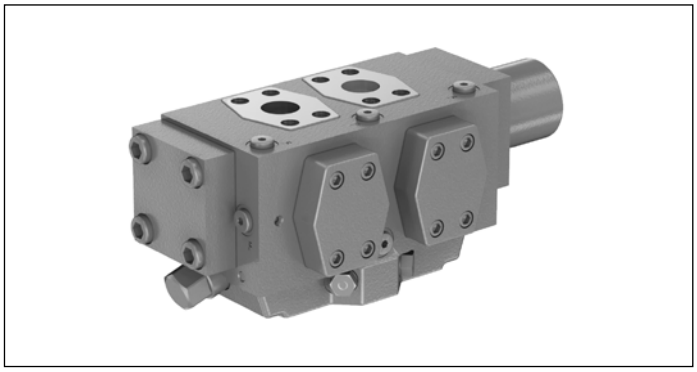
Counterbalance valve
BVD/BVE Series 52

RE 95528
Edition: 05.2016



- Size 32
- Nominal pressure Motor side 450 bar
  Pump side 350 bar
- For winches and track drives in open circuit

Features

- Damping for stable lowering and safe downhill movement
- Simple adaptation to application
- Compact design and direct mounting to axial piston motors A6VM and A6VE
- Available in a set with axial piston motors A6VM and A6VE
- Standard working ports according to SAE J518
- Integrated brake release port, with or without pressure reduction
- Good efficiency through reduced flow losses
- Four working ports (see type code, pos. 04)
- Rotationally symmetric
- Suitable for high flow rates

Contents

Type code

01	02	03	04	05		06	07	08		09	10	11	12	13	14		15
					/	52			–	V	0	1	K00		T03	–	

Valve type

01	Counterbalance valve, double-acting	**BVD**
	Counterbalance valve, one-sided	**BVE**

Size

02	Flow, nominal	$q_{v\,nom}$ 650 l/min	**32**

Control range

			BVD	BVE	
03	Start/end of opening of counterbalance spool (spring value without return flow pressure)	20 to 38 bar	●	●	**W**
		10 to 30 bar	●	–	**V**

Working port

		SAE J518	Hole distance	
04		1 1/4 in	84 mm	**38**
		1 1/4 in	104 mm (bearing 90° offset)[1]	**31**

Ports for brake release

05	With high pressure	**S**
	With reduced high pressure 21^{+4} bar (brake release valve)	**L**[2]

Series

06	Series 5, index 2	**52**

Version of port and fastening threads

07	Metric, port threads with profiled sealing ring according to DIN 3852	**N**

Long spring cover (see page 11)

08	On port side **C**, lift via port **C**	**C**
	On port side **D**, lift via port **D**	**D**

Seal

09	FKM (fluoroelastomer)	**V**

Counterbalance spool

10	Version 33	**33**

Opening characteristics of counterbalance spool

11	Standard	**0**

Residual opening in counterbalance spool

12	Without	**K00**

Damping D1 (channel to counterbalance spool)

13	**BVE**	Throttle pin installed on port side **C**			**C4599**
		Throttle pin installed on port side **D**			**D4599**
	BVD	Throttle pin, comparative diameter	**Inlet**	**Outlet**	
			0.4 mm	2.0 mm	**D4599**
			0.4 mm	0.7 mm	**D4580**

● = Available – = Not available

1) The screws are not included in the scope of delivery. These can be supplied by Bosch Rexroth on request.
2) On request

01	02	03	04	05		06	07	08		09	10	11	12	13	14		15
					/	**52**			**–**	**V**	**0**	**1**	**K00**		**T03**	**–**	

Damping D2 (reservoir outlet)

14	Without	**T00**
	With orifices on port side **C** and **D** ø0.3 mm (D1 max. D45XX)	**T03**
	With orifice installed on port side **C**	**C03**
	With orifice installed on port side **D**	**D03**

Standard / special version

15	Standard version	**0**
	Standard version with installation variant, e.g. ports open or closed, contrary to standard	**Y**
	Special version	**S**

● = Available **–** = Not available

Notice

- ▶ Note the project planning notes on page 13.
- ▶ In addition to the type code, please specify the relevant technical data when placing your order.

Technical data

Hydraulic fluid

The axial piston motor used is decisive for the selection of hydraulic fluid. For further information, please refer to our data sheets during project planning.
Note: At no point of the component may the temperature be higher than 115 °C.

Working pressure range

Pressure at working port C/D (on the pump side) or C´/D´ (on the motor side)		Definition
Nominal pressure p_{nom}	On the pump side: 350 bar On the motor side: 450 bar	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	On the pump side: 400 bar[1)] On the motor side: 500 bar	Restrictions: ▶ maximum acceleration $7g$ ▶ maximum 1 million load changes

Determination of cracking pressure p_1 (values without return flow)
The throttle chain from D_1 and D_2 is used to damp the opening and closing speeds of the counterbalance spool. The actual pump pressure is reduced by the throttle chain from D_1 and D_2 and controls the counterbalance spool.

▼ **Circuit diagram BVD**

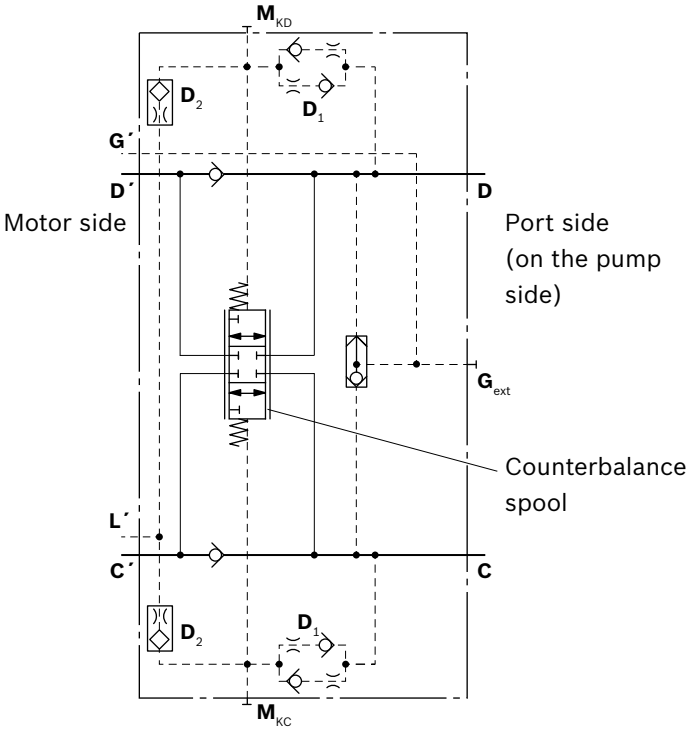


Table of values

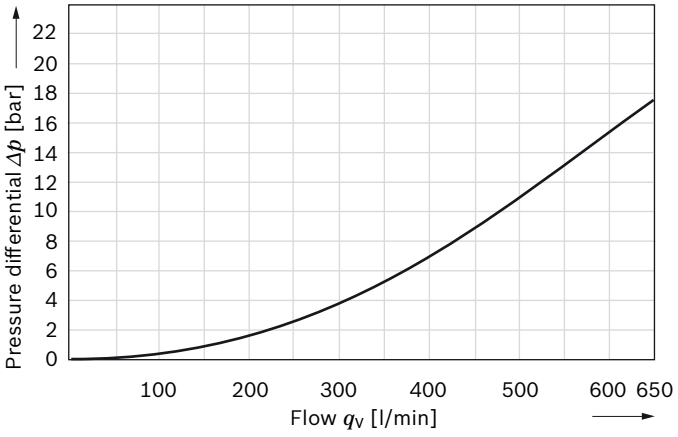
Valve type					BVD...W	BVD...V	BVE...W
Nominal pressure		p	bar	On the pump side	350	350	350
				motor side	450	450	450
Flow, nominal		$q_{v\,max}$	l/min		650	650	650
Start of opening of counterbalance spool at port M_K		$\Delta p_{K\,B}$	bar		20	10	20
End of opening of counterbalance spool at port M_K		$\Delta p_{K\,E}$	bar		38	30	38
Pressure reducing valve for brake release (fixed setting)	Maximum control pressure	p	bar	BVE...L/	21^{+4}	21^{+4}	21^{+4}
	Beginning of control	p	bar	BVE...L/	10^{+4}	10^{+4}	10^{+4}
Weight approx.		m	kg		37	37	42

Notice
- ▶ Theoretical values, without efficiency and tolerances; values rounded
- ▶ Exceeding the maximum or falling below the minimum permissible values can lead to a loss of function, a reduction in operational service life or total destruction of the valve.

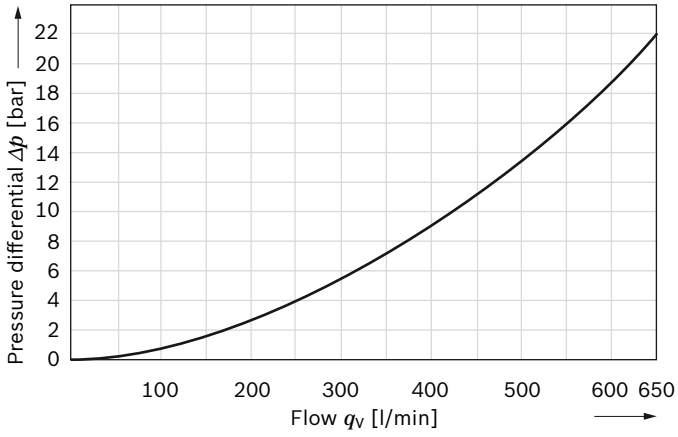
1) With versions “T03”, “C03” and “D03” (concerns damping “D2”, for reservoir outlet), pressures that are higher than the nominal pressure are **not** permitted

Characteristic curves for counterbalance spool 33

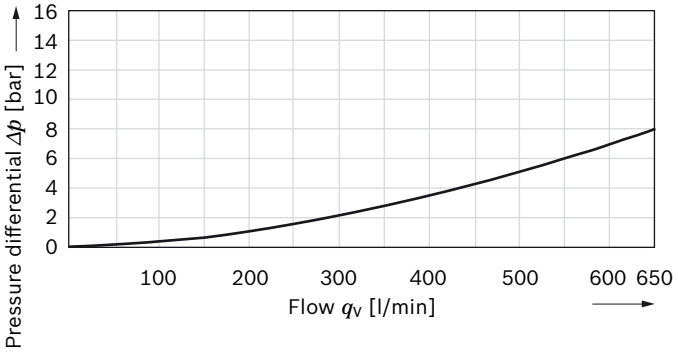
▼ **Pressure differential at the outlet (via valve spool) D´ → D or C´ → C working port at rear (38)**



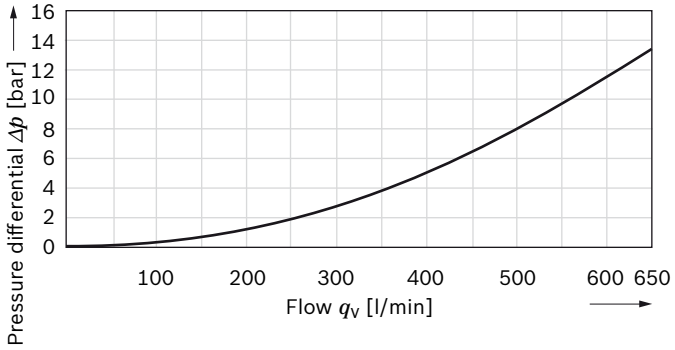
▼ **Pressure differential D´ → D or C´ → C (via valve spool) with working port offset by 90° (31)**



▼ **Pressure differential at the inlet (via check valve) C → C´ or D → D´ working port at rear (38)**



▼ **Pressure differential C → C´ or D → D´ (via check valve), with working port offset by 90° (31)**



The above parameters are based on:

- Oil viscosity ν = approx. 21 mm²/s
- Oil temperature ϑ = 50 °C
- Counterbalance spool fully open

Notice

- Pressure Δp of approx. 20 to 50 bar is normal for determining the maximum flow in winch drives.
- If the desired flow (pressure difference) does not match the counterbalance spool described here, please contact us.

Functional description

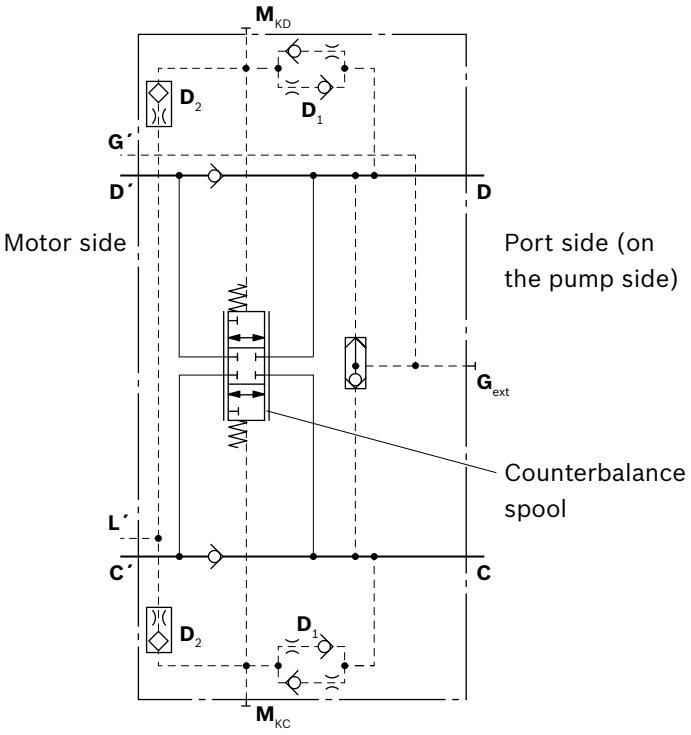
Counterbalance valves are designed to reduce the danger of overspeed and cavitation of axial piston motors in open circuits. Cavitation occurs if, during braking or load-lowering, the rotational speed of the motor is greater than it should be for the given inlet flow, causing the supply pressure to fall sharply. If the supply pressure drops below the given value $\Delta p_{K\,E}$, the counterbalance spool will move towards the close position. The cross-sectional area in the counterbalance valve return channel is then reduced, creating a bottleneck in the return flow of the hydraulic fluid. The pressure increases and brakes the motor until the rotational speed of the motor reaches the specified value for the given inlet flow.

The counterbalance valve is available in two versions.
BVD: Throttling effect in both flow directions, e.g. for moving forward and backward
BVE: Throttling effect in one flow direction, e.g. for lowering with pulling loads
See BVE circuit diagram on page 7

Brake release

Version S
Counterbalance valve with shuttle valve and port **G_{ext}** (plugged), without brake release valve (pressure reduction). The respective high pressure is balanced via the shuttle valve and is available at port **G_{ext}** for venting the mechanical holding brake. The brake vent function without pressure reduction via the brake release valve is only employed if the mechanical holding brake is approved for the maximum working pressure.

▼ **Circuit diagram BVD...S**



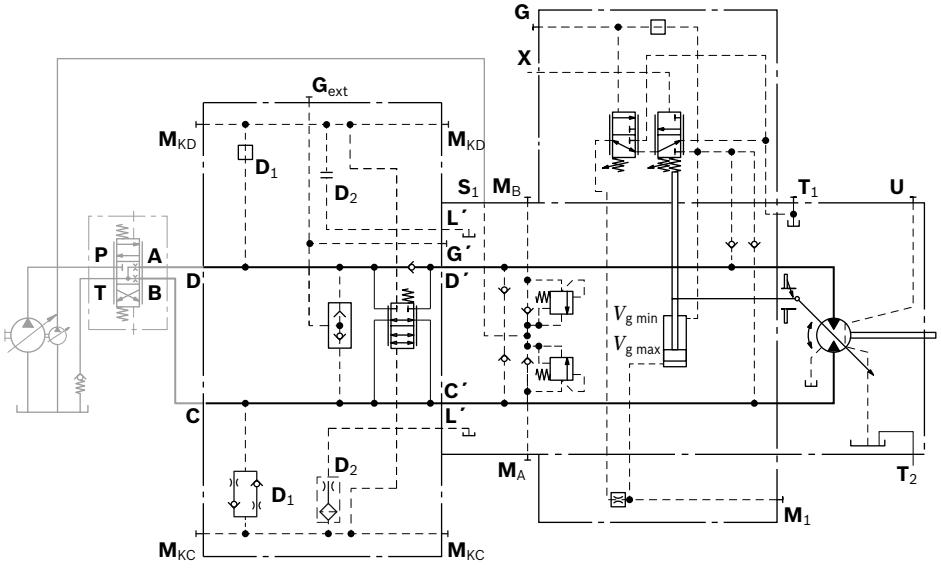
Version L
Counterbalance valve with shuttle valve, brake release valve for pressure reduction and port **Br** (plugged).
The respective high pressure is balanced and fed to the brake release valve (pressure reducing valve) via the shuttle valve. This opens from approx. 10 bar and reduces the respective working pressure to approx. 21^{+4} bar. This brake vent function is employed when the mechanical brake on the gear unit cannot handle the full system pressure.
The maximum permissible brake release pressure must be agreed with the winch or track drive manufacturer.

Example applications

Variable motor with integrated pressure relief valve in the port plate and mounted counterbalance valve.
Counterbalance valve for size 32 winches, without brake release valve (S), with counterbalance spool (pos. 10), without internal residual opening (K00, mandatory for winches), with weak damping (D4599). E.g.: A6VM215HP5D1P001B/71MWV0S4A29W0-0 + BVE32W38S/52ND-V330K00C4599D03S00 mounted to a Rexroth winch gearbox

Winch drive application

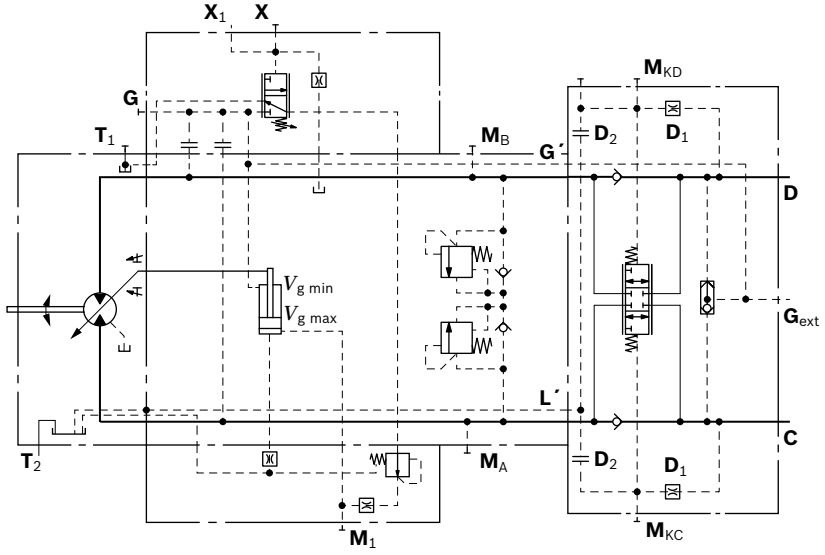
- Circuit diagram example for winch drive in cranes (BVE)



As an alternative to the above example, other Bosch Rexroth axial piston motors (A6VM and A6VE) can also be used.

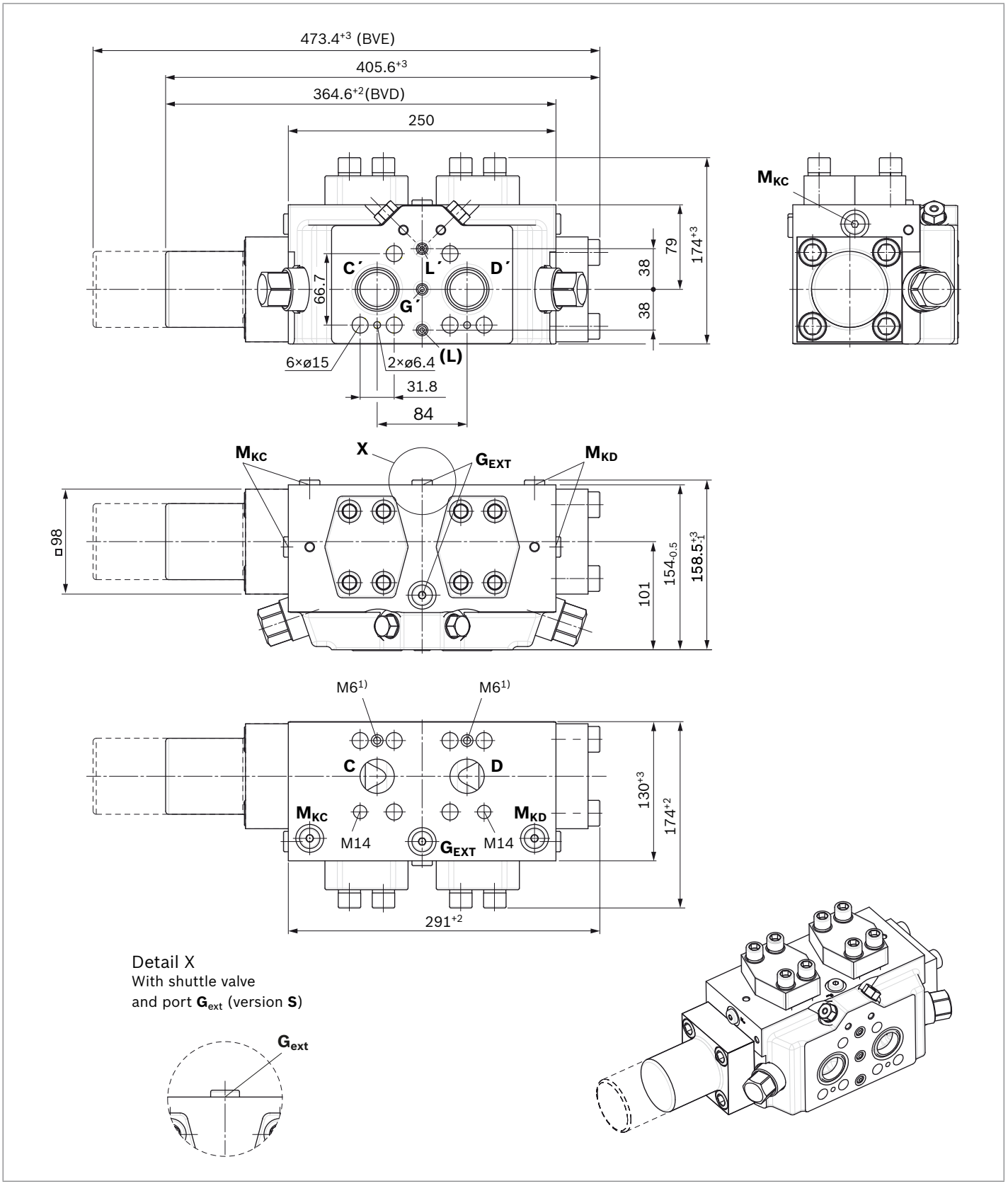
Track drive application

- Circuit diagram example for track drive in excavator crawlers (BVD)



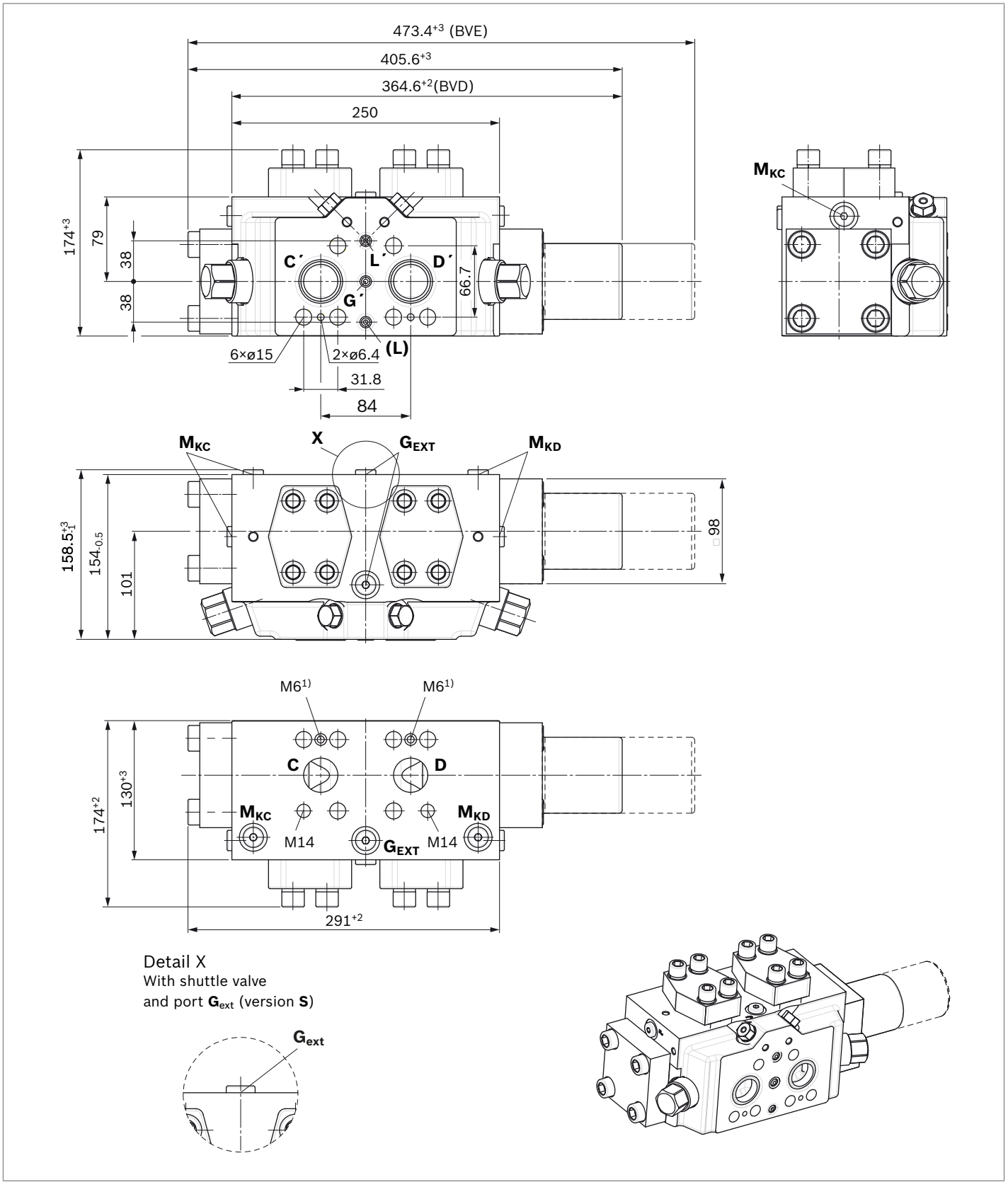
Dimensions

Long spring cover on port side C, lift via port C



1) DIN912

Long spring cover on port side D, lift via port D

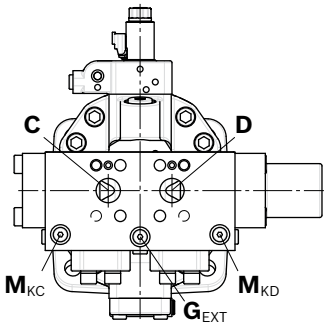
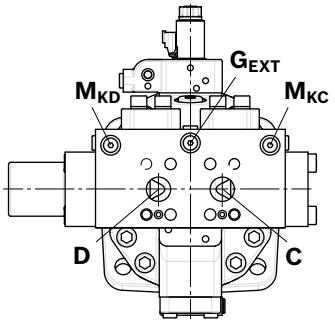
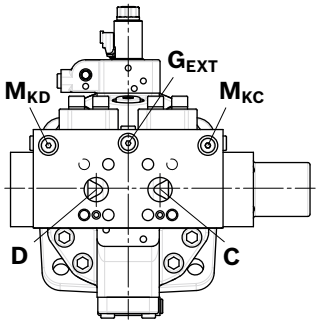
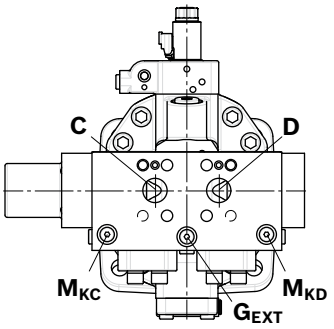


1) DIN912

Ports		Standard	Size	p_{max} [bar][1)]	State[5)]
C, D	Working port Fastening thread	SAE J518[2)] DIN 13	1 1/4 in M14 × 2; 19 deep	400	O
G_{ext}	Brake release, high pressure	DIN 3852[3)]	M14 × 1.5; 12 deep	400	X
C´, D´	Working channel to motor[4)]		ø32	500	O
G´	Balanced high pressure, channel to motor[4)]		ø4.2	400	O
L´	Drain channel to motor[4)]		ø4.2	10	O
V_F	Threaded plug for filter channel[4)]	DIN 6149	M16 × 1.5; 13 deep	400	X
M_K	Measuring pressure in counterbalance spool	DIN 3852[3)]	M14 × 1.5; 12 deep	400	X

1) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
2) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
3) The countersink can be deeper than as specified in the standard.
4) No customer ports. Subject to technical change
5) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

BVE installation variants for winch drives

Motor direction of rotation (lift)	**Clockwise**	**Counter-clockwise**
Flow direction at motor (lift)	**A** to **B**	**B** to **A**
Braking effect at the motor port plate	**A**	**B**
Beginning of control, motor	Beginning of control $V_{g\,max}$	Beginning of control $V_{g\,max}$
Counterbalance valve type with long spring cover on port side D [1)]	BVE32.../52.D	BVE32.../52.D
Installation variants		
Counterbalance valve type with long spring cover on port side C [1)]	BVE32.../52.C	BVE32.../52.C
Installation variants		

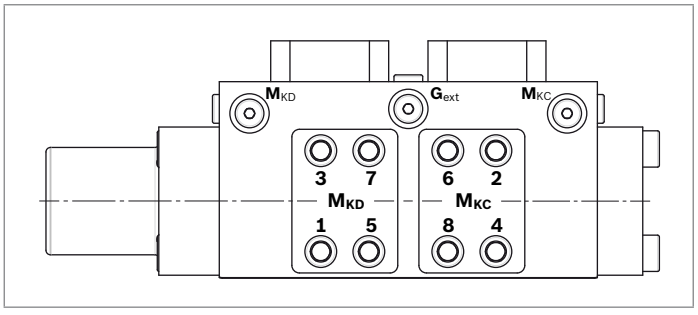
1) The throttling effect is always on the side with the long spring cover

Mounting of the counterbalance valve

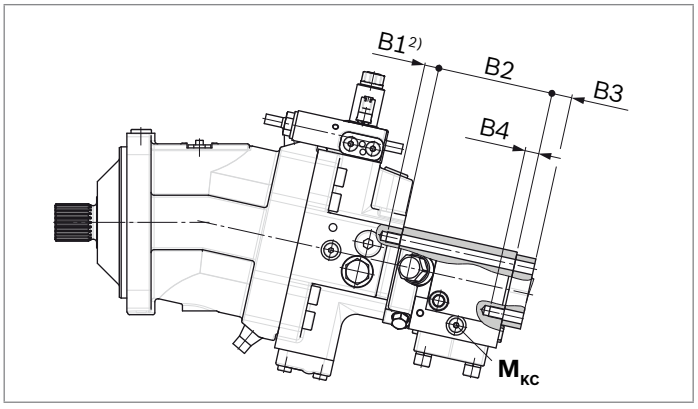
When delivered, the counterbalance valve is fastened to the motor with two tacking screws (transport lock). The tacking screws may not be removed while mounting the working lines! If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be fastened to the motor port plate using the provided tacking screws.
The counterbalance valve is finally mounted to the motor by fitting the SAE flange with the following screws:

6 screws (1, 2, 3, 4, 5, 8)	Length B1+B2+B3
2 screws (6, 7)	Length B3+B4

Tighten the screws in two steps in the specified sequence from 1 to 8 (see figure below).
In the first step, the screws must be tightened with half the tightening torque, and in the second step with the maximum tightening torque (see table below).



Thread	Property class	Tightening torque [Nm][1)]
M14	10.9	172



Axial piston motor	A6VM/65	A6VE/65	A6VM/71	A6VE/71
Size	200	200	215, 280	215
Dimension B1	M14 × 2; (19 deep[1)])			
Dimension B2	154 -0.5			
Dimension B3	Customer-specific			
Dimension B4	M14 × 2; 19 deep			

Notes on the motor port plate

- All four threaded bores at the SAE port and additional bores for tacking screws must always be present
- Drain bores and port G_{ext} must be present
- Minimum thread reach according to VDI2230

1) The tightening torque applies to the thread friction rate of μ = 0.10 (corresponds to the “lightly oiled” state of the screws)
2) The depth depends on the motor

Project planning notes

- The BVD/BVE counterbalance valve is intended for use in an open circuit.
- The project planning, installation and commissioning of the counterbalance valve require the involvement of qualified skilled personnel.
- Before using the counterbalance valve, please read the corresponding motor instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.
- Before finalizing your design, please request a binding installation drawing.
- The specified data and notes contained herein must be observed.
- For safety reasons, controls with beginning of control at $V_{g\,min}$ (e.g., HA) are not permissible for winch drives, e.g. anchor winches.
- Depending on the operating conditions of the axial piston unit (working pressure, fluid temperature), the characteristic curve may shift.
- Preservation: Our axial piston units are supplied as standard with preservative protection for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in the data sheet 90312 or the motor instruction manual.
- Not all versions of the product are approved for use in a safety function according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_d$) for functional safety.
- Please note the details regarding the tightening torques of port threads and other threaded joints in the motor instruction manual.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure of the counterbalance valve. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working ports and function ports are only intended to accommodate hydraulic lines.
- System optimization (reduction) for the first prototype is recommended with regard to the valve block, axial piston motor, counterbalance valve and holding brake.
- The counterbalance valve converts the entire kinetic energy/potential energy into heat during the braking/lowering process. For this reason, sufficient cooling and/or reservoir capacity must be provided.
- We recommend ordering an axial piston motor and counterbalance valve as a single unit. This guarantees optimum configuration and joint examination.

To avoid cavitation in the axial piston motor, the following must be observed:

- The complete system must be designed in the customer vehicle so that the counterbalance valve closes more quickly than the control block in the customer vehicle. The recommendation is a proportional valve with programmable ramp.
- Control block: the control spool should be designed with a throttled A-B-T connection in the neutral position.
- An oil supply at port S of the motor reduces the risk of cavitation. Ensure sufficient supply pressure and quantity. An oil supply on the motor is recommended.
- During commissioning, it must be ensured that all boundary conditions, e.g. minimum pressure at the motor input, are observed.

Ordering details

When placing the order, the following parameters are necessary to ensure correct acceptance at our test benches:

- Motor type code
- Counterbalance valve type code
- Flow
- Application (e.g. winch, track drive)
- Pressure setting of the secondary pressure relief valves in the motor

For the design of the brake release valve, we require the minimum pressure for releasing the mechanical holding brake. Counterbalance valve and axial piston motor can be ordered as a ready-assembled and tested assembly group.

Type selection (type code)

Control range

The control range defines the pressure range at which the counterbalance spool starts to open. The control range of the counterbalance spool is to be chosen so that the mechanical holding brake is fully open before the counterbalance spool starts to open.

Brake release

The integrated pressure reducing valve is necessary when the mechanical brake on the gearbox cannot handle the full system pressure. The maximum permissible brake release pressure must be agreed with the gearbox manufacturer. The counterbalance valve reduces the high pressure to the value stated.

Counterbalance spool version

The counterbalance spool version depends on the maximum flow required through the counterbalance valve.
Selection of the counterbalance spool for the required flow in accordance with characteristic curves on page 5.
If the desired flow is not within the range of the counterbalance spool supplied, please contact us.

Residual opening in counterbalance spool

In winch drive and track drive applications, any residual opening is prohibited, since otherwise the load would not stay suspended. For that reason, version “K00” is prescribed.

Damping

The throttle pin from D1 (inlet) and the orifice D2 (reservoir outlet), plus the counter pressure at the counterbalance spool, determine the actual cracking pressure of the counterbalance spool at the working port.
The damping D1 (outlet) and D2 determine the closing speed of the counterbalance spool. The larger the comparative diameter D1 (outlet), the faster the counterbalance spool will close (see table on page 4).
For the initial equipment (prototype), we recommend damping D1 = D4599 and D2 = T03 for winch drives.
For the initial equipment (prototype), we recommend damping D1 = D4599 and D2 = T00 for track drives.

Safety instructions

Failure to observe any of the following points can lead to uncontrolled operating conditions with serious personal injury and material damage.

- The counterbalance valve does **not** replace the mechanical holding brake. If necessary, provide mechanical braking systems.
- The mechanical holding brake in the winch gearbox must only be effective after the counterbalance spool has closed. Otherwise, the brake will be subject to wear.
- Note the maximum permissible cracking pressure of the holding brake. If necessary, use the integrated pressure reducing valve as a brake release valve with reduced high pressure (version “L”).
- Counterbalance valves should only be operated in combination with close-by secondary pressure relief valves in order to protect the motor against pressure peaks.
  The motor port plate already contains the secondary pressure relief valves.
- Cavitation must be prevented for safety reasons – see project planning notes for remedial measures
- During and shortly after operation, there is a risk of getting burnt on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control equipment (e.g. valve spools) can, under certain circumstances get stuck in position as a result of contamination (e.g. impure hydraulic fluid, abrasion, or residual dirt from components). As a result, the hydraulic fluid flow and the build-up of torque in the axial piston unit can no longer respond correctly to the operator's specifications. Even the use of various filter elements (external or internal flow filter) will not rule out a fault but merely reduce the risk.
  The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to set the consumer being driven to a safe position (e.g. safe stop) and if necessary to ensure it is properly implemented.
- Moving parts in high-pressure relief valves may in certain circumstances become stuck in an undefined position due to contamination (e.g. contaminated hydraulic fluid). This can result in restriction or loss of the load holding function in lifting winches.
  The machine/system manufacturer must check whether additional measures are required on the machine for the relevant application in order to keep the load in a safe position and ensure they are properly implemented.
- When using the axial piston motor in winch drives, make certain that the technical limit values are not exceeded under all operating conditions. If the axial piston motor is extremely overloaded (e.g., if the maximum permissible rotational speeds are exceeded during weighing of the anchor while the ship is in motion), the rotary group may be damaged and, in the worst case, the axial piston motor may burst. The machine manufacturer/system manufacturer is to undertake additional measures, up to and including encapsulation.

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