Turkey

Servo Hidrolik Pnömatik A.S. Mr. Servet Akgün AKÇABURGAZ MAHALLESİ, HADIMKÖY YOLU NO. 166 TR-34500 ESENYURT/İSTANBUL Tel. +90 212 886 959 1 Fax: +90 212 886 959 2 e-mail: servo@servohidrolik.com.tr www.servohidrolik.com.tr

Ukraine

Izumrud Ltd. Mr. Valentyn V. Soldatkin Dekabristov Str. 7 UK-02121 Kiev, Ukraine Tel. +38 044 560-3367 Fax: +38 044 563-6160 e-mail: vvs@cyfra.net www.gidravlika.kiev.ua

Hungary

Jankovits Hidraulika Kft. Mr. István Jankovits Juharfa u. 20 HU-9027 Györ Ipari Park Tel. +36 965 120 60 Fax: +36 96 4 195 37 e-mail: info@jankovitshidraulika.hu

Uruguay

see FLUTECNO, S.R.L. / Argentinien / Argentina

USA

HAWE North America Inc. Mrs. Dani Boon 9009-K Perimeter Woods Drive Charlotte, NC 28216 Tel. +1 704 509-1599 Fax: +1 704 509-6302 e-mail: sales@hawehydraulics.com www.hawehydraulics.com

Venezuela

see FLUTECNO, S.R.L. / Argentinien / Argentina

Vietnam

Provina Technology Ltd. Mr. Dac-Vong Do 148 Bis Nam Ky Khoi Nghia, District 1 Ho Chi Minh City, Vietnam Tel. +84 8 829 890 1 Fax: +84 8 829 548 6 e-mail: wang_xd@hawe.com.cn



6 Pamphlet index

Pamphlet	Туре	Page	Pa
D 1191	В	246	D
D 1741	DA, EA	<u>172</u>	D
D 2055/1	PH, PHF, PHS, PHG		D
D 3056	RHV	<u>252</u>	D
D 3726	MVG, MVP, MVE	<u>178</u>	D
D 3990	DSV, DSVP	210	D
D 4350	DF, DV, DVE, PG, PV	<u>184</u>	D
D 4416	Ν	<u>254</u>	D
D 4583	AV	<u>238</u>	D
D 4711	HSA, HSE	<u>262</u>	D
D 5116	HRP	250	D
D 5440	DG	266	D
D 5440 E/1	DG 5E	266	D
D 5440 F	DG 6	266	D
D 5440 T/2	DT 11	266	D
D 5440 T/1	DT 2	266	D
D 5579	VDM, VDX	<u>192</u>	D
D 5600	PE, MPE		D
D 5650/1	SG, SP	<u>80</u>	D
D 5700	SKS, SKV, SKG		D
D 5700	SM (indiv. part)		D
D 5700 AM	SKS, SKV		D
D 5700 H	SKS, SKV		D
D 5700 K	SKS, SKV		D
D 5870	Actuations: RE, RD, BE, BD	<u>80</u>	D
D 6010	R	<u>46</u>	D
D 6010 D	R	<u>46</u>	D
D 6010 DB	R	<u>46</u>	D
D 6010 G	R (DC-Version)	<u>46</u>	D
D 6010 H	R	<u>46</u>	D
D 6010 S	R	<u>46</u>	D
D 6105	RH	<u>252</u>	D
D 6110	DRH	<u>252</u>	D
D 6170	AE, AL, AS, ASE, ALZ	<u>208</u>	D
D 6233	SF, SD, SK, SKR, SU	<u>218</u>	D
D 6250	Actuations: NE, NU, ND, NM, KD, KM	<u>80</u>	D
D 6460	NV		_
D 6465	EB	<u>230</u>	D
D 6511/1	Actuations: A., C.,Y., V., S., U., D., K., R., W., X., P., BX., ZX, OX, TX.	<u>80</u>	D D
			D

Pamphlet	Туре	Page
D 6560	ES (indiv. part)	
D 6560 WSR	WSR	
D 6600	FB, KFB	
D 6820	Z	<u>46</u>
D 6905 A/1	Connection blocks: A, NA	<u>32</u>
D 6905 B	Connection blocks: B	<u>32</u>
D 6905 C	Connection blocks: C.	<u>32</u>
D 6905 TÜV	Connection blocks: AX.	<u>32</u>
D 6910	RZ	<u>62</u>
D 6910 H	RZ	<u>62</u>
D 6920	SB, SQ	222
D 6960	F	<u>254</u>
D 6969 B	BC	<u>230</u>
D 6969 R	RC	242
D 6990	LB	<u>256</u>
D 7000/1	DMV, DMVN, MV., SV.	<u>178</u>
D 7000 E/1	MV.	<u>178</u>
D 7000 M	MV.	<u>178</u>
D 7000 TÜV	MVX	<u>178</u>
D 7016	WV, WVC, WVH	<u>258</u>
D 7032	HSV, HZV	<u>162</u>
D 7055	Actuations: ME, MD, MU	<u>80</u>
D 7065	Х	<u>272</u>
D 7077	X 84	<u>272</u>
D 7100	LHK	<u>212</u>
D 7120	ADM	<u>192</u>
D 7121	BSE, MSE, QSE	
D 7147/1	DH, H, HD, HE	<u>74</u>
D 7150	CR	<u>210</u>
D 7161	NE	<u>206</u>
D 7163	MSD., MSUD., SVS.	<u>276</u>
D 7165	RHC, RHCE	<u>248</u>
D 7184	BMVD, BMVE	
D 7200	MP, MPW	<u>22</u>
D 7200 H	MP, MPW	<u>22</u>
D 7207	MPN, MPNW	<u>22</u>
D 7230	SKH, SKP, SKC; SC, SH (indiv. part)	<u>SKP, SKH</u>
D 7235	HF, HFC, HFE	<u>272</u>
D 7260	DL, L (indiv. part)	<u>98</u>
D 7260 SR	DLS, DLSR	<u>98</u>
D 7275	FG	<u>232</u>



Pamphlet	Туре	Page	Pamphlet	Туре	Page
D 7280	LP	<u>68</u>	D 7625	PM, PMZ	<u>200</u>
D 7280 H	LP	<u>68</u>	D 7647	VH, VHR, VHP	<u>170</u>
D 7300	D., F., G., H., K., P., T., WG. (R,	<u>124</u>	D 7650	НМС, НМВ	<u>166</u>
D 7300 H	S, S, ZS, S9, Z1, ZZ, 4, Z4, 49)	12/	D 7690	AVT, AVM	<u>238</u>
D 7300 N		124	D 7700-2	PSL, PSV; SL (indiv. part)	<u>104</u>
D 7300 N	ND	124	D 7700-3	PSL, PSV; SL (indiv. part)	<u>104</u>
D 7302	VB	<u>130</u>	D 7700-5	PSL, PSV; SL (indiv. part)	<u>104</u>
D 7310	FP, FPX		D 7700-F	PSLF, PSVF; SLF (indiv. part)	<u>110</u>
D 7325	RK, ER	242	D 7700 H	HMPL, HMPV	<u>104</u>
D 7340	VR	186	D 7700-F	PSLF, PSVF; SLF (indiv. part)	<u>110</u>
D 7381	TQ	228	D 7700 CAN	PSL, PSV	<u>104</u>
D 7394	TV	228	D 7710 MV	CMV, CSV	<u>182</u>
D 7395	SJ	222	D 7710 NE	CNE	<u>204</u>
D 7400	BVG, BVP	156	D 7710 TÜV	CMVX	<u>182</u>
D 7410	RF	<u>62</u>	D 7711	CAV	<u>238</u>
D 7445	RK, RB	242	D 7712	CRB, CRK, CRH	<u>244</u>
D 7451	SW	<u>84</u>	D 7713	CQ, CQR, CQV	236
D 7451 P	SWP	<u>84</u>	D 7722	SVP	
D 7451	SW, SWR, SWP	<u>84</u>	D 7730	Q, QR, QV	232
D 7451 N	NSWP	<u>84</u>	D 7736	CSJ	222
D 7451 PA	SWPN		D 7745	CDK	<u>196</u>
D 7458	ADC, ADM, ADME, AM	<u>190</u>	D 7745 L	CLK	<u>196</u>
D 7470 A/1	WN, WH	136	D 7765	BVG, BVP	<u>156</u>
D 7470 B/1	BWN, BWH	138	D 7765 N	NBVP	<u>156</u>
D 7485/1	PMV, PMVP	188	D 7770	LHDV	212
D 7485 N	NPMVP	188	D 7785 A	VZP	<u>144</u>
D 7486	PDV, PDVE, PDM	188	D 7785 B	BVZP	<u>146</u>
D 7490/1	EM, EMP	<u>152</u>	D 7787	NSMD	<u>116</u>
D 7490/1E	EMP 21 DE (DSE)	<u>152</u>	D 7788	ВА	<u>34</u>
D 7493	HSR	<u>94</u>	D 7788 BV	BVH	<u>40</u>
D 7493 E	HSF	<u>94</u>	D 7813	MSD 4P53(63)	276
D 7493 L	HSL	94	D 7817/1	EV 22K2	276
D 7529	LV	208	D 7825	DSJ	222
D 7540	ED, RD, RDF	234	D 7831/1	EV 1M	276
D 7555 B	BE	230	D 7831 D	EV 1D	<u>276</u>
D 7555 R	RE	242	D 7832	MSE	276
D 7557/1	SE, SEH	224	D 7833	MSD.	276
D 7571	AC; CS (indiv. part)	268	D 7835	MNG	276
D 7584/1	PDM, PDMP	202	D 7837	EV 1G	276
D 7600-2	НК	<u>26</u>	D 7844	EJ	276
D 7600-3	НК	<u>26</u>	D 7845-2	PLVC	<u>278</u>
D 7600-3L	HKL	<u>26</u>	D 7845-4	PLVC	<u>278</u>
D 7600-4	HK, HKF	<u>26</u>	D 7845 IO	CAN IO 14	<u>278</u>

Pamphlet	Туре	Page
D 7845 M	PLVC	<u>278</u>
D 7854	BR	
D 7876	CDSV	<u>210</u>
D 7900	HC, HCW	<u>14</u>
D 7900 G	HCG	<u>14</u>
D 7915	VP	<u>160</u>
D 7918	LHT	<u>212</u>
D 7921	BVE	<u>156</u>
D 7940	NPC	<u>12</u>
D 7941	DK	<u>196</u>
D 7951	SWS	<u>88</u>
D 7960	V30D	<u>50</u>
D 7960 E	V30E	<u>50</u>
D 7960 N	V60N	<u>54</u>
D 7961	V40M	<u>58</u>
D 7969	AC	<u>268</u>
D 7969	HPS	<u>270</u>
D 8010	KA, KAW	<u>18</u>
D 8010-4	KA, KAW	<u>18</u>
D 8010 M	KAM	<u>18</u>
Sk 7493 RL	HSRL	<u>94</u>
Sk 7650 B2	НМВ	<u>166</u>
Sk 7650 B33	НМВ	<u>166</u>
Sk 7650 HST	HST	<u>166</u>
Sk 7650-HSW	HSW	<u>166</u>
Sk 7758 HMT	НМТ	<u>166</u>
Sk 7951-J-6/2	SW	<u>84</u>
Sk 8040	PFM	



6 Type index

Туре	Pamphlet	Page
A (connection block)	D 6905 A/1	<u>32</u>
A. (actuation)	D 6511/1	<u>80</u>
AC	D 7571	268
AC	D 7969	268
ADC	D 7458	<u>190</u>
ADM	D 7120	<u>192</u>
ADM	D 7458	<u>190</u>
ADME	D 7458	<u>190</u>
ADS (indiv. part)	D 7450	<u>84</u>
AE	D 6170	184
AF. (connection block)	D 6010 H	<u>46</u>
AL	D 6170	208
AL. (connection block)	D 6905 A/1	<u>32</u>
ALZ	D 6170	208
AM	D 7458	<u>190</u>
AN. (connection block)	D 6905 A/1	<u>32</u>
AP. (connection block)	D 6905 A/1	<u>32</u>
AS	D 6170	<u>184</u>
AS (connection block)	D 6905 A/1	<u>32</u>
ASE	D 6170	184
AV	D 4583	238
AV (connection block)	D 6905 A/1	<u>32</u>
AVM	D 7690	238
AVT	D 7690	238
AX. (connection block)	D 6905 TÜV	<u>32</u>
В	D 1191	246
B. (connection block)	D 6905 B	<u>32</u>
BA	D 7788	<u>34</u>
BC	D 6969 B	230
BE	D 7555 B	<u>230</u>
BE (actuation)	D 5870	<u>80</u>
BF. (connection block)	D 6010 H	<u>46</u>
BMVD	D 7184	
BMVE	D 7184	
BR	D 7854	
BSE 2-18	D 7121	
BVE	D 7921	<u>156</u>
BVG	D 7400	<u>156</u>
BVG	D 7765	<u>156</u>
BVH	D 7788 BV	<u>40</u>
BVP	D 7400	156

Туре	Pamphlet	Page
BVP	D 7765	<u>156</u>
BVZP	D 7785 B	<u>146</u>
BWH	D 7470 B/1	<u>138</u>
BWN	D 7470 B/1	<u>138</u>
BX. (actuation)	D 6511/1	<u>80</u>
C. (connection block)	D 6905 C	<u>32</u>
C. (actuation)	D 6511/1	<u>80</u>
CAN IO	D 7845 IO	<u>278</u>
CAV	D 7711	<u>238</u>
CDK	D 7745	<u>196</u>
CDSV	D 7876	<u>210</u>
CLK	D 7745 L	<u>196</u>
CMV	D 7710 MV	<u>182</u>
CMVX	D 7710 TÜV	<u>182</u>
CNE	D 7710 NE	<u>204</u>
CQ	D 7713	<u>236</u>
CQR	D 7713	<u>236</u>
CQV	D 7713	<u>236</u>
CR	D 7150	<u>164</u>
CRB	D 7712	<u>244</u>
CRH	D 7712	<u>248</u>
CRK	D 7712	<u>244</u>
CSJ	D 7736	222
CSV	D 7710 MV	<u>182</u>
D (actuation)	D 6250	<u>80</u>
D 21	D 7300	<u>124</u>
D 22	D 7300	<u>124</u>
D 3	D 7300	<u>124</u>
D 4	D 7300	<u>124</u>
D. (actuation)	D 6511/1	<u>80</u>
DA	D 1741	<u>172</u>
DF	D 4350	<u>184</u>
DG	D 5440	<u>266</u>
DG 5E	D 5440 E/1	<u>266</u>
DG 6	D 5440 F	<u>266</u>
DH	D 7147/1	<u>74</u>
DK	D 7941	<u>196</u>
DL	D 7260	<u>94</u>
DLS, DLSR	D 7260 SR	<u>94</u>
DMV	D 7000/1	<u>178</u>
DMVN	D 7000/1	<u>178</u>



Туре	Pamphlet	Page
DR	D 7300	<u>124</u>
DRH	D 6110	<u>252</u>
DS	D 7300	<u>124</u>
DSJ	D 7825	222
DSV	D 3990	<u>210</u>
DT 11	D 5440 T/2	<u>266</u>
DT 2	D 5440 T/1	<u>266</u>
DV	D 4350	<u>184</u>
DVE	D 4350	<u>184</u>
DZ	D 7941	<u>146</u>
DZ 3	D 7300	<u>124</u>
DZ 4	D 7300	<u>178</u>
EA	D 1741	<u>172</u>
EB	D 6465	<u>230</u>
ED	D 7540	<u>234</u>
EF. (connection block)	D 6010 H	<u>46</u>
EJ	D 7844	<u>276</u>
EK	D 7325	242
EM	D 7490/1	<u>152</u>
EM	D 7490/1E	<u>152</u>
EMP	D 7490/1	<u>152</u>
ER	D 7325	<u>242</u>
ES (indiv. part)	D 6560	
EV 1	D 7831 D	<u>276</u>
EV 1 G	D 7837	<u>276</u>
EV 1 M	D 7831/1	<u>276</u>
EV 22 K	D 7817/1	<u>276</u>
ex G.	D 7300	<u>124</u>
F	D 6960	<u>254</u>
F 21	D 7300	<u>124</u>
F 22	D 7300	<u>124</u>
F 3	D 7300	<u>124</u>
F 4	D 7300	<u>124</u>
FB	D 6600	
FB	D 6600-01	
FF. (connection block)	D 6010 H	<u>46</u>
FG	D 7275	<u>232</u>
FP	D 7310	
FPX	D 7310	
FR	D 7300	<u>124</u>
FS	D 7300	<u>124</u>
FZ 3	D 7300	<u>124</u>
FZ 4	D 7300	<u>124</u>

Туре	Pamphlet	Page
G 21	D 7300	<u>124</u>
G 22	D 7300	<u>124</u>
G 3	D 7300	<u>124</u>
G 39	D 7300	<u>124</u>
G 4	D 7300	<u>124</u>
G 49	D 7300	<u>124</u>
GR	D 7300	<u>124</u>
GS	D 7300	<u>124</u>
GZ 3	D 7300	<u>124</u>
GZ 4	D 7300	<u>124</u>
Н	D 7147/1	<u>74</u>
H 21	D 7300	<u>124</u>
H 22	D 7300	<u>124</u>
Н 3	D 7300	<u>124</u>
H 4	D 7300	<u>124</u>
HC	D 7900	<u>14</u>
HCG	D 7900 G	<u>14</u>
HCW	D 7900	<u>14</u>
HD	D 7147/1	<u>74</u>
HE	D 7147/1	<u>74</u>
HF	D 7235	<u>272</u>
HFC	D 7235	<u>272</u>
HFE	D 7235	<u>272</u>
НК	D 7600-2	<u>26</u>
НК	D 7600-3	<u>26</u>
НК	D 7600-4	<u>26</u>
HKF	D 7600-4	<u>26</u>
HKL	D 7600-3L	<u>26</u>
HKLW	D 7600-3L	<u>26</u>
НМВ	D 7650	<u>164</u>
НМВ	Sk 7650 B2	<u>164</u>
НМВ	Sk 7650 B33	<u>164</u>
НМС	D 7650	<u>166</u>
HMF	Sk 7758 HMT etc.	<u>166</u>
HMPL	D 7700 H	<u>104</u>
HMR	Sk 7758 HMR	<u>166</u>
HMS	Sk 7758 HMS	<u>166</u>
НМТ	Sk 7758 HMT	<u>166</u>
HPS	D 7969	<u>270</u>
HR	D 7300	<u>124</u>
HRP	D 5116	<u>250</u>
HS	D 7300	<u>124</u>
HSA	D 4711	<u>262</u>

Туре	Pamphlet	Page
HSE	D 4711	262
HSF	D 7493E	<u>88</u>
HSL	D 7493L	<u>88</u>
HSN	Sk 7758 HMT etc.	110
HSR	D 7493	<u>88</u>
HSRL	Sk 7493 RL	<u>88</u>
HST	Sk 7650 HST	<u>110</u>
HSV	D 7032	<u>104</u>
HSW	Sk 7650-HSW2	<u>110</u>
HZ 3	D 7300	124
HZ 4	D 7300	<u>124</u>
HZV	D 7032	<u>104</u>
K 21	D 7300	<u>124</u>
K 22	D 7300	<u>124</u>
К 3	D 7300	124
К 4	D 7300	124
K. (actuation)	D 6511/1	<u>80</u>
KA	D 8010	<u>18</u>
KA	D 8010-4	<u>18</u>
KAW	D 8010	<u>18</u>
KAW	D 8010-4	<u>18</u>
KFB	D 6600	
KFB	D 6600-01	
KM (actuation)	D 6250	<u>80</u>
KR	D 7300	124
KS	D 7300	124
KZ 3	D 7300	124
KZ 4	D 7300	124
L (indiv. part)	D 7260/1	94
LB	D 6990	256
LHDV	D 7770	212
LHK	D 7100	212
LHT	D 7918	212
LP	D 7280	<u>68</u>
LP	D 7280 H	<u>68</u>
LV	D 7529	208
MD (actuation)	D 7055	<u>80</u>
ME (actuation)	D 7055	<u>80</u>
MNG	D 7835	276
MP	D 7200	22
MP	D 7200 H	22
MPE	D 5600	
MPN	D 7207	22

Туре	Pamphlet	Page
MPNW	D 7207	22
MPW	D 7200	22
MPW	D 7200 H	22
MS	D 7163	262
MSD	D 7163	262
MSD	D 7813	262
MSD	D 7833	262
MSE	D 7832	242
MSE 18	D 7121	
MU (actuation)	D 7055	80
MV	D 7000/1	178
MV	D 7000 M	178
MVX	D 7000 TÜV	178
MVA	D 7000 E/1	178
MVB	D 7000 E/1	178
MVCS	D 7000/1	178
MVD	D 7000 E/1	178
MVE	D 3726	178
MVE	D 7000/1	178
MVF	D 7000 E/1	178
MVG	D 3726	178
MVH	D 7000 E/1	178
MVK	D 7000 E/1	178
MVP	D 3726	178
MVP	D 7000/1	178
MVS	D 7000/1	178
MVT	D 7000/1	178
MVU	D 7000 E/1	178
MVZ	D 7000 E/1	178
Ν	D 4416	
NA	D 6905 A/1	<u>32</u>
NBVP	D 7765 N	156
ND	D 7300 N	124
ND (actuation)	D 6250	80
NE	D 7161	206
NE (actuation)	D 6250	<u>80</u>
NF	D 7300 N	124
NG	D 7300 N	124
NH	D 7300 N	124
NK	D 7300 N	124
NM (actuation)	D 6250	<u>80</u>
NP	D 7300 N	124
NPC	D 7940	<u>12</u>



Туре	Pamphlet	Page
NPC	D 7940	<u>18</u>
NPMVP	D 7485 N	<u>188</u>
NS	D 7787	<u>116</u>
NSWP	D 7451 N	<u>84</u>
NT	D 7300 N	<u>124</u>
NU (actuation)	D 6250	<u>80</u>
NV	D 6460	
NWG	D 7300 N	<u>124</u>
OX (actuation)	D 6511/1	<u>80</u>
P 21	D 7300	<u>124</u>
P 22	D 7300	<u>124</u>
Р 3	D 7300	<u>124</u>
Ρ4	D 7300	<u>124</u>
P. (actuation)	D 6511/1	<u>80</u>
РВ	D 7557/1	<u>224</u>
PDM	D 7584/1	<u>202</u>
PDM	D 7486	<u>202</u>
PDMP	D 7584/1	<u>202</u>
PDV	D 7486	<u>188</u>
PDVE	D 7486	<u>188</u>
PE	D 5600	
PFM	Sk 8040	
PG	D 4350	<u>184</u>
PHF	D 2055/1	
PHG	D 2055/1	
PHS	D 2055/1	
PLVC	D 7845-2	<u>278</u>
PLVC	D 7845-41	<u>278</u>
PLVC	D 7845 M	<u>278</u>
PM	D 7625	200
PMV	D 7485/1	<u>188</u>
PMVP	D 7485/1	<u>188</u>
PMVPS	D 7485/1	<u>188</u>
PMVS	D 7485/1	<u>188</u>
PMZ	D 7625	200
PR	D 7300	<u>124</u>
PS	D 7300	<u>124</u>
PSL	D 7700-2	<u>104</u>
PSL	D 7700-3	<u>104</u>
PSL	D 7700-5	<u>104</u>
PSLF	D 7700-F	<u>110</u>
PSLF	D 7700-7F	<u>110</u>
PSV	D 7700-2	<u>104</u>

Туре	Pamphlet	Page
PSV	D 7700-3	<u>104</u>
PSV	D 7700-5	<u>104</u>
PSVF	D 7700-F	<u>110</u>
PSVF	D 7700-7F	<u>110</u>
PV	D 4350	<u>184</u>
PZ 3	D 7300	<u>124</u>
PZ 4	D 7300	<u>124</u>
Q	D 7730	<u>232</u>
QR	D 7730	<u>232</u>
QSE 18	D 7121	
QV	D 7730	232
R	D 6010	<u>46</u>
R	D 6010 H	<u>46</u>
R	D 6010 D	<u>46</u>
R	D 6010 DB	<u>46</u>
R	D 6010 S	<u>46</u>
R. (actuation)	D 6511/1	<u>80</u>
RB	D 7445	242
RC	D 6969 R	242
RD	D 7540	<u>234</u>
RD (actuation)	D 5870	<u>80</u>
RDF	D 7540	<u>234</u>
RE	D 7555 R	242
RE (actuation)	D 5870	<u>80</u>
RF	D 7410	<u>234</u>
RG	D 6010	<u>46</u>
RG	D 6010 H	<u>46</u>
RG	D 6010 D	<u>46</u>
RG	D 6010 DB	<u>46</u>
RG	D 6010 S	<u>46</u>
RH	D 6105	<u>252</u>
RHC	D 7165	<u>248</u>
RHCE	D 7165	<u>248</u>
RHV	D 3056	
RK	D 7445	<u>242</u>
RZ	D 6910	<u>234</u>
RZ	D 6910 H	<u>234</u>
S. (actuation)	D 6511/1	<u>80</u>
SB	D 6920	<u>222</u>
SC. (indiv. part)	D 7230	<u>SKP, SKH</u>
SD	D 6233	<u>218</u>
SE	D 7557/1	224
SEH	D 7557/1	224

Туре	Pamphlet	Page
SF	D 6233	<u>218</u>
SG	D 5650/1	<u>80</u>
SH. (indiv. part)	D 7230	<u>SKP, SKH</u>
SJ	D 7395	222
SK	D 6233	<u>218</u>
SKC	D 7230	<u>SKP, SKH</u>
SKG	D 5700	
SKH	D 7230	<u>SKP, SKH</u>
SKP	D 7230	<u>SKP, SKH</u>
SKR	D 6233	<u>218</u>
SKS	D 5700	
SKS	D 5700 AM	
SKS	D 5700 H	
SKS	D 5700 K	
SKV	D 5700	
SKV	D 5700 AM	
SKV	D 5700 H	
SKV	D 5700 K	
SL (indiv. part)	D 7700-2	<u>110</u>
SL (indiv. part)	D 7700-3	<u>104</u>
SL (indiv. part)	D 7700-5	<u>104</u>
SLF (indiv. part)	D 7700-F	<u>110</u>
SLF (indiv. part)	D 7700-7F	<u>110</u>
SM (indiv. part)	D 5700	
SP	D 5650/1	<u>80</u>
SQ	D 6920	222
SU	D 6233	<u>218</u>
SV	D 7000/1	<u>178</u>
SVC	D 7000/1	<u>178</u>
SVP	D 6330	
SVP	D 6330	
SVS	D 7163	262
SW	D 7451	<u>84</u>
SWC	D 7450	<u>84</u>
SWP	D 7451	<u>84</u>
SWPN	D 7451 PA	
SWR	D 7451	<u>88</u>
SWS	D 7951	<u>88</u>
T 21	D 7300	<u>124</u>
T 22	D 7300	124
Т 3	D 7300	124
Τ4	D 7300	124
TQ	D 7381	228

Туре	Pamphlet	Page
TR	D 7300	<u>124</u>
TS	D 7300	<u>124</u>
TV	D 7394	228
TX. (actuation)	D 6511/1	<u>80</u>
TZ 3	D 7300	<u>124</u>
TZ 4	D 7300	<u>124</u>
U. (connection block)	D 6905 A/1	<u>32</u>
U. (actuation)	D 6511/1	<u>80</u>
V 30	D 7960	<u>50</u>
V 30 E	D 7960 E	<u>50</u>
V 40 M	D 7961	<u>58</u>
V 60 N	D 7960 N	<u>54</u>
V. (actuation)	D 6511/1	<u>80</u>
VB	D 7302	<u>130</u>
VDM	D 5579	144
VDX	D 5579	144
VH	D 7647	170
VHP	D 7647	170
VHR	D 7647	170
VP	D 7915	160
VR	D 7340	186
VZP	D 7785 A	144
W. (actuation)	D 6511/1	80
WG 21	D 7300	124
WG 22	D 7300	124
WG 3	D 7300	124
WG 4	D 7300	124
WGR	D 7300	124
WGS	D 7300	124
WGZ 3	D 7300	124
WGZ 4	D 7300	124
WH	D 7470 A/1	136
WN	D 7470 A/1	136
WSR	D 6560 WSR	A-10
WV	D 7016	258
WVC	D 7016	258
WVH	D 7016	258
X (accessories)	D 7065	272
X 84	D 7077	272
X. (actuation)	D 6511/1	<u>80</u>
Y. (actuation)	D 6511/1	80
Z	D 6820	<u>46</u>
ZX (actuation)	D 6511/1	<u>80</u>



6 Index

(
(CETOP	85

A

accumulatorachieve an	268 268
Air-driven hydraulic pumps	. 68
Assembly kits (overview)	293
ATEX	290
ATEX-conform	290
ATF	281

B

Bottom acting ram presses	288
Brake fluid	283

С

CAN bus nodes		278
Cartridge valves		293
СЕТОР.		125
Check valves	240,	242
Circulation valves		204
Clamping, devices		286
clamping modules		116
Compact hydraulic power packs	10), 10
Compressibility		299
Connection fitting		272
Contamination		284
controllers		. 50
Controls		278
Control spool valves		. 76
Conversion table		301
Counter balance		167

D

Devices for operating pressure up to 700 bar	291
Devices for special applications	286
Devices with unit approval (TÜV-CE), specimen approval (Germa	in
Lloyd), or for automotive industry	294
Differential pressure valves	178
Dual-stage pumps	. 62

Ε

Ecologically compatible pressure fluids	282
economy circuit	276
Electronic accessories	276
Electronic amplifiers	276
Environmentally friendly fluids	283
Explosion hazardous areas	290

F

Filter, connection blocks	. 32
Filter, connection blocks with pressure filter	32
Filter, connection blocks with return filter	. 32
filter fineness	284
Filtration	284
Fire inhibiting pressure fluids	282

Fittings	272
Flow control valves	216
Flow rate regulator	124
Follow-up valves	184
formulae	295
Formulas	295

G

gear pump	14
German Lloyd	294

Н

H, HL, HLP, HVLP type fluids	281
HEES type fluids	282
HEPG type fluids	282
HETG type fluids	282
HFA, HFC, HFD type fluids	282
High-pressure/low-pressure pumps	62
High-pressure pumps 10, 44	, 61
Hydraulic accessories 143, 264,	272
hydraulic accumulators	268
Hydraulic clamps	261
Hydraulic cylinder	. 98
Hydraulic cylinders	261
Hydraulic fluids	281
hydraulic miniature accumulators	268
Hydraulic oil	281
Hydraulic power packs	10
hydraulic systems	295

Ι

Industria	l trucks	289
-----------	----------	-----

L

lifting/lowering valves	162
Lifting equipment	289
Line rupture safety valves	256
Load-holding valves	212
load-sensing principle	104
lowering brake valves	222

Μ

Metering valves	216
Mineral oils	281
Mobile applications	289
motor pump	46

Ν

NG6 (CETOP) standard connection pattern...... 34

0

Oil change	281
Oil recommendations	281
Oil temperature	281

Parallel connection within valve bank	120 76
piston-type accumulator	270
power supply unit	276
Power supply units	276
precision throttle valves	232
pre-fill valves	254
pre-load valves	186
Pressure controller	266
Pressure filter	. 32
Pressure fluids	281
Pressure gauge	272
pressure gauges	272
Pressure loading valves	178
pressure loss	297
pressure sensor	266
Pressure switches	266
Pressure valves	178
Programmable logic valve control	278
Programmable logic valve controls	277
Pure mechanical devices	290

R

radial piston pumps		. 46
Reducing connector		272
Reducing connectors		272
restrictor check valves	230,	234
Return filter		32

S

safeguard pressure gauges, for example	210
Safety valves	178
Screen filter	272
Screen filters	273
Screw-in valves and installation kits	293
seals	284
Seated valves	120
Sequence valves	178
Series connection within valve bank 76, 1	120
Shut-off valves	238
Single connection blocks	32
Spool valves	76
Standard pumps and power packs	45
Switch-off valves	208
Switch units, press control valves	164

Т

The task of pressure-reducing valves	190
Throttles	232
Throttle shut-off valves	238
Type PLVC programmable logic valve control	278

U

Units,	conversion	table	301
--------	------------	-------	-----

V

Valves with TÜV-approval 2	286
variable displacement axial piston pumps	50
Variable displacement pumps	50

Wire	mesh	filter	272
wire	mesh	filters	273





HAWE Hydraulik SE Streitfeldstraße 25 D-81673 München Tel. +49 89 37 91 00-0 Fax +49 89 37 91 00-12 69 info@hawe.de http://www.hawe.de

Solutions for a World under Pressure

