Rexroth
Bosch Group

Trailer Brake Valves

RE 66 137/05.11
Replaces:
RE 66 137/11.08

Shut-down brake valve, BV1

Nominal pressure: p_{nom} = 250 bar
Flow: Q_{max} = 100 l/min

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Features

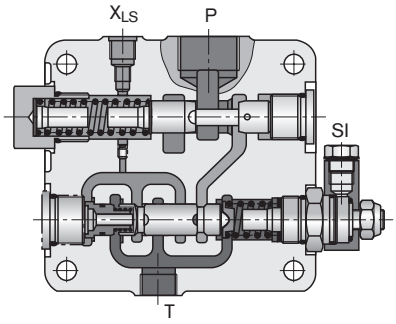
Hydraulic remotely powered brake system for trailers in agricultural vehicles

- priority function for hydraulic trailer brake
- for use in OC or LS systems
- proportional deceleration between tractor and trailer
- simple matching of the trailer brake to the tractor brake
- limitation of the max. trailer brake pressure
- simple integration in the hydraulic system
- pressure safeguarding for trailer brake pressure max. 150 bar

General

Shut-down brake valve, BV1
– with flange and pipe construction
– control fluid: mineral oil or brake fluid
– approx. 30 l/min brake fluid flow
– Q_p: approx. 100 l/min

Preferred applications
– shutdown technology with priority function
– priority function for brake fluid flow
– for OC and OCLS systems
– for French system



Central hydraulics, LT43
– throttle brake valve
– max. 3-x priority function
– with flange construction
– control fluid: mineral oil
– $Q_{p\ max} < 200$ l/min

Preferred applications
– for large oil flows
– for multiple priority functions (steering, brake valve, low pressure)
– for CCLS system
– accumulator charging valve possible
– for French system
For further information, see RE 66 235

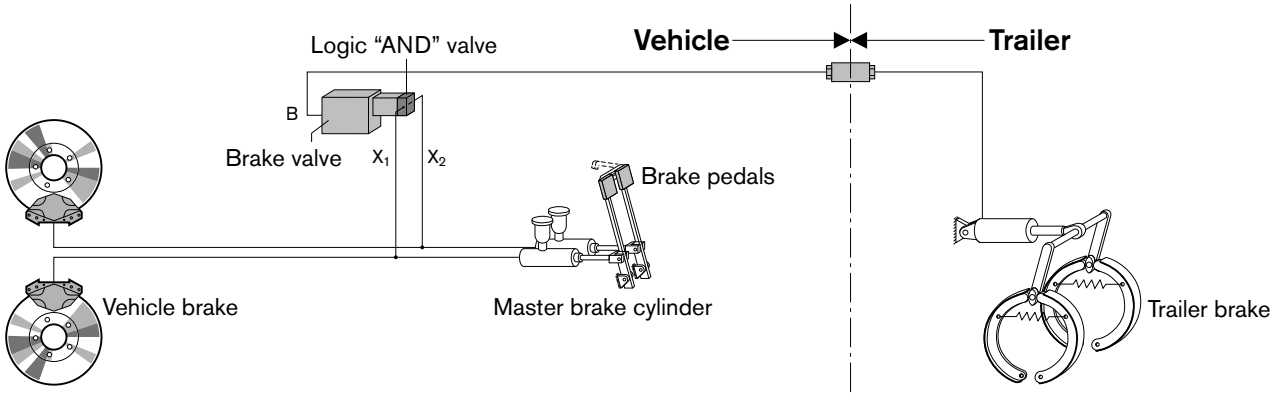
Construction

The hydraulic remotely powered brake system is used primarily for the deceleration of heavy trailers in agricultural vehicles.

The structure of the system is simple and represents an economical solution to the problem of braking in agricultural transportation.

The hydraulic brake system is suitable for both one-/two-axis trailers as well as for two trailers behind one tractor.

The brake valve described in the following can be used both as an auxiliary brake of a tractor, of a self-propelled working machine or of a special vehicle.



Valve with logic functions prevents brake-valve actuation during single-wheel braking.

- Hydraulic trailer brake system with pressure build-up principle.
- Simple integration of the trailer brake valve in the existing tractor hydraulics.
- System with high power density and small device size.
- Simple operation of the trailer brake from the tractor.
- Possible control both with hydraulic or mechanical tractor operating brake as well as with single-wheel brake.
- Easy to match the trailer brake to the tractor brake.
- System with simultaneous and proportional deceleration of the tractor and of the trailer.
- Hydraulic energy requirement only upon initiation of the braking operation and for correcting the brake pressure.
- Simple, low-loss limitation of the max. deceleration of the trailer.
- Braking force and braking time for the trailer independent of the operational state of the tractor hydraulics.
- Relatively short response time (approx. 50 ms) of the trailer brake system.
- Parallel operation of the brake system with the tractor hydraulics is possible.
- No additional costs for the energy supply of the remotely powered brake system of the trailer.

Determining the control piston Ø

Control piston Ø	Pressure ratio	Control volume, shut-down brake valve
d_x [mm]	i_d	V_x [cm³]*)
6	1:1	0.18
8	1:1.78	0.32
10	1:2.78	0.50
12	1:4	0.72
14	1:5.44	1.0
16	1:7	1.3
20	1:11.11	2.0
22	1:13.44	2.41

*) V_x = control volume of piston 6

The hydraulic trailer brake valve enables a proportional deceleration between tractor and trailer. To adjust the two brake systems, the brake pressures p_b and p_x are matched to one another.
The following relationship exists for these two brake pressures:

$$\frac{p_x}{p_b} = \frac{d_b^2}{d_x^2} = i_d \text{ (pressure ratio)}$$

Where:
p_x – tractor brake pressure in bar
p_b – trailer brake pressure in bar
d_b – diameter of control piston 2 on surface 13
d_b = 6 mm
d_x – diameter of control piston 6 in mm
For the piston diameter d_x of control piston 6 in the trailer brake valve, this yields:

$$d_x = 6 \cdot \sqrt{\frac{p_b}{p_x}}$$

The piston diameter d_x is adjusted to match the two brake pressures.

Design example
Maximum trailer brake pressure
p_b = 150 bar.
Maximum tractor brake pressure
p_x = 33 bar.
Calculated piston diameter

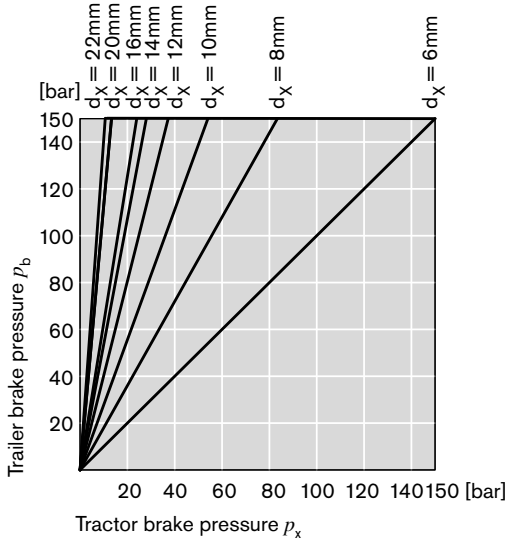
$$d_x = 6 \cdot \sqrt{\frac{150}{33}} \text{ mm} = 12.8 \text{ mm}$$

Selected piston diameter
d_x = 12 mm.

Piston diameter d_x of control piston 6 in the trailer brake valve.
(Theoretical relationship between p_b and p_x)

Remarks
In draft standard ISO 5697, the following values are defined for the hydraulic trailer brake system:
1. The system must be operationally safe for max. 150 bar.
2. The necessary maximum deceleration of the trailer should occur at a trailer brake pressure p_b from 120 to 150 bar.

The matching of the two pressures p_b and p_x (selection of control piston 6) is performed by the tractor manufacturer. Matching is selected so that no unstable driving conditions arise in the tractor.



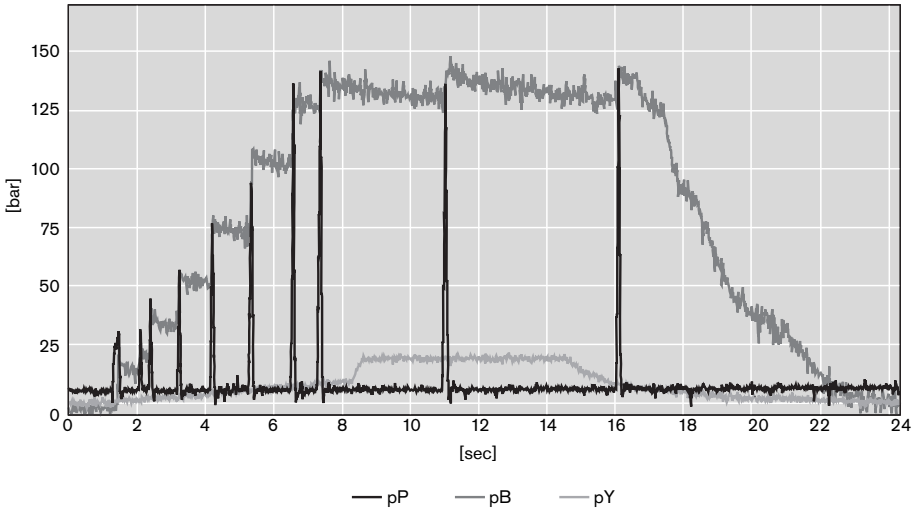
Shut-down brake valve

Fixed pump and variable pump:

Advantage
- energetically favorable behavior
- pump (pP) switches off after necessary brake pressure is reached and switches back on if the brake pressure drops below the permissible value.

Disadvantage
- when the pump switches on, small impacts may be audible or small impacts may be perceptible in the brake pedal.
- max. pressure build-up in approx. 7 switching stages.

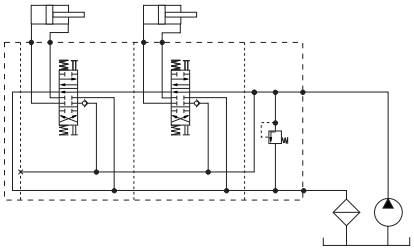
Pressure build-up (slow) with readjustment frequency

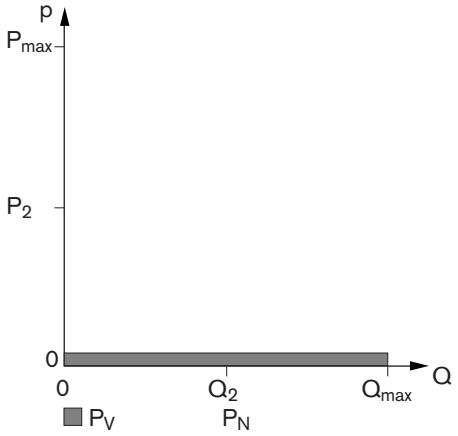


pP = pump pressure pB = brake pressure pY = control pressure

Constant flow system, characteristics

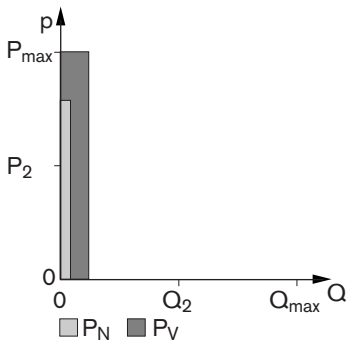
Load not actuated

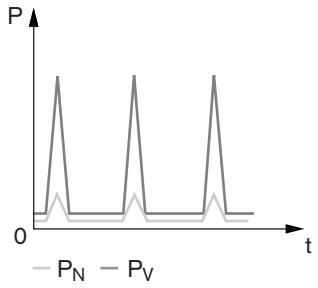




P_N Effective power
P_V Dissipation power

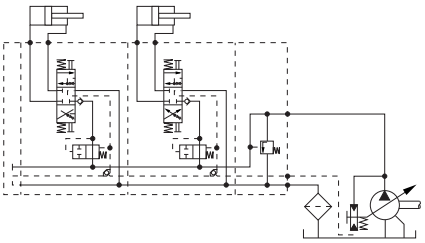
Shut-down brake valve is actuated

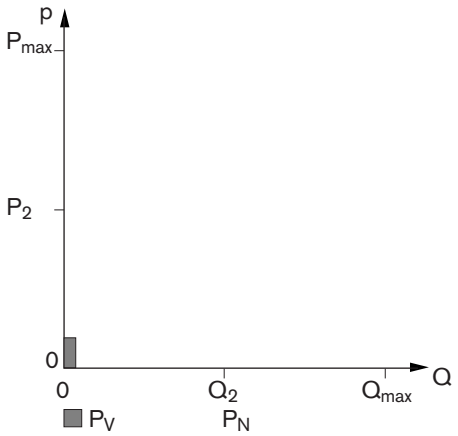




Closed center load sensing system, characteristics

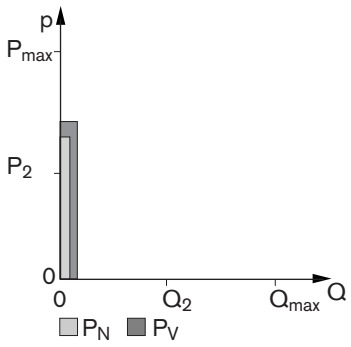
Load not actuated

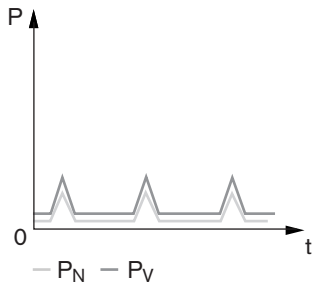




P_N Effective power
P_V Dissipation power

Shut-down brake valve is actuated

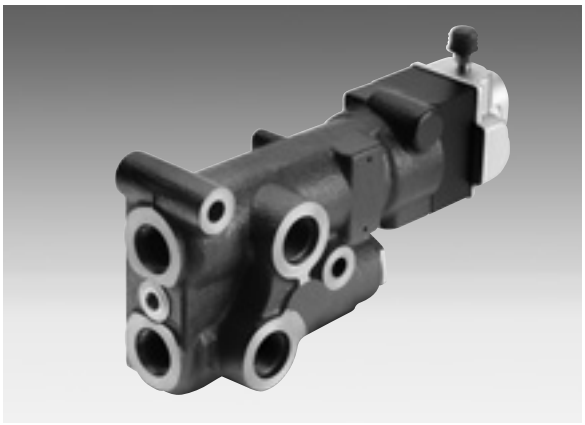




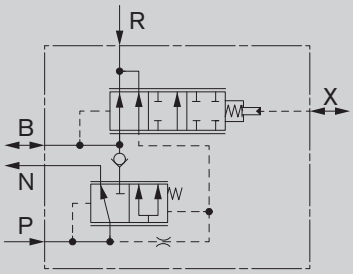
Shut-down brake valve, BV1

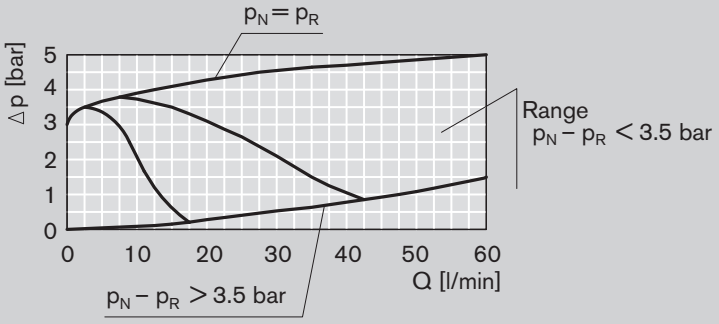
Pipe construction

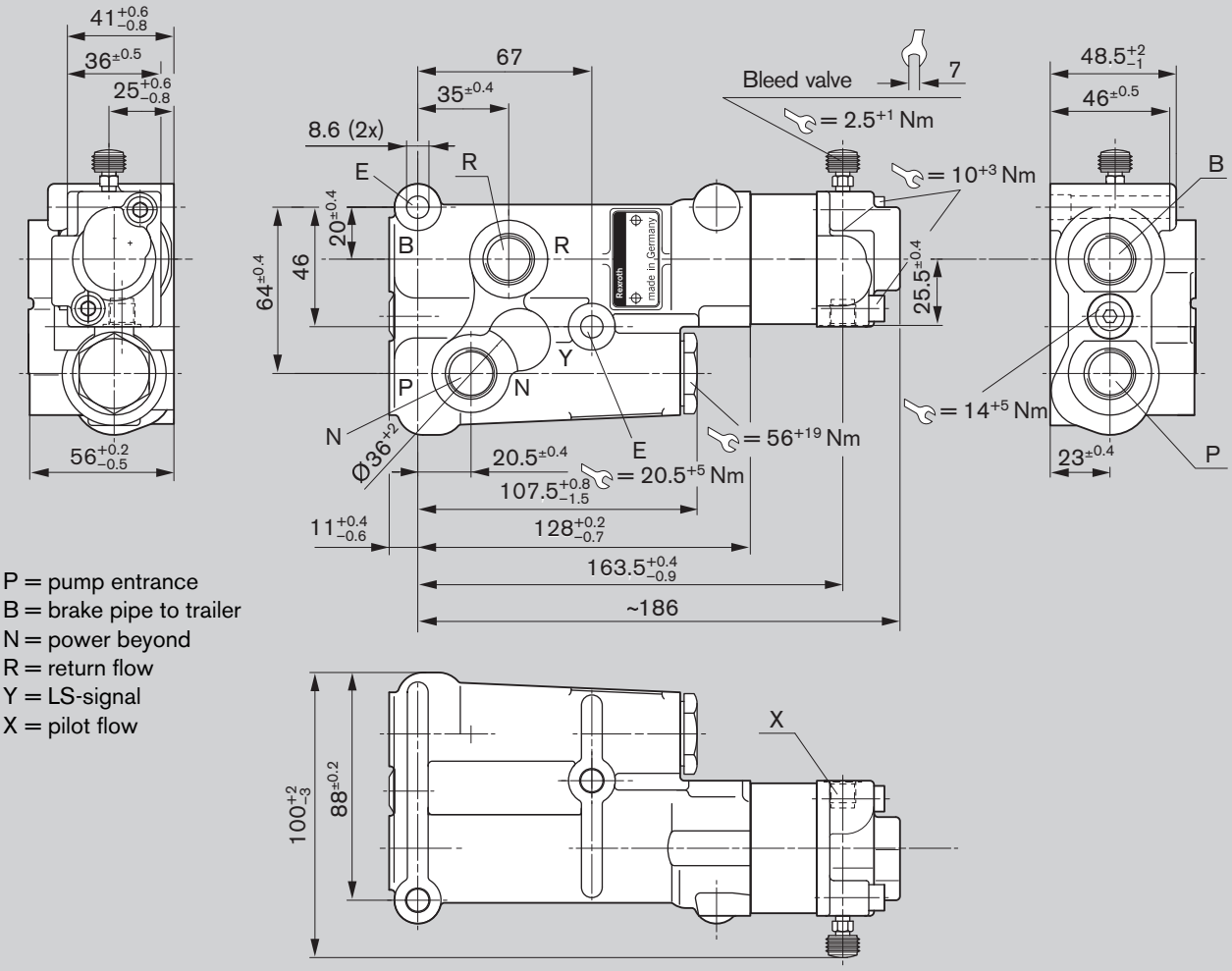
Characteristics $P \rightarrow N$
$\nu = 35\ mm^2/s$
$T = 50\,°C$



Dimensions





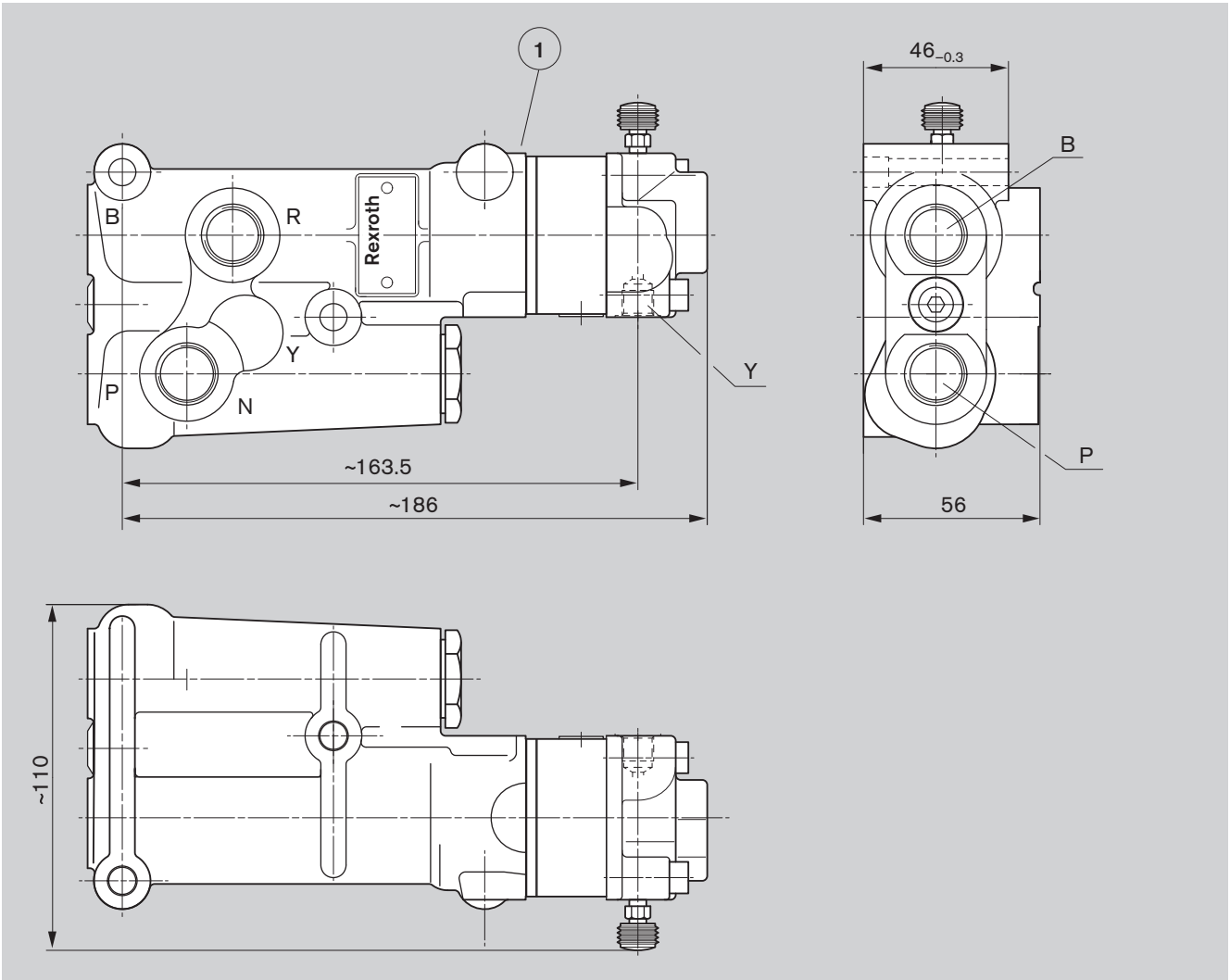


P = pump entrance
B = brake pipe to trailer
N = power beyond
R = return flow
Y = LS-signal
X = pilot flow

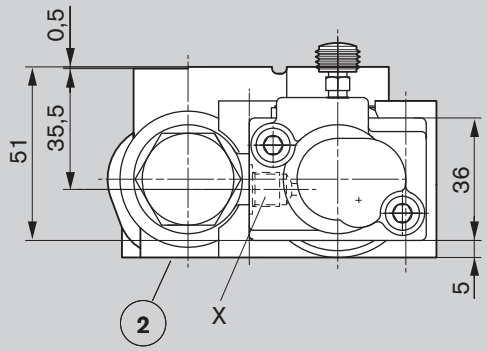
Characteristics

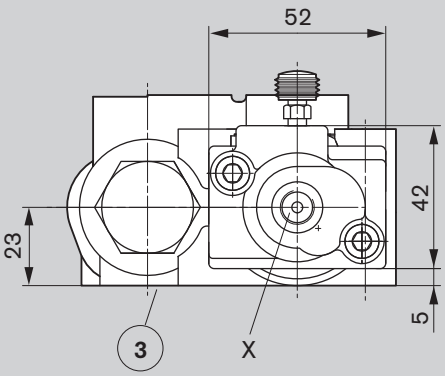
Design	Proportional control valve with priority function
Line ports	Screw-in thread, see order details on page 9
Installation position	Bleed valve at top, vertical
Ambient temperature	–25...+60 °C
Hydraulic fluid to trailer brake	Mineral-based hydraulic oils acc. to DIN/ISO, other fluids, e.g. environmentally acceptable fluids, on request
Hydraulic fluid in control head	Mineral-based hydraulic oils acc. to DIN/ISO, other fluids, e.g. environmentally acceptable fluids, on request. ATE brake fluid
Viscosity	10...400 mm^2/s
Temperature of hydraulic fluid	–25...+80 °C
Filtration	Oil contamination class 10 acc. to NAS 1638 obtained with filter $\beta_{25} = 75$
Permissible peak pressure	P: 250 bar; N: 250 bar; B: 150 bar, R: see assembly notes on page 16
Nominal flow	80 l/min; > 80 l/min on request

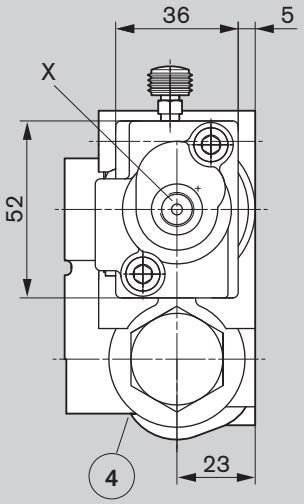
Installation position BV1, pipe construction

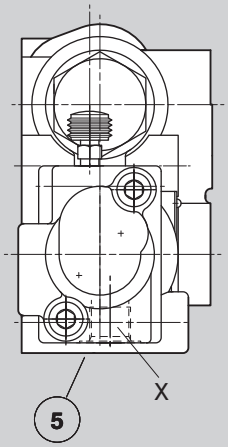


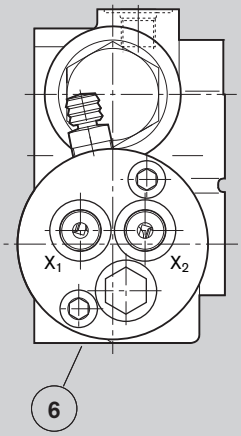
Installation position BV1, pipe construction

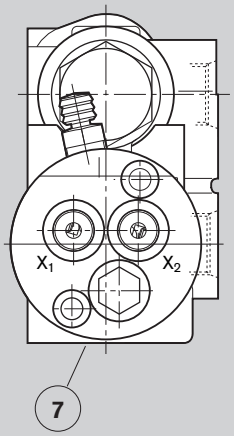


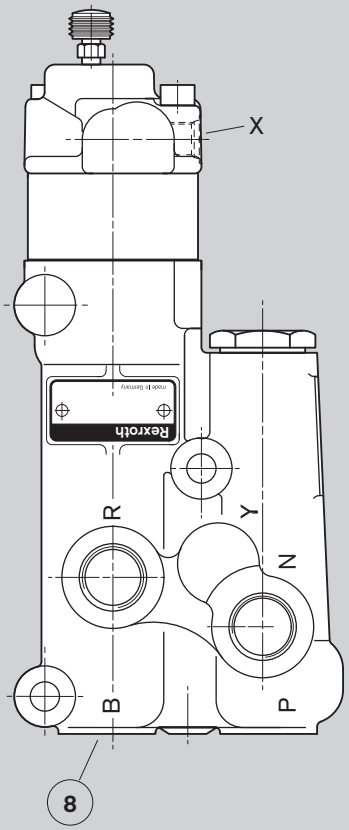




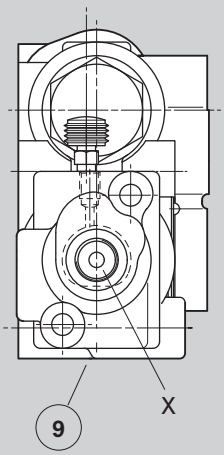


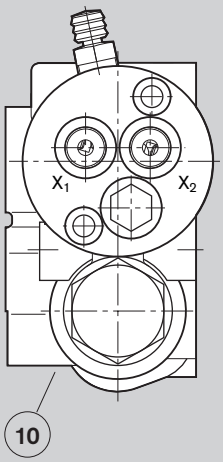






P = pump entrance
B = brake pipe to trailer
N = power beyond
R = return flow
Y = LS-signal
X = pilot flow





Order details for shut-down brake valve, pipe construction

Mineral oil

Control piston Ø mm	Installation position of bleed valve	Constant flow (l/min)	Ports								Part number
			Y LS port	**P** M18 x 1.5	**B** M18 x 1.5	**R** M18 x 1.5	**N** M18 x 1.5	ISO 6149	DIN 3852 – part 1	**X**	
10	1	30		X	X	X	X	X		M10 x 1 DIN 74235-FI = ISO 4038	**0 538 008 374**
20	5	30		X	X	X	X	X		M12 x 1.5 DIN 3852 – part 1	**0 538 008 370**
20	1	30		X	X	X	X	X		M10 x 1 DIN 74235-FI = ISO 4038	**0 538 008 372**
20	3	30		X	X	X	X		X	M10 x 1 DIN 74235-FI = ISO 4038	**R 917 005 787**
20	6	30	M10 x 1	X	X	X	X	X		M10 x 1 ISO 9974-1	**R 917 003 105**

ATE brake fluid

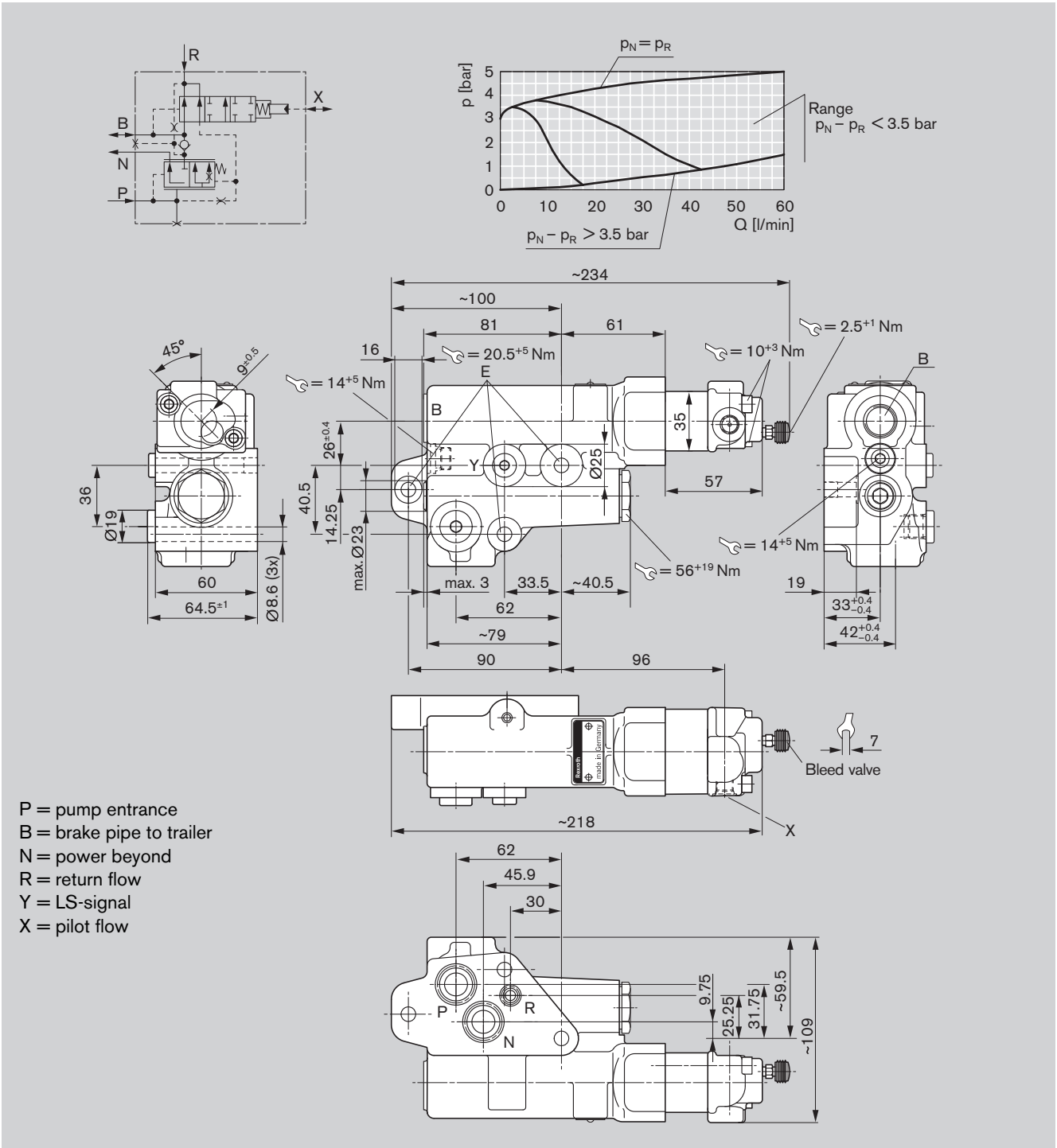
Control piston Ø mm	Installation position of bleed valve	Constant flow (l/min)	Ports								Part number
			Y LS port	**P** M18 x 1.5	**B** M18 x 1.5	**R** M18 x 1.5	**N** M18 x 1.5	ISO 6149	DIN 3852 – part 1	**X**	
8	2	15		X	X	X	X	X		M10 x 1 DIN 74235-FI = ISO 4038	**0 538 008 339**
14	1	15		X	X	X	X	X			**0 538 008 338**
14	1	30		X	X	X	X	X			**0 538 008 345**
14	5	30		X	X	X	X	X			**R 917 000 202**
16	1	30		X	X	X	X	X			**0 538 008 346**
20	1	15		X	X	X	X	X			**0 538 008 337**
20	1	30		X	X	X	X	X			**0 538 008 347**
20	6	30	M10 x 1	X	X	X	X	X		M12 x 1 DIN 74235-FI = ISO 4038	**R 917 003 103**
22	6	30	M10 x 1	X	X	X	X	X		M12 x 1 DIN 74235-FI = ISO 4038	**R 917 003 104**

Shut-down brake valve, BV1

Flange construction

Characteristics $P \rightarrow N$
$\nu = 35\ mm^2/s$
$T = 50\,°C$

Dimensions

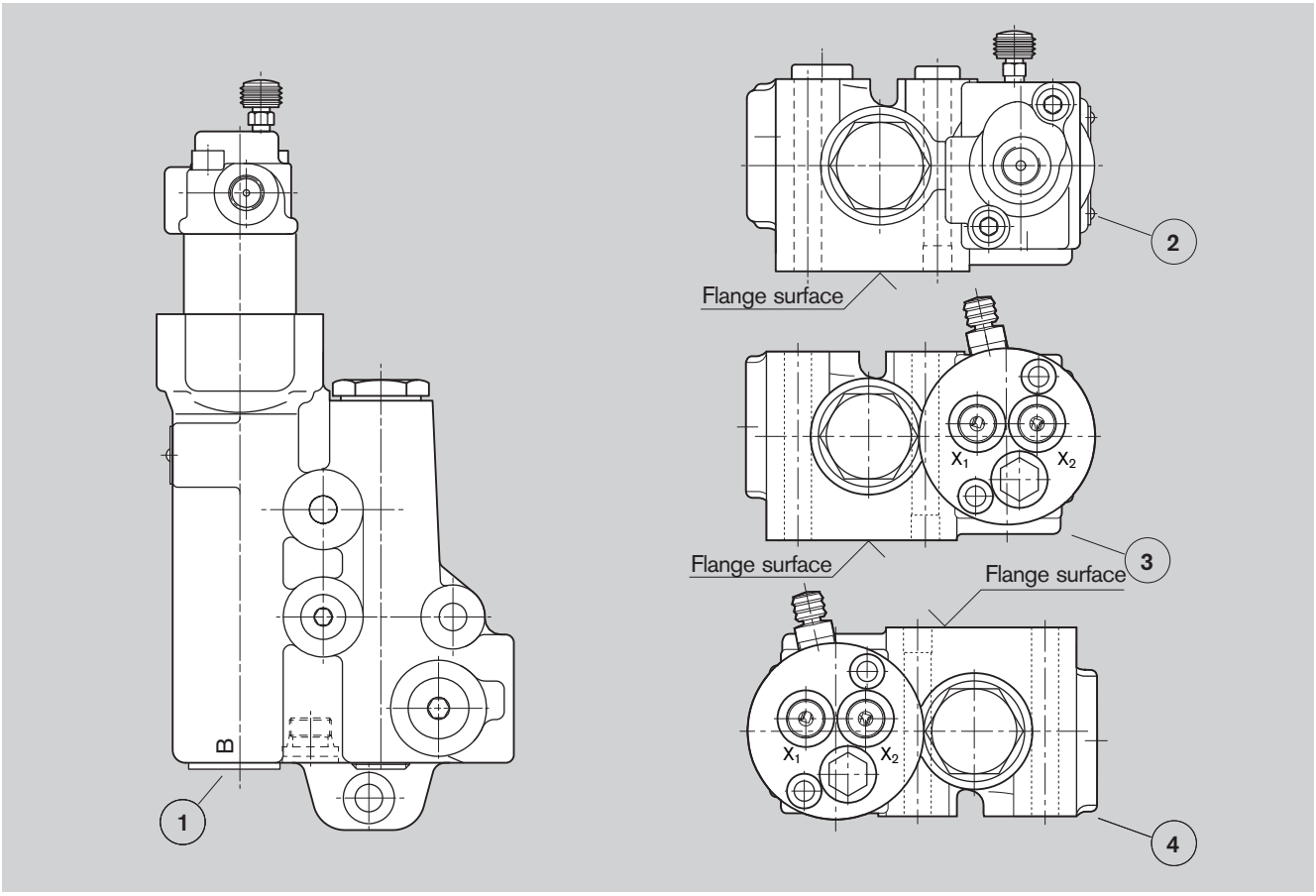


P = pump entrance
B = brake pipe to trailer
N = power beyond
R = return flow
Y = LS-signal
X = pilot flow

Characteristics

Design	Proportional control valve with priority function
Line ports	Screw-in thread, see order details on page 12 ports P, N, R in flange
Installation position	Bleed valve at top, vertical
Ambient temperature	–25...+60 °C
Hydraulic fluid to trailer brake	Mineral-based hydraulic oils acc. to DIN/ISO, other fluids, e.g. environmentally acceptable fluids, on request
Hydraulic fluid in control head	Mineral-based hydraulic oils acc. to DIN/ISO, other fluids, e.g. environmentally acceptable fluids, on request. ATE brake fluid
Viscosity	10...400 mm^2/s
Temperature of hydraulic fluid	–25...+80 °C
Filtration	Oil contamination class 10 acc. to NAS 1638 obtained with filter $\beta_{25} = 75$
Permissible peak pressure	P: 250 bar; N: 250 bar; B: 150 bar, R: see assembly notes on page 16
Nominal flow	100 l/min; > 100 l/min on request

Installation position BV1, flange construction



Order details for shut-down brake valve, flange construction

Mineral oil

Control piston Ø mm	Installation position of bleed valve	Constant flow (l/min)	Ports				Part number
			Y LS port	**B**	ISO 6149	**X**	
14	2	30	M10 x 1	M18 x 1.5	X	M12 x 1 DIN 74235-FI = ISO 4038	**0 538 008 413**
20	1	30		M18 x 1.5	X	M10 x 1 DIN 3852 – part 3 = ISO 6148	**0 538 008 410**
20	2	30		M18 x 1.5	X	M10 x 1 DIN 3852 – part 1	**0 538 008 414**
20	1	30		M18 x 1.5	X	M10 x 1 DIN 3852 – part 3 = ISO 6148 **)	**0 538 008 417**
20	2	30		M18 x 1.5 *)	X	M10 x 1 DIN 3852 – part 1	**0 538 008 418**

*) DIN 3852 – part 1
**) with throttle check valve

Shut-down brake valve, function

The trailer brake valve consists of the following elements:

– **Flow-control valve 1**
(with throttle 9 and orifice 11) for controlling the flow Q_p and for regulating the hydraulic flow for the trailer brake.

– **Pilot spool 2**
(with piston surface 13) for controlling flow-control valve 1 and regulating the trailer brake pressure.

– **Check valve 3**
prevents the oil from flowing back from brake line B to port N.

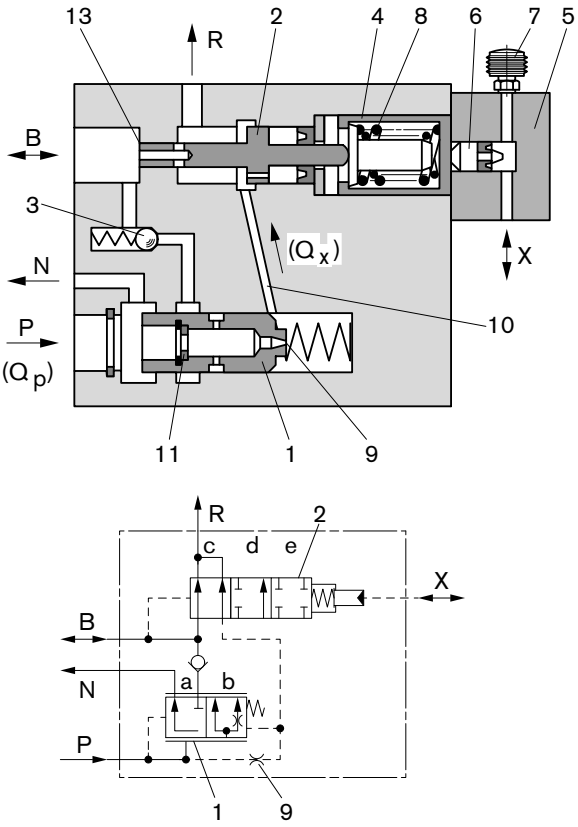
– **Pressure-relief element 4**
(with pre-tensioned springs 8) for limiting the trailer brake pressure.

– **Control head 5**
(with piston 6 and bleed valve 7) for controlling the trailer brake valve by means of the tractor operating brake.

Ports of the trailer brake valve
P = port for the pump line
N = port for downstream tractor hydraulics
B = port for the trailer brake
R = port for the tank
X = port for the control line from the tractor operating brake

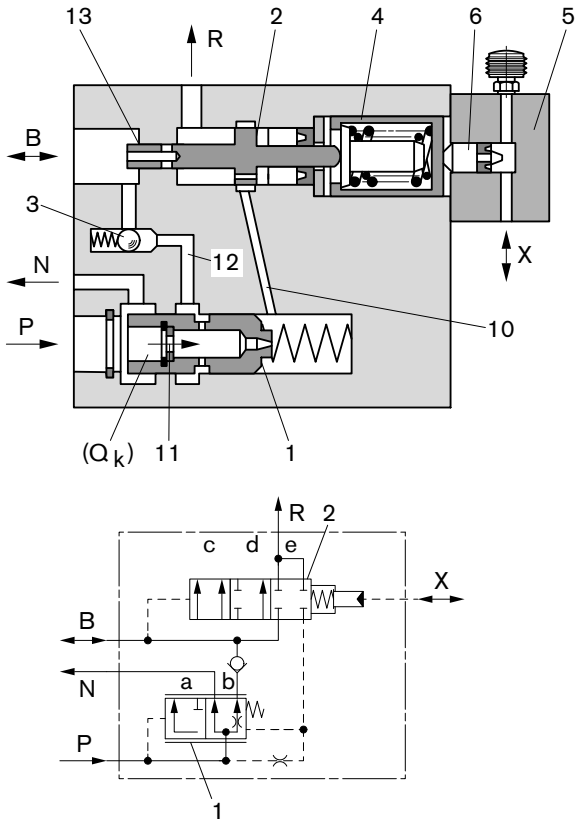
Trailer brake – disengaged

Control line X is depressurized.
The brake line is relieved via pilot spool 2 and port R to the tank.
The flow Q_p of the pump flows from port P past flow-control valve 1 and then with $Q_p - Q_x$ via port N to the tractor hydraulics.
A small pilot oil flow Q_x of approx. 0.6 l/min flows from port P via orifice 11, throttle 9, borehole 10, pilot spool 2 and port R to the tank. The pressure differential at throttle 9 thereby keeps flow-control valve 1 in free feed-through position a. Flow-control valve 1 has no regulating function.



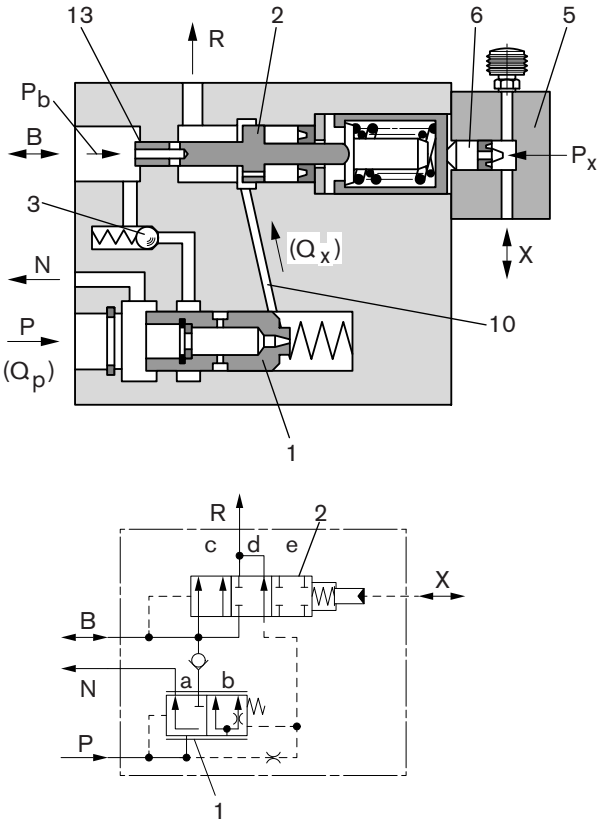
Partial braking of the trailer brake – initiating

Piston 6 of control head 5 is pressurized by the tractor operating brake via control line X. This pushes pilot spool 2 to the left, first separating brake line B and then borehole 10 from the tank.
Pilot spool 2 is moved from position c to position e. The pilot oil flow is blocked. As a result, flow-control valve 1 is controlled in the regulating function to position b. A constant flow Q_k (approx. 30 l/min) flows from port P via orifice 11, borehole 12, check valve 3 and port B to the trailer brake. Orifice 11 is designed for constant flow Q_k.
A residual flow Q_r flows past flow-control valve 1, then via port N to the tractor hydraulics.
The pressure in trailer brake line B builds up and acts against the pressure on piston 6 at surface 13 on pilot spool 2.



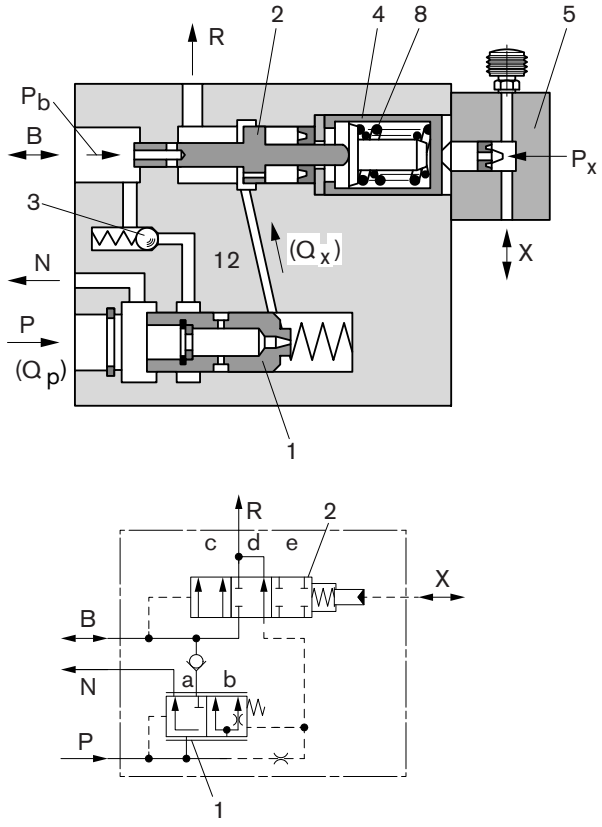
Partial braking of the trailer brake

The trailer brake pressure p_b (acting on surface 13 of pilot spool 2) is in equilibrium with the tractor brake pressure p_x (acting on piston 6).
Brake line B remains separated from the tank; the oil in the trailer brake is, thus trapped.
After pressure equilibrium is reached, pilot spool 2 is moved to the right and opens borehole 10 via port R to the tank. Pilot spool 2 is in position d.
Flow-control valve 1 is thereby moved to position a and has no regulating function.
As with the disengaged trailer brake, the flow Q_p of the pump flows to the tractor hydraulics via port N with $Q_p - Q_x$ and pilot oil flow Q_x flows to the tank via pilot spool 2.



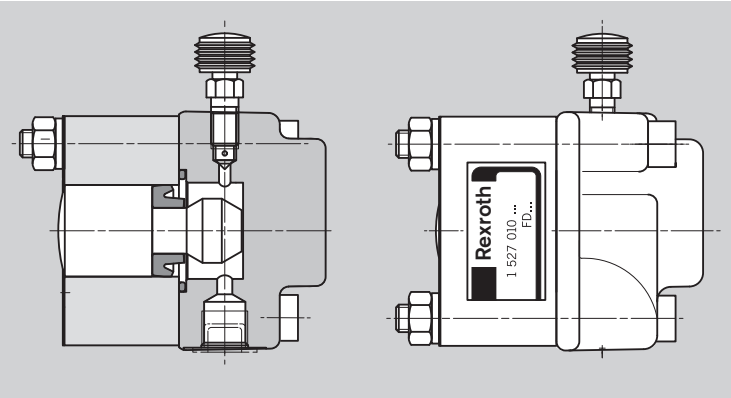
Maximum braking of the trailer brake – brake pressure limited

Flow-control valve 1 and pilot spool 2 have the same slide positions (a and d) as with partial braking.
The hydraulic flows Q_p and Q_x flow as with partial braking.
The maximum permissible trailer brake pressure p_b (e.g. 150 bar) is achieved.
A further increase of the trailer brake pressure is prevented, even if the tractor brake pressure rises further. Here, pressure-relief element 4 is moved to the left.
Springs 8, pre-tensioned to the maximum permissible trailer brake pressure p_b, are pushed in. If trailer brake pressure p_b increases, e.g. due to external influences, pilot spool 2 briefly opens brake line B to the tank, thereby preventing a further rise of the brake pressure.
In all function positions of the trailer brake valve, the tractor hydraulics can be used freely via port N and can be subjected to pressure. This has no noteworthy repercussions on the trailer brake.
The trailer brake has priority above the tractor hydraulics. The maximum pressure of the tractor hydraulics can be greater than the maximum trailer brake pressure.



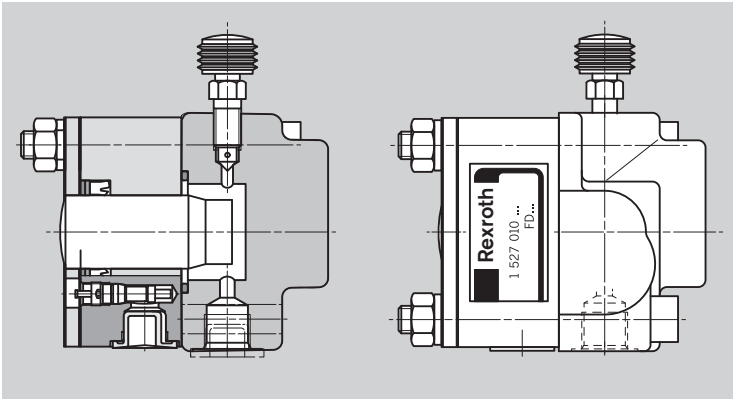
Spare parts

Control head, 2-part, for mineral oil



Control piston Ø mm	Part number
10	**1 537 010 270**
12	**1 537 010 271**
14	**1 537 010 272**
16	**1 537 010 273**
20	**1 537 010 274**

Control head, 2-part, for ATE brake fluid



Control piston Ø mm	Part number
10	**1 537 010 253**
12	**1 537 010 254**
14	**1 537 010 252**
16	**1 537 010 257**
20	**1 537 010 251**

⚠ DANGER

For safety reasons, control heads must only be changed in authorized repair shops.

Assembly notes

Hydraulic line between hydraulic pump and trailer brake valve
The dimensions for this line can be selected to match the lines already in place for the tractor hydraulics from the hydraulic pump to the directional valves.

Hydraulic line between trailer brake valve and trailer brake cylinder
The clear opening of the pipeline should be > 10 mm. No long hoses may be used (max. hose length for connecting to the trailer brake coupling < 1 m).

Control line between tractor brake and trailer brake valve (or pressure sensor and trailer brake valve)
The dimensions of the line must be selected so that no noticeable expansion (accumulator effect) occurs in the line. The clear opening should be ≧ 3 mm. Do not use hoses.

Return line between trailer brake valve and tank
While the brake is disengaged, the return pressure at port R of the trailer brake valve acts on the brake cylinder of the trailer. For this reason, the return pressure must be low enough that the return springs of the trailer brake ensure adequate ventilation of the brake shoes. The return line must be dimensioned accordingly. If possible, lines R and N should not be laid next to one another.

Bleeding the lines
Malfunctions during the initial commissioning can be avoided if all lines are sufficiently air bled. This applies, in particular, to the control system and brake line B. A bleed valve is mounted on the control head of the trailer brake valve for air bleeding the control system.
The bleed valve must be arranged on the trailer brake valve so that it is mounted in the top position in accordance with the specified installation conditions.

Control volume of the trailer brake valve
The control volume is relatively small (see table on page 3, determining the control piston Ø). In general, the size of the master brake cylinder of the tractor brake does not need to be increased.

Control medium
Note whether the existing hydrostatic tractor operating brake is operated with mineral oil or with a special brake fluid (e.g. Ate blue). The seal in the control head of the trailer brake valve must be changed accordingly.

Hydraulic circuit of the trailer brake valve
To ensure that the trailer brake is given preference in the supply of hydraulic oil, assemble as follows:
– Trailer brake valve between hydraulic pump and tractor hydraulics.

Pressure relief for the trailer brake and for the tractor hydraulics
Pressure relief for the trailer brake is built into the trailer brake valve. The pressure-relief valve for the tractor hydraulics can be connected both to the P-line as well as to the N-line of the trailer brake valve. When connecting to the P-line, it must be set to a higher value than the pressure relief of the trailer brake valve.

Safety when decoupling and separating the trailer
Brake line B between tractor and trailer is depressurized while the trailer is decoupled. If a hydraulic accumulator or a mechanical spring accumulator is mounted on the trailer, automatic deceleration can be achieved upon decoupling or separating of the trailer. The applicable specifications of the technical monitoring organizations must be observed.

Note

RE 66 137-B/07.04: Product-Specific Operating Instructions.
The product-specific operating instructions contain supplementary information for the brake valves.

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