Power Brake Valves

Designation	Type	Data sheet	Page
Single-circuit power brake valve	LT 05	RE 66143	829
Accumulator charging valve	LT 06	RE 66191	833
Dual-circuit power brake valve	LT 07	RE 66146	839
Hand brake valve	LT 08	RE 66148	847
Relay valve	LT 09	RE 66153	851
Single-circuit power brake valve of compact design	LT 12	RE 66218	857
Dual-circuit power brake valve of compact design	LT 13	RE 66221	873
Dual-circuit power brake valve of compact design	LT 17	RE 66228	891
Inching remotely powered brake valve	LT 31	RE 66227	901
Steering brake valve	LT 10	RE 66154	905

For the latest information on power brake valves, please visit our website:
www.boschrexroth.com/power-brakes

Rexroth
Bosch Group

Single-circuit remotely powered brake valve LT 05

RE 66143/08.04 1/4
Replaces: 01.03

Data sheet


H6749

Component series 3X
Nominal braking pressure
60, 80, 100 and 125 bar

Table of contents

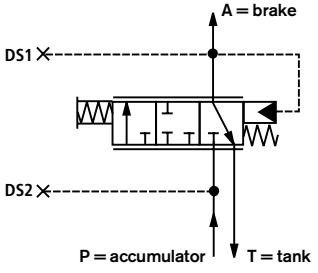
Applications

- Earthmoving machines
- Industrial trucks
- Forestry and agricultural machines
- Special vehicles

Features

- Small installation dimensions
- Integrated maximum pressure relief function for the braking circuit
- Braking pressure proportional to the operating force
- Low hysteresis
- Weight 2.7 kg

Symbol



Function and connections

Connections

The valve must be connected as shown in the circuit diagram. Port T is to be connected to a drain line (the pressure of the drain line acts on the brakes → max. 0.5 bar).

Function of the single-circuit brake valve

The brake valve is a direct operated 3-way pressure reducing valve (pressure build-up: The pressure increases in relation to the operating force).

Ordering code

LT	05	MK	A – 3X /	– 02	M		*

Component series 30 to 39 = 3X
(30 to 39: unchanged installation and connection dimensions)

Nominal braking pressure 60 bar = 060
Nominal braking pressure 80 bar = 080
Nominal braking pressure 100 bar = 100
Nominal braking pressure 125 bar = 125

[1] **Standard brake pedal, material no.: R900412419**

Further details in clear text

Pedal
No code = Without pedal
12 = LT 19 with pedal rubber pad [1]

M = NBR seals, suitable for mineral oil (HL, HLP) to DIN 51524

Connection thread (see page 4)
02 = Metric thread

Connections

Hydraulic – see also symbol on page 1

- A: Brake line to the wheel brakes
- P: Accumulator line and accumulator (diaphragm-type accumulator)
- T: Drain line
- DS1: Pressure switch for activating the stoplight (see pages 1 and 4)
- DS2: Pressure switch for monitoring the accumulator pressure (see pages 1 and 4)

Mechanical

- Valve operation of the SBS foot brake with pedal (see page 3)

Technical data (for applications outside these parameters, please consult us!)

Hydraulic fluid			Mineral oil (HL, HLP) to DIN 51524; bio-degradable hydraulic fluids on enquiry
Hydraulic fluid temperature range		°C	– 20 ... + 80
Viscosity range		mm^2/s	2.8 ... 380
Max. permissible degree of contamination of the hydraulic fluid, cleanliness class to ISO 4406 (c)			Class 20/18/15
Accumulator pressure, max.		bar	200
Braking pressure	Foot brake (SBS)	bar	... 125 (for pressure stage, see ordering code)
Weight	(Valve without pedal)	kg	2.7

Legal requirements

A requirement that all legal stipulations have in common is that a vehicle must be road safe in all operating conditions. The currently valid national and international regulations form the basis for engineering a braking system. In addition, the braking system must be designed in accordance with state of the art.

Braking systems must be approved in accordance with valid national and international regulations.

☞ **The responsibility for this lies with the vehicle manufacturer.**

⚠ Safety notes

- Damaged seals must be immediately replaced.
- Damaged valves must be repaired, even if their function is not impaired.

Installation notes

- Rubber parts must **not** be painted.
- Operating elements must not be directly exposed to high-pressure jet cleaning.
- The cross-sections of hydraulic transmission elements (pipes, hoses) must be selected so that at low operating temperatures the pressure drop between hydraulic accumulator and brake cylinder remains low.
- Maximum tank pressure 0.5 bar (the tank must be mounted above the valve!)
- For the max. permissible degree of contamination, see technical data.
- Damaged seals must be immediately replaced.
- The tank pressure must not exceed the brake application pressure.

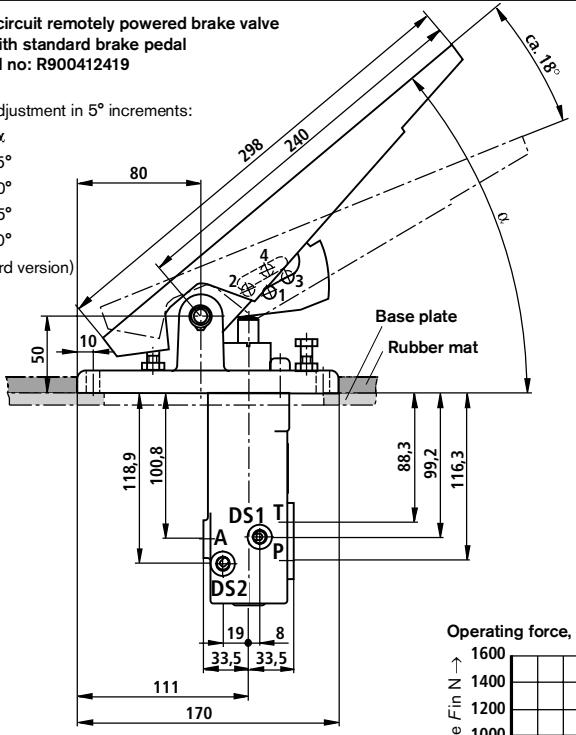
Installation drawing: with pedal (in mm)

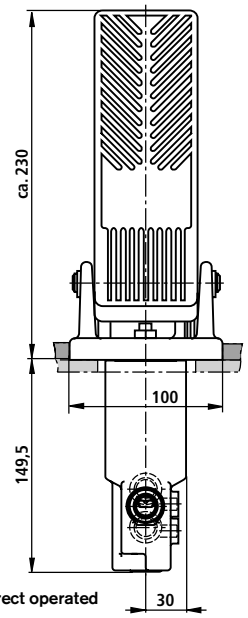
Single-circuit remotely powered brake valve fitted with standard brake pedal
Material no: R900412419

Angle adjustment in 5° increments:

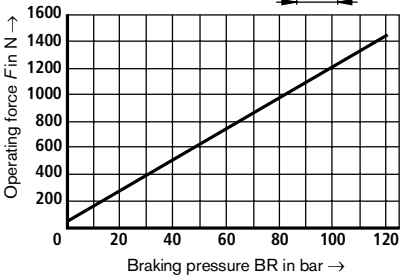
Hole	α
1	25°
2	30°
3	35°
4	40°

(Standard version)

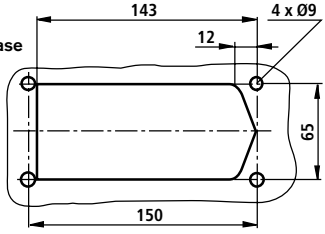




Operating force, direct operated



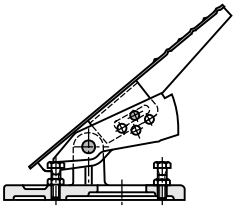
Mounting hole pattern in the base plate



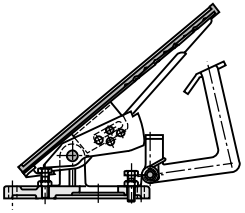
Installation note: In the case of installation below the base plate, take care that the movement of the pedal is not impaired by accumulated dirt.

Brake pedal variants LT 19 and LT 20 (further variants on enquiry)

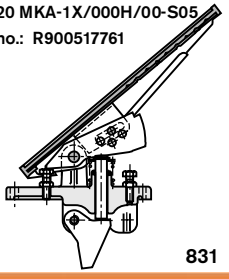
Type: LT 19 MKA-1X/000/00-S09
Material no.: R900571680



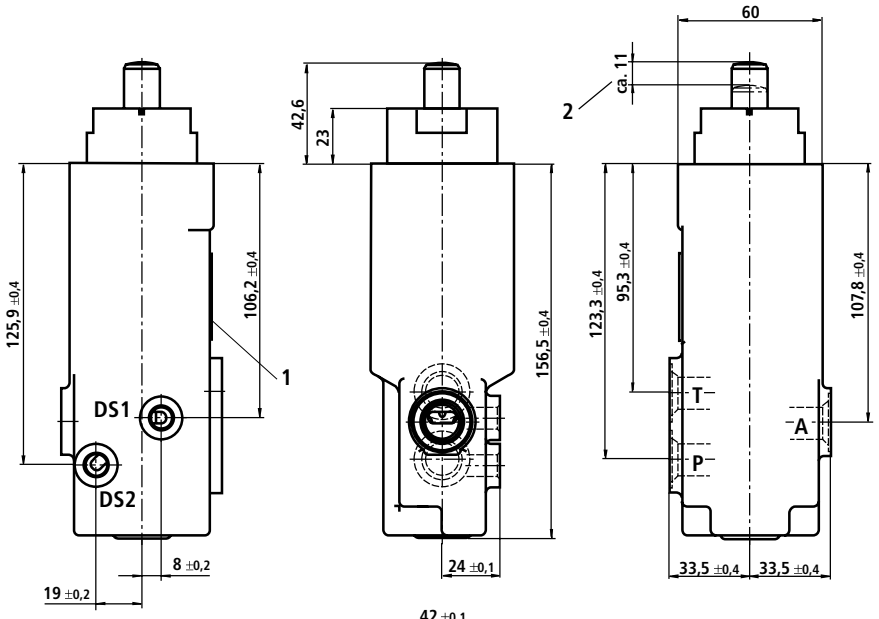
Type: LT 19 MKA-1X/000H/00-S01
Material no.: R900328534

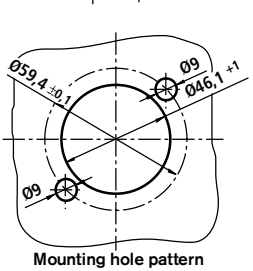


Type: LT 20 MKA-1X/000H/00-S05
Material no.: R900517761

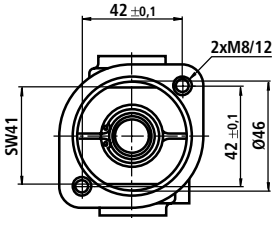


Unit dimensions: without pedal (in mm)

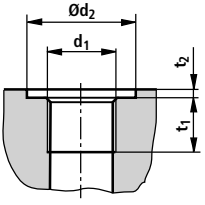




Mounting hole pattern



1 Nameplate
2 Operating stroke (depending on variant)



Port	d_1	$Ød_2$	t_1	t_2
A	M16x1,5	23	13	1
P	M16x1,5	23	13	1
T	M16x1,5	23	13	1
DS1	M10x1	16	9	–
DS2	M10x1	16	9	–

P = Service brake accumulator (service circuit)
T = Tank
A = Service brake (service circuit)
DS1 = Stoplight pressure switch
DS2 = Accumulator pressure pressure switch

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Rexroth
Bosch Group

Accumulator charging valve LT 06

RE 66191/10.2011 1/6
Replaces: 08.2004
English

Data sheet


LT 06-3X

Component series 3X

Maximum operating pressure 200 bar
Approx. 4 bar Δp with a flow of 70 l/min

Table of contents

Features

- Simple and quick installation
- Reduced piping effort
- Small installation dimensions
- Integration into existing hydraulic systems is possible
- Quickly ready-for-operation
- Flexible connection possibilities of accumulators
- Connection possibilities for downstream consumers

Function

Accumulator charging valves or pressure shut-off valves assume the function of keeping a pressure level in an accumulator circuit within certain limit values (cut-in pressure, cut-out pressure). The switching pressure differential is approx. 18 % of the cut-off pressure.

CAUTION! If downstream consumers (**N**) generate a higher pressure than the cut-off pressure of the accumulator charging valve, the pressure of the accumulator circuit is raised to this level. The pressure of the downstream consumers (**N**) must be 30 % lower than the accumulator pressure (N < Accumulator pressure –30 %).

The valve basically consists of a pilot control with pressure adjustment element (**1**), pressure compensator (**2**) and check valve (**3**).

Changing the pump flow over from accumulator charging to neutral circulation

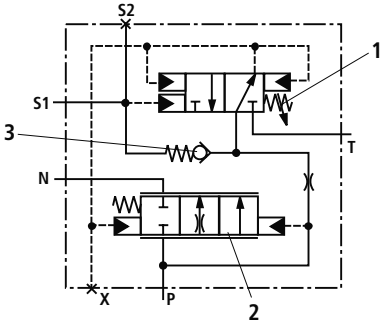
During the charging process, the pump feeds oil via the check valve (**3**) into the accumulator circuit. To this end, the pressure is directed via the pilot line and pilot control to the load signal side of the pressure compensator (**2**). This pressure compensator throttles the pump flow until the pressure that builds up in the accumulator circuit overcomes the spring force of the pressure adjustment element (**1**).

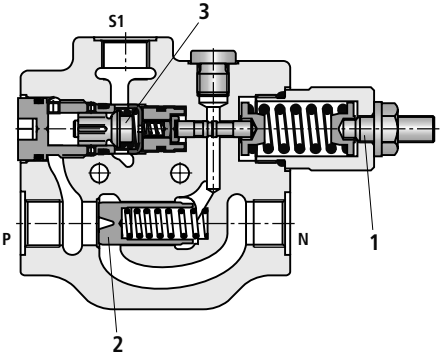
The pilot control element reconnects the load signal line of the pressure compensator (**2**) from **S1** to **T**. The pressure compensator (**2**) then re-directs the pump flow from **P** to **N** and the check valve (**3**) closes. The charging process is completed and the pump flow flows with a low Δp through the charging valve.

Changing the pump flow over from neutral circulation to accumulator charging

When the pressure in the accumulator circuit falls below the lower switching point (cut-in point), **P** is connected to the load signal chamber of the pressure compensator (**2**) and the pump flow is directed again into the accumulator circuit.

Symbol, Cross-section





1 Pressure adjustment element (factory setting)
2 Pressure compensator
3 Check valve

P Pump
T Tank
S1 Accumulator circuit 1
S2 Accumulator circuit 2
X Load Sensing (LS)
N Downstream consumers

Ordering code

LT 06 – 3X / / *

Component series 30 to 39 (30 to 39: unchanged installation and connection dimensions) = **3X**

Pressure stage of the accumulator circuit
100 bar = **100**
150 bar = **150**
185 bar = **185**
200 bar = **200**

Accumulator charging flow
Approx. 6 l/min = **B18**
Approx. 17 l/min (Standard) = **B40**

Further details in clear text

Sealing material
M = NBR seals, suitable for mineral oil (HL, HLP) acc. to DIN 51524
⚠ CAUTION!
Observe sealing compatibility of the hydraulic fluid used!

Line connections
02 = Metric threads acc. to DIN 3852-1
50 = Threads acc. to DIN ISO 6149-1

Preferred standard types:

Pressure stage [bar]	LT 06 B18 Part No.	LT 06 B40 Part No.
150	R900455464	R900427591
200	R900586937	R900427595

Technical data (For applications outside these parameters, please consult us!)

General			
Weight		kg	approx. 3
Installation position			upright preferred, pressure adjustment element face upwards
Ambient temperature range		°C	–25 to +80
Coating			Single-coat varnish RAL 5010

Hydraulic			
Max. operating pressure in the accumulator circuit		bar	200
Max. supply pressure	• Port **P**	bar	200
Max. tank pressure	• Port **T**	bar	zero pressure to tank
Max. flow (with approx. 4 bar Δp)	• Accumulator charging flow **P** → **S**	l/min	approx. 17 (Standard = **B40**)
	• Pump flow **P** → **N**	l/min	70
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524, other hydraulic fluids, such as HEES (synthetic esters) according to VDMA 24568 as well as hydraulic fluids as specified under RE 90221, on inquiry.
Hydraulic fluid temperature range		°C	–20 to +80
Viscosity range		mm^2/s	2,8 to 380
Maximum permitted degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 20/18/15, for this we recommend a filter with a minimum retention rate of $\beta_{10} \geq 75$.

General notes

Installation notes

- Observe the minimum distance of 30 cm to the valve while cleaning with a high-pressure cleaner.
- The cross-sections of hydraulic transmission elements (pipes, hoses) must be selected so that at low operating temperatures the pressure drop between hydraulic accumulator and brake cylinder remains low.
- Port **T** must be connected separately at zero pressure to tank.
- Ensure that the brake system is always vented.
- Protect the pressure compensator from falling down while removing the plug from port **P**.

Notes for the repair

- Damaged valves must be repaired, even if their function is not impaired.

Intended use

Accumulator charging valves LT 06 are hydraulic components and are therefore either covered by the cope of the completely or the partly completed machinery in the sense of the EC machinery directive 2006/42/EC. The component is exclusively intended to be assembled together with other components to form partly completed or complete machinery. The component may only be commissioned if it has been integrated in the machine for which it is designed.

You may use the product as follows:

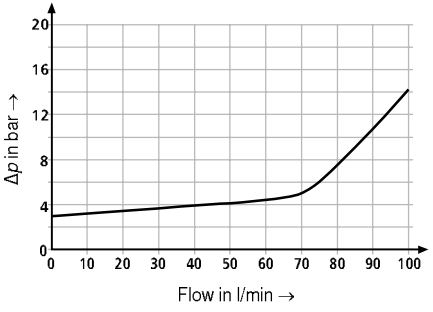
Accumulator charging valves LT 06 have been developed for the application in mobile working machinery

▶ Comply with the technical data.

The product is only intended for professional use and not for private use.

Characteristic curve

Pressure loss Δ*p* from P → N



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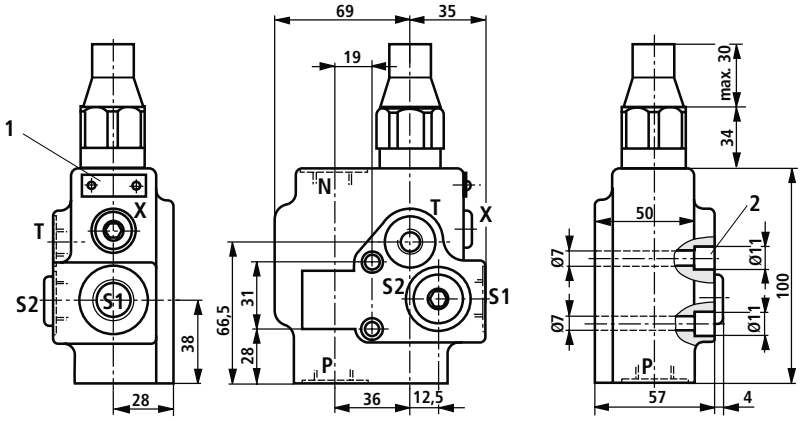
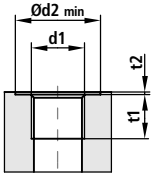
Unit dimensions (in mm)



1 Name plate
2 Fixing holes

Ports acc. to DIN 3852-1

Port	d_1	Ød_2	t_1	t_2
P, N	M18x1,5	32	12	1
S1, S2	M18x1,5	32	12	1
T, X	M12x1,5	19	12	1



Ports **S2, X** are plugged by default.

5

Spare parts

Protective cap (Color code orange) for pressure adjustment element	**Part number:**	**R900025379**

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Rexroth
Bosch Group

Dual-circuit remotely powered brake valve LT 07

RE 66146/07.2011 1/8

Replaces: 10.2003
English

Data sheet

Component series 2X

Nominal braking pressure
60, 80, 100 and 120 bar


H/A 4597

Table of contents

Features

- Small installation dimensions
- Integrated maximum pressure limitation of the brake circuit
- Brake pressure proportional to actuation lorce
- Synchronisation through low hysteresis
- All consumer ports on one side
- Optimal piping by freely swivelling fixnig flange
- External brake pressure return possible
- Ergonomic adaption of the pedal blade angle possible
- All pedal variations with slip resistant, removable rubber plates

5

Function

The dual-circuit remotely powered brake valve LT 07 is a directly operated pressure relief valve in 3-way design with stepless mechanical operation.

It has a maximum pressure relief of secondary circuits and infinitely adjustable pressure in the secondary circuits (braking circuits) which is in proportion to the travel of the operating element (**4**) or to the actuation travel angle of the pedal (**8**).

With the failure of one brake circuit the second brake circuit remains fully functional due to the mechanical contact of both spools (**2**). The actuation force at the pedal remains unchanged.

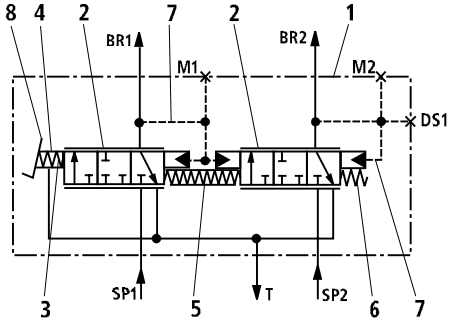
The dual-circuit remotely powered brake valve consists mainly of the housing (**1**) and control spool (**2**), main compression springs (**3**), operating element (**4**) and the return springs (**5**) and (**6**).

The valve is operated via the operating element (**4**). This pushes the main compression springs (**3**) against both control spools (**2**). Firstly the control edges closes at channel **T**, afterwards the flow from **SP** to **BR** is released in both braking circuits.

The pressure building up in the brake lines pushes simultaneously via the brake pressure returns (**7**) behind the control spool against the main compression spring (**3**) so that the brake pressure (secondary pressure) rises in proportion to the deflection of the operating element (**4**). With the deflection of the operating element kept constant, the control spool (**2**) moves into the control position and holds the defined pressure in channels **BR1** and **BR2** constant. Thereby the pressure in **BR1** is only approx. 2 bar higher than in **BR2**. The actuation force of the operating element is therefore proportional to its deflection.

When the main compression springs (**3**) are unloaded, the return springs move the control spools back to initial position. The control edges close from **SP** to **BR** and open **BR** towards **T.** Thus closes the secondary circuits (braking circuits).

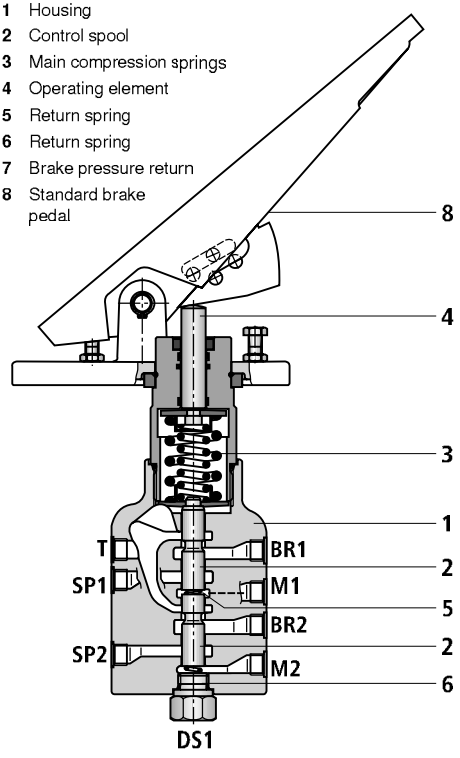
Symbol, cross-section



SP1	Supply operating brake circuit 1
SP2	Supply operating brake circuit 2
T	Tank
BR1	Operating brake circuit 1
BR2	Operating brake circuit 2
M1	Brake pressure return (Operating brake circuit 1) [1]
M2	Brake pressure return (Operating brake circuit 2) [1]
DS1	Pressure switch (brake light)

[1] Optionally pressure switch (brake light)

1 Housing
2 Control spool
3 Main compression springs
4 Operating element
5 Return spring
6 Return spring
7 Brake pressure return
8 Standard brake pedal



Ordering code

LT 07 | M – 2X / | /02 | M | | *

Type of actuation
Mechanical = **M**

Component series 20 to 29 = **2X**
(20 to 29: unchanged installation and connection dimensions)

Nom. braking pressure
60 bar = **060**
80 bar = **080**
100 bar = **100**
120 bar = **120**

02 = **Line connections** (see table on page 6)
Metric threads acc. to DIN 3852-1

M = **Sealing material**
NBR seals, suitable for mineral oil (HL, HLP) acc. to DIN 51524
CAUTION!
Observe sealing compatibility of the hydraulic fluid used!

No code = **Accessories**
Without
12 = Fitted with a standard brake pedal

Further details in clear text

Preferred standard types:

Braking pressure [bar]	LT 07 without pedal Part No.	LT 07 with fitted standard pedal (12) Part No.
060	R900900612	R900900334
080	R900907143	R900904638
100	R900905251	R900904622
120	R900907144	R900907145

Technical data (For applications outside these parameters, please consult us!)

General			
Weight	• Without pedal	kg	4,7
	• With standard pedal	kg	6,4
Installation position			upright preferred
Ambient temperature range		°C	–25 to +80
Coating			Single-coat varnish RAL 5010

Hydraulic			
Operating brake pressure, max.	• Port **BR1, BR2**	bar	120
Supply pressure, max.	• Port **SP1, SP2**	bar	200
Tank pressure, max.	• Port **T**	bar	0,5 (Tank pressure must not exceed the pressure being applied by the brake.)
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524, other hydraulic fluids, such as HEES (synthetic esters) according to VDMA 24568 as well as hydraulic fluids as specified under RE 90221, on inquiry.
Hydraulic fluid temperature range		°C	–20 to +80
Viscosity range		mm^2/s	2,8 to 380
Maximum permitted degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 20/18/15, for this we recommend a filter with a minimum retention rate ofn $\beta_{10} \geq 75$.

5

General notes

Installation notes

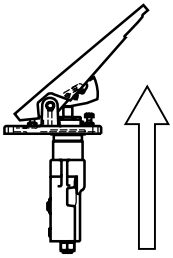
- Rubber parts must **not** be painted..
- Operating elements must not be directly exposed to highpressure jet cleaning.
- The cross-sections of hydraulic transmission elements (pipes, hoses) must be selected so that at low operating temperatures the pressure drop between hydraulic accumulator and brake cylinder remains low.
- The tank must be mounted above the brake valve LT 07 to avoid drainage of the brake valve.

Notes for the repair

- Damaged valves must be repaired, even if their function is not impaired.

Installation position

- Upright preferred.



Intended use

Brake vavles LT 07 are hydraulic components and are therefore either covered by the cope of the completely or the partly completed machinery in the sense of the EC machinery directive 2006/42/EC. The component is exclusively intended to be assembled together with other components to form partly completed or complete machinery. The component may only be commissioned if it has been integrated in the machine for which it is designed.

You may use the product as follows:

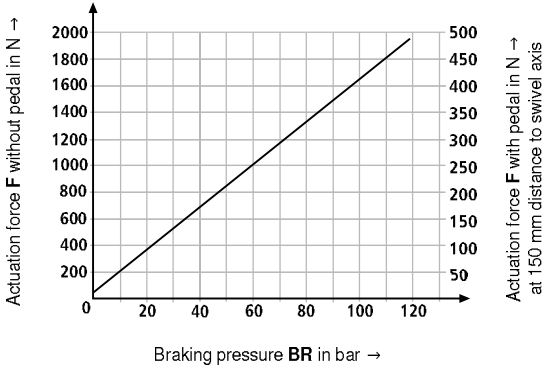
The brake valves LT 07 have been developed for the application in mobile working machinery.

▶ Comply with the technical data.

The product is only intended for professional use and not for private use.

Theoretical characteristic curves

Actuation force without and with pedal according to braking pressure



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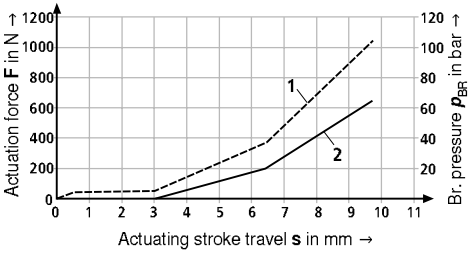
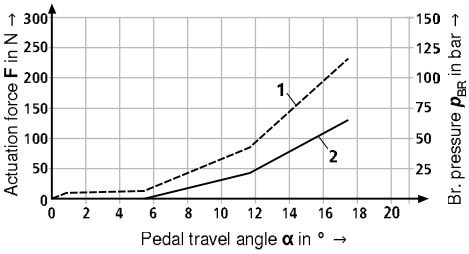
Theoretical characteristic curves (Preferred types)

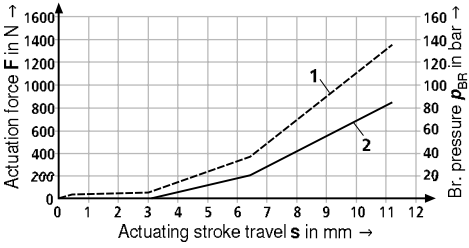
Without pedal	With pedal

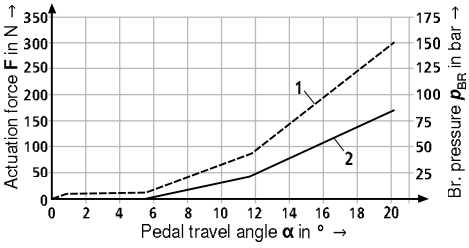
- **60 bar;** **1** = Force **F**, **2** = Braking pressure **BR**



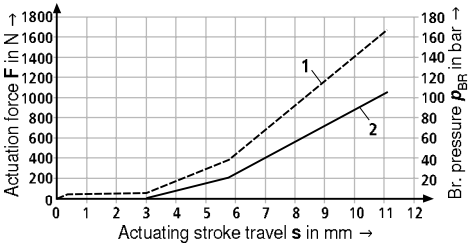


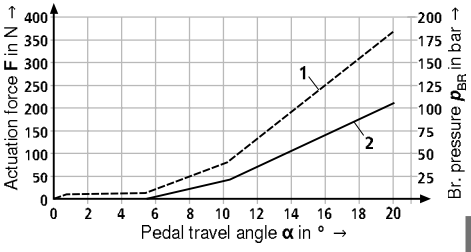
- **80 bar;** **1** = Force **F**, **2** = Braking pressure**BR**



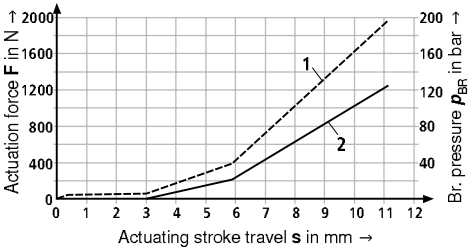


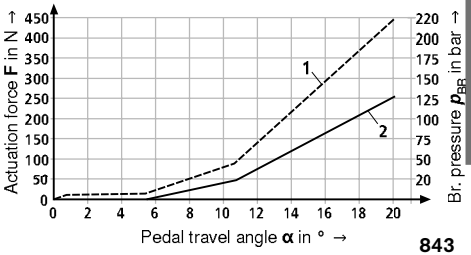
- **100 bar;** **1** = Force **F**, **2** = Braking pressure **BR**



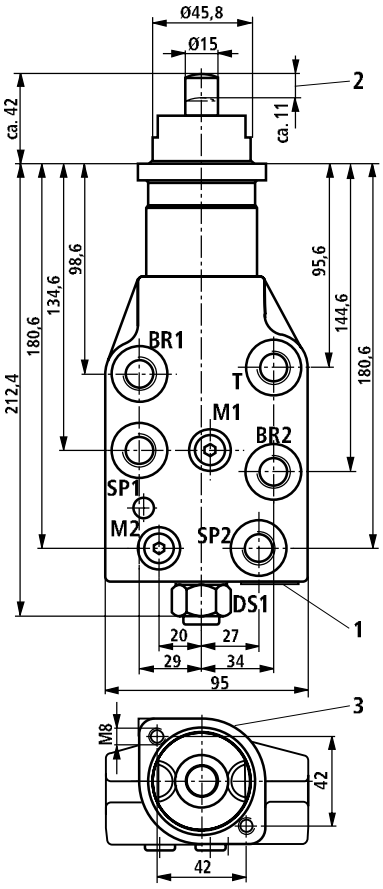


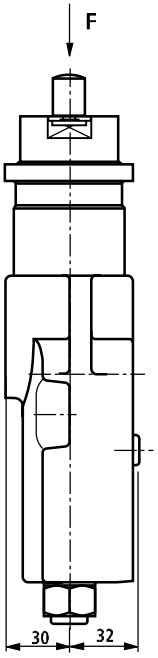
- **120 bar;** **1** = Force **F**, **2** = Braking pressure **BR**



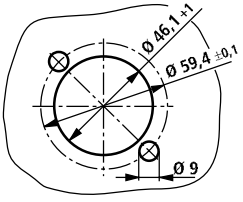


Unit dimensions: Without pedal (in mm)





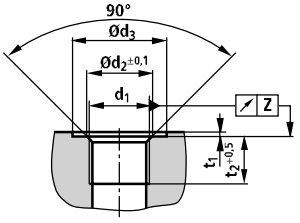
1 Name plate
2 Actuating stroke tavel
3 Fixing flange swiveling 360°
F Actuation force



Assembly interface in base plate

Ports acc. to DIN 3852-1

Port	d_1	$Ød_2$ ±0,1	$Ød_3$	t_1	t_2	z
BR1; BR2	M16x1,5	16,4	26	1,5	12	0,05
SP1; SP2	M16x1,5	16,4	26	1,5	12	0,05
T	M16x1,5	16,4	26	1,5	12	0,05
DS1	M12x1,5	12,4	20	0,9	11	0,1
M1, M2	M10x1	10,4	27	1,5	8	0,05



Ports **DS1**, **M1** and **M2** plugged by default.

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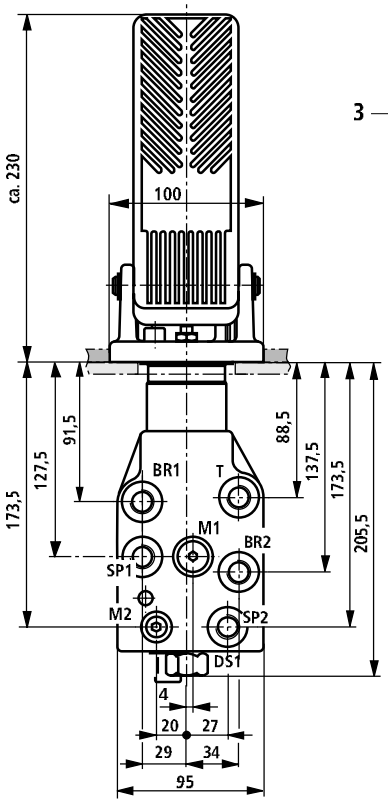
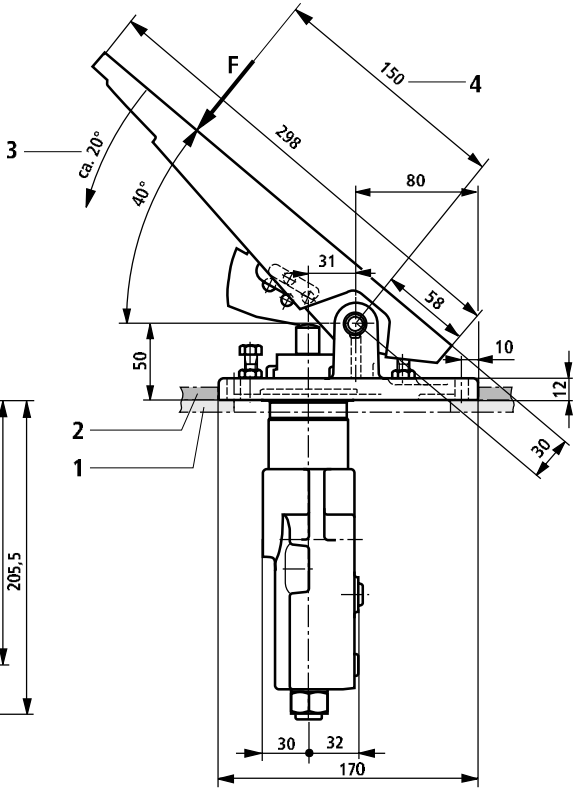
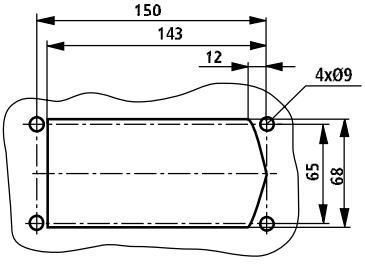
Unit dimensions: With standard pedal (in mm)







Assembly interface in base plate

1 Base plate
2 Rubber mat
3 Actuation angel
4 Distance
F Actuation force

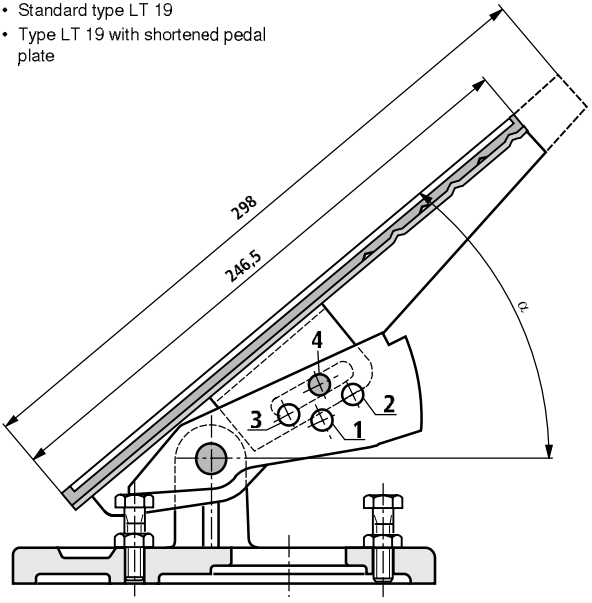
ASSEMBLY NOTE!

When assembling below the base plate it must be taken care that the movement of the pedal cannot be affected by dirt.

Brake pedal variations LT 19 and LT 20 (Further variants on request)

The brake valve LT 07 is optionally provided with or without pedal.
The following pedals are available:

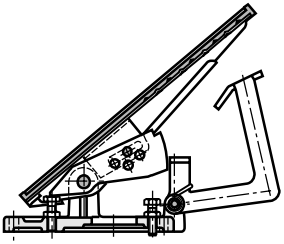
- Standard type LT 19
- Type LT 19 with shortened pedal plate



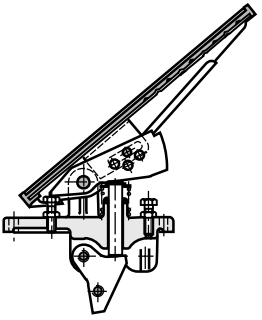
Pedal angle α:

1 Hole 1 = 25°
2 Hole 2 = 30°
3 Hole 3 = 35°
4 Hole 4 = 40° (Standard)

- Type LT 19 with detent



- Type LT 20 for horizontal fitted brake valves



NOTE!
All pedal variations are fitted with a slip resistant, removable rubber plate by default.

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Rexroth
Bosch Group

Hand brake valve LT 08

RE 66148/07.09 1/4
Replaces: 07.03

Data sheet

Component series 2X


HAD 6881/02

Table of contents

Features

- Pipe line installation
- Integrated maximum pressure relief
- Good fine control
- Mechanically operated

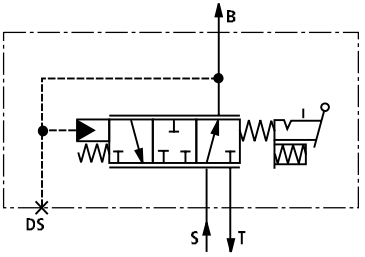
Function, Symbol

The hand brake valve is designed as a direct operated 3-way pressure reducing valve and is designed for use in spring loaded braking systems; other applications, however are also possible.

In position 1 (see Unit dimensions) of the hand lever the through flow from S to B is open. The spring load braking system is, therefore opened with the pressure applied in B. In this position the maximum defined pressure in B is limited according to type of the valve 25, 40, 60, 100 or 125 bar independent of the pressure at input S.

By moving the hand lever into the detent position 2, the pressure from B to T is decreased directly proportional to the travel of the lever and the operating speed. The pressure at port B can be finely controlled with hand lever. The spring load braking system is activated.

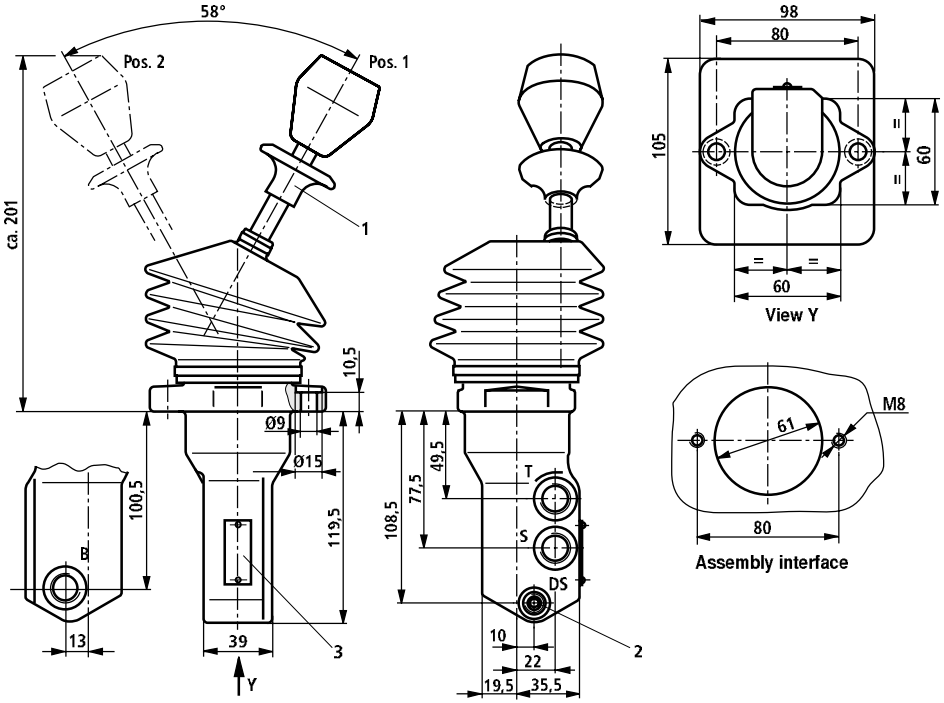
The operating lever is released by lightly lifting the release *ring* (1).



Technical data (for applications outside these parameters, please consult us!)

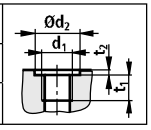
Supply pressure, max.	bar	200
Tank pressure, max.	bar	0.5
Pressure fluid		Mineral oil (HL, HLP) to DIN 51524
Pressure fluid temperature range	°C	–20 to +80
Viscosity range	mm^2/s	2.8 to 380
Maximum permitted contamination level of hydraulic fluid Purity class to ISO 4406 (c)		Class 20/18/15, we recommend for this a filter with a minimum retention rate of $\beta_{10} \geq 75$
Weight	kg	3.2

Unit dimensions (Dimensions in mm)



1 Release ring
2 Connection possibility for a pressure switch
3 Name plate

Pos. 1 Travel operation
Pos. 1 Brake position, detented

	Port	d_1	d_2	t_1	t_2	
02	S, T, B	M16x1.5	24.3	12	1	
	DS	M12x1.5	18	12	1	

Order details

LT	08	MM	A –2X/	/02	M	*

Component series 20 to 29
(20 to 29: unchanged installation and connection dimensions) = 2X

Brake ventilation pressure
Pressure stage 25 bar = 025
Pressure stage 40 bar = 040
Pressure stage 60 bar = 060
Pressure stage 80 bar = 080
Pressure stage 100 bar = 100
Pressure stage 125 bar = 125

Connection thread
02 = Metric thread

Sealing material
M = NBR seals, suitable for mineral oil (HL, HLP) to DIN 51524
⚠ Caution!
Observe sealing compatibility of the hydraulic fluid used!!

Further details in clear text

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Bosch Group

Relay valve LT 09

RE 66153/01.2011 1/6
Replaces: RE 66152

Data sheet

Component series 2X

Maximum brake pressure 200 bar


HAD7835

Table of contents

Features

- Relay valves are used in vehicles with very long brake lines or very large brake cylinder volumes.
- The connection is directly at the axis which is to be decelerated.
- The brake pressure is proportional to the control pressure.

Function

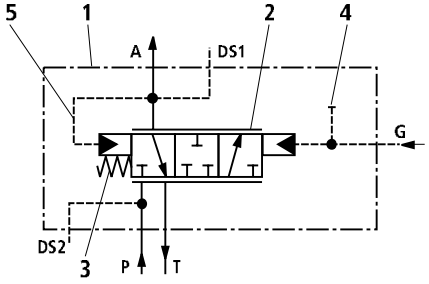
The hydraulic relay valve is a directly operated proportional pressure reducing valve of 3-way design with hydraulic pilot.

The relay valve consists mainly of the housing (**1**), control spool (**2**), return spring (**3**) and bleed screw (**4**).

The valve is controlled via a hydraulic control pressure in port **G**. This control pressure directly effects the control spool (**2**). Firstly the control edge closes at port **T**, afterwards the flow from **P** to **A** is released.

The pressure which builds up in the brake line **A** simultaneously pushes via the pilot oil drilling (**5**) behind the control spool (**2**) against the control pressure so that the brake pressure rises in proportion to the control pressure. With the control pressure being held constant, the control spool (**2**) moves into the control position and holds the value set in channel **A** constant. When the control pressure decreases, the return spring closes via the control spool (**2**) from **P** to **A** and opens **A** to **T**, so that the braking circuit is unloaded.

Symbol



P	Pump
T	Tank
A	Operating brake
G	Control pressure
DS1	Pressure switch for brake light
DS2	Pressure switch for accumulator

Order details

LT	09	HA–2X	/	/	M	*

Type of operation
Hydraulic = **HA**

Unit series 20 to 29 (20 to 29: unchanged installation and connection dimensions) = **2X**

Pressure stage
Details given in bar, 3-digit (max. 200 bar)
e.g. 150 bar = **150**

Further details given in clear text

Seal material
M = NBR seals, suitable for mineral oil (HL, HLP) to DIN 51524

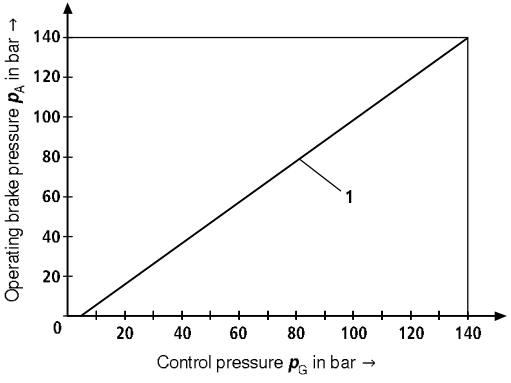
Pipe connections
02 = Metric threads to DIN 3852-1
50 = Connection threads to DIN ISO 6149-1

Technical data (for applications outside these parameters, please consult us!)

General			
Weight		kg	3
Installation position			upright, bleed screw at the top (see page 4)
Ambient temperature range	ϑ	°C	–20 to +80

Hydraulic			
Supply pressure, max.	p_P	bar	250
Control pressure, max.	p_G	bar	140
Operating brake pressure, max.	p_A	bar	200
Tank pressure, max.	p_T	bar	0.5
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524, other hydraulic fluids, such as HEES (synthetic esters) according to VDMA 24568 as well as hydraulic fluids as specified under RE 90221, on inquiry.
Hydraulic fluid temperature range	ϑ	°C	–20 to +80
Viscosity range	ν	mm²/s	2.8 to 380
Maximum permitted degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 20/18/15, for this we recommend a filter with a minimum retention rate of $\beta_{10} \geq 75$

Characteristic curve



1 Standard; ratio $\frac{p_A}{p_G} = 1:1$

Further ratios on inquiry.

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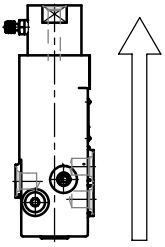
General notes

Installation notes

- Rubber parts must **not** be painted.
- Operating elements must not be directly exposed to high-pressure jet cleaning.
- The cross-sections of hydraulic transmission elements (pipes, hoses) must be selected so that at low operating temperatures the pressure drop between hydraulic accumulator and brake cylinder remains low.
- Preferrably the accumulators should be installed near the relay valve.
- The tank pressure must not exceed the brake application pressure.
- The tank must be mounted above the relay valve LT 09.

Installation position

- Upright, bleed screw at the top.



Notes for the repair

- Damaged valves must be repaired, even if their function is not impaired.

Intended use

Relay valves LT 09 are hydraulic components and are therefore either covered by the cope of the completely or the partly completed machinery in the sense of the EC machinery directive 2006/42/EC. The component is exclusively intended to be assembled together with other components to form partly completed or complete machinery. The component may only be commissioned if it has been integrated in the machine for which it is designed.

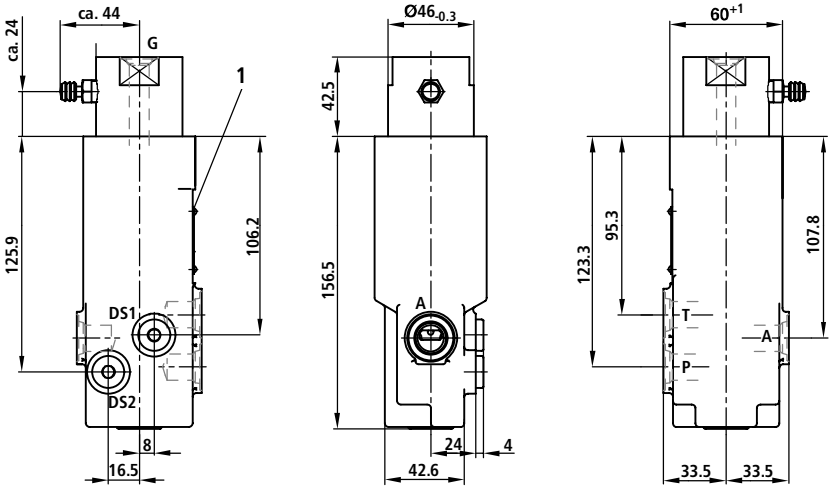
You may use the product as follows::

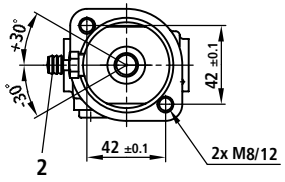
The relay valves LT 09 have been developed for the application in mobile working machinery.

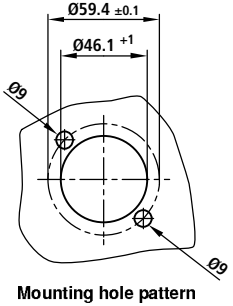
▶ Comply with the technical data.

The product is only intended for professional use and not for private use.

Unit dimensions (in mm)







Mounting hole pattern

P	Pump
T	Tank
A	Operating brake
G	Control pressure
DS1	Pressure switch for brake light
DS2	Pressure switch for accumulator

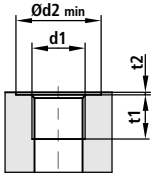
1 Name plate

2 Bleed screw, alignment varies within ±30° relatively to the housing; Tightening torque M_A = 15 Nm, SW12

Line connections

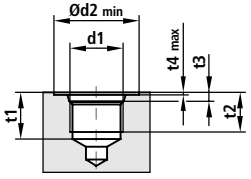
Type: LT 09 HA-2X/ ... 02 ... Ports to DIN 3852-1

Port	d_1	Ød_2	t_1	t_2
P	M16x1.5	23	13	1
T	M16x1.5	23	13	1
A	M16x1.5	23	13	1
G	M12x1.5	18	13	1
DS1	M10x1	16	9	–
DS2	M10x1	16	9	–



Type: LT 09 HA-2X/ ... 50 ... Ports to DIN ISO 6149-1

Port	d_1	Ød_2	t_1 min	t_2 min	t_3 +0.4	t_4 max
P	M16x1.5	24	15.5	13	2.4	1.5
T	M16x1.5	24	15.5	13	2.4	1.5
A	M16x1.5	24	15.5	13	2.4	1.5
G	M12x1.5	19	14	11.5	2.4	1.5



Ports **DS1, DS2** to DIN 3852-1 (see above), pluged by default.

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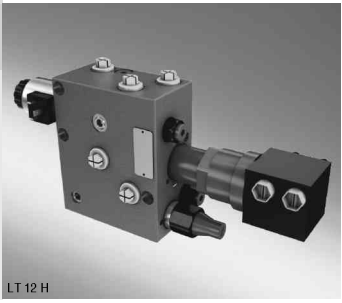
Single-circuit power brake valve of compact design LT 12

RE 66218/05.2012 1/16
Replaces: 09.2007
English

Data sheet


LT 12 H

Component series 3X

Maximum braking pressure 125 bar

Table of contents

Features

Advantages of a compact remotely powered braking system:

- Simple and quick installation
- Piping is reduced to a minimum
- Small space requirement
- Integration into existing hydraulic systems is possible
- Quickly ready-for-operation
- Fast response times
- Sensitive metering
- Minimum number of components

Application areas:

- Earth moving machines
- Fork lift trucks
- Forestry and agricultural machines
- Municipal vehicles
- Special vehicles

5

Function

The LT 12 is a single-circuit brake valve in compact design, which combines all necessary functions in one housing.

The function of the accumulator charging valve (1)

The accumulator charging valve loads, as a priority, the accumulator. When the accumulator pressure falls below the switch-on pressure of the charging valve, the accumulators are loaded until the switch-off pressure is reached. The accumulators are loaded with a flow ol e.g. 17 l/min (version B40). If the pump supplies more than e.g. 17 l/min, then the subsequent actuators are supplied with the difference.

Note: If subsequent consumers (**N**) generate a higher pressure than the cut-off pressure of the accumulator charging valve, the pressure of the accumulator circuit is raised to this level.

Accumulator circuit separation

The valve supplies the both braking circuits service brake (BBA) and parking brake (FBA). The accumulators **S1** (BBA) and **S2** (FBA) are separated by an inverted shuttle valve (**2**). If the BBA fails, the FBA will keep functional and can be used as "auxiliary brake".

The function of the single-circuit brake valve (4)

Mechanical actuation:
The single-circuit brake valve LT 12 is a directly operated 3-way pressure reducing valve with continuous operation.

It comes with an infinitely variable metering of the brake pressure in the BBA (BR1) proportional to the travel of the actuator and to the actuating force. The maximum brake pressure of the BBA must be set at the brake pedal (e.g. LT 20), see page 8.

Hydraulic actuation:
With hydraulic operation, the tandem master cylinder is operated by an appropriate pedal. The pressure fluid fed by the tank is piped to the pickup-head of the LT 12 proportional to the pedal travel. The tandem master cylinder as well as the pickup-head of the LT 12 have two separate chambers.

The pickup-spools steer in line proportional to the fed pressure fluid and charge the main brake spools via the brake pressure control springs.

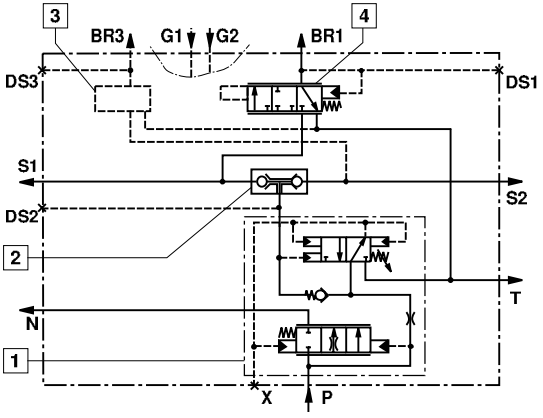
The function of the mechanical operated parking brake/ auxiliary brake (4)

The parking brake valve is a direct operated 3-way pressure reducing valve. When the valve is actuated, the pressure falls in proportion to the actuation. The valve controls the pressure sensitively. Therefore the function "auxiliary brake" can also be operated.

The function of the electrical operated parking brake (4)

The electrically switched parking brake is a 3/2-way directional valve. When the valve is switched with a voltage, then the parking brake is released with the accumulator pressure from accumulator **S2**. The auxiliary brake function cannot be performed.

Symbol



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1	Accumulator charging valve
2	Shuttle valve
3	Parking brake (optional)
4	Single-circuit brake valve

P	Pump
T	Tank
N	Drain or subsequent consumers
BR1	Service brake (BBA)
BR3	Parking brake (FBA)
S...	Accumulator line and accumulators
DS...	Pressure switch for monitoring
G...	Hydraulic operation of the service brake
X	Load Sensing (LS)

Technical data (For applications outside these parameters, please consult us!)

General			
Line connections			Metric threads
Weight		kg	approx. 10
Installation position			Horizontal (preferred)
Ambient temperature range		°C	–25 to +80
Coating			Single-coat varnish RAL 5010

Hydraulic			
Accumulator pressure, max.		bar	200
Operating brake pressure, max.	• Service brake (BBA)	bar	125
	• Parking brake (FBA) Version **M**	bar	120 (proportional)
	• Parking brake (FBA) Version **E**	bar	Relates to the accumulator charging pressure / depending on the accumulator charging valve
System pressure, max.		bar	210
Accumulator charging pressure, max.	• Switch-off pressure	bar	200
	• Switch-on pressure	bar	approx. 20% below switch-off pressure
Flow, max.	• Accumulator charging flow	l/min l/min	Version B40: approx. 17 l/min (Standard) Version B18: approx. 6 l/min
	• Pump flow	l/min	70
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 Biodegradable hydraulic fluids on inquiry
Hydraulic fluid temperature range		°C	–20 to +80
Viscosity range		mm^2/s	2,8 to 380
Maximum permitted degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 20/18/15, for this we recommend a filter with a minimum retention rate of $\beta_{10} \geq 75$.

Electric			
Type of voltage			Direct current
Supply voltage		V	12 DC; 24 DC
Type of protection acc. to VDE 0470-1 (DIN EN 60529) DIN 40050-9	• Version **K4**		IP 65 with mating connector correctly mounted and locked [1]
	• Version **C4**		IP 66 with mating connector correctly mounted and locked [1]
			IP 69K with Rexroth mating connector (Mat. no. R901022127) [1]
	• Version **K40**		IP 69K with mating connector correctly mounted and locked [1]

[1] Mating connectors are not included in the scope of supply and need to be ordered separately, see data sheet RE 08006.

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Ordering code

LT 12		3X/	…		…				/02	M		*

Single-circuit-compact brake-block = **LT12**

Type of actuation (BBA)
Mechanical = **M**
Hydraulic = **H**

Series 30 to 39 = **3X**
(30 to 39: unchanged installation and connection dimensions)

Characteristic curve
Linear = **L**
Progressive = **P**

Pressure of the service brake system (BBA)
40 bar = **040**
60 bar = **060**
80 bar = **080**
100 bar = **100**
125 bar = **125**

Type of actuation parking brake (FBA)
Without FBA = **–**
Mechanical = **M**
Electrically switched = **E** [1]

Lifting pressure of parking brake (FBA) [1] = **XXX**
Without FBA = **000**
20 bar = **020**
40 bar = **040**
60 bar = **060**
80 bar = **080**
100 bar = **100**
120 bar = **120**

Accumulator charging pressure
A = 100 bar
B = 120 bar
C = (Standard) 150 bar
D = 165 bar
E = 185 bar
F = 200 bar

Accumulator charging flow
B40 = Approx. 17 l/min (Standard)
B18 = ca. 6 l/min

Voltage of solenoid
AG12 = 12 V
AG24 = 24 V

Type of plug [2]
N **K4** = Plug-in connector
N **K40** = Deutsch plug
N **C4** = Junior timer, 2-pin (AMP)
N = Standard with manual override

02 = Metric threads

Sealing material
M = NBR seals, suitable for mineral oil (HL, HLP) acc. to DIN 51524
CAUTION! Observe sealing compatibility of the hydraulic fluid used!

Auxiliary equipment
16 = With operating rod

Further details in clear text

[1] With electrically switched FBA **E** the lifting pressure of the FBA relates to the accumulator charging pressure. Observe the hysteresis!
[2] Mating connectors are not included in the scope of supply and need to be ordered separately, see data sheet RE 08006.

General notes

Installation notes

- Rubber parts *must* ***not*** *be painted.*.
- Operating elements must not be directly exposed to high-pressure jet cleaning.
- The cross-sections of hydraulic transmission elements (pipes, hoses) must be selected so that at low operating temperatures the pressure drop between hydraulic accumulator and brake cylinder remains low.
- The tank pressure must not exceed the apply pressure of the brake.
- Ensure that the brake system is always vented.

Notes for the repair

- Damaged valves must be repaired, even if their function is not impaired.

Intended use

Brake valves LT 12 are hydraulic components and are therefore either covered by the cope of the completely or the partly completed machinery in the sense of the EC machinery directive 2006/42/EC. The component is exclusively intended to be assembled together with other components to form partly completed or complete machinery. The component may only be commissioned if it has been integrated in the machine for which it is designed.

You may use the product as follows:

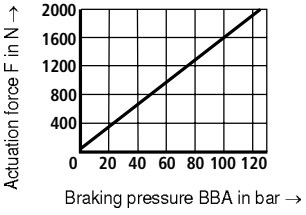
The brake valves LT 12 have been developed for the application in mobile working machinery.

▶ Comply with the technical data.

The product is only intended for professional use and not for private use.

Characteristic curve

Actuation force, service brake directly operated (without pedal)



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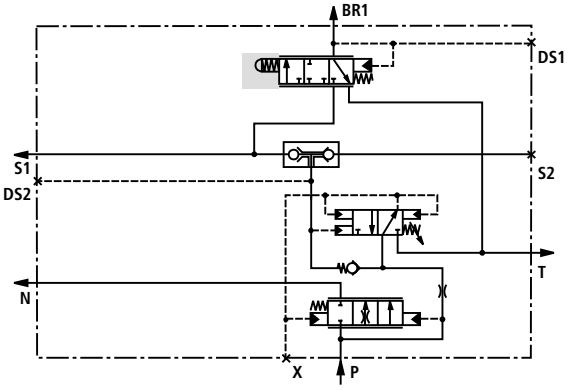
Circuit diagrams

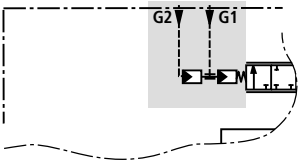
Version LT 12 | M | 3X/... | – | ...

- Mechanical (foot operation)
- Without parking brake



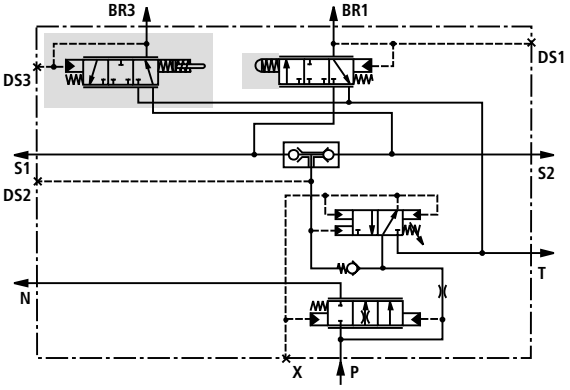
Version LT 12 | H | 3X/... | – | ...

- Hydraulic (foot operation)
- Without parking brake



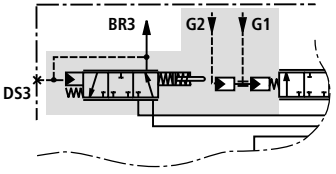
Version LT 12 | M | 3X/... | M | ...

- Mechanical (foot operation)
- Mechanical parking brake (hand operation)



Version LT 12 | H | 3X/... | M | ...

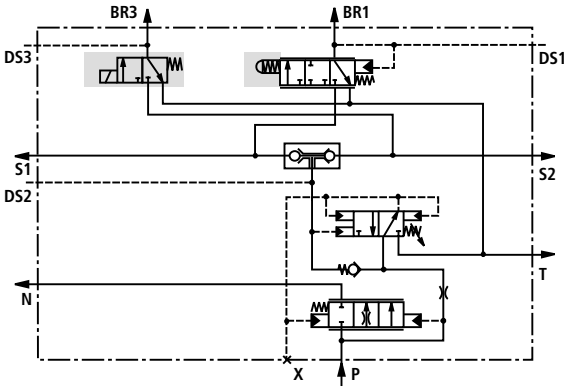
- Hydraulic (foot operation)
- Mechanical parking brake (hand operation)



Circuit diagrams

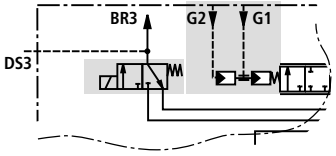
Version LT 12 | M | 3X/... | E | ...

- Mechanical (foot operation)
- Electric parking brake



Version LT 12 | H | 3X/... | E | ...

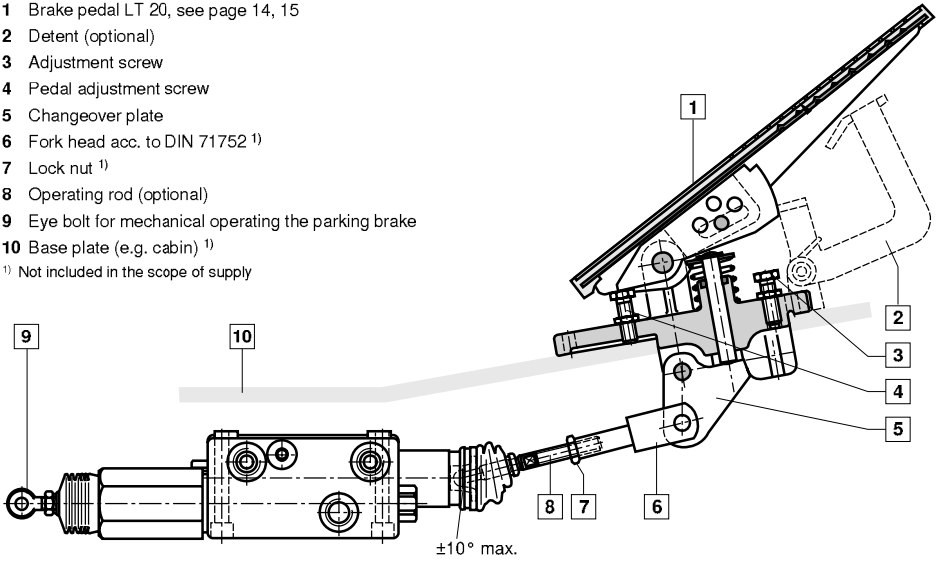
- Hydraulic (foot operation)
- Electric parking brake



Design: LT 12 with mechanical operation

1 Brake pedal LT 20, see page 14, 15
2 Detent (optional)
3 Adjustment screw
4 Pedal adjustment screw
5 Changeover plate
6 Fork head acc. to DIN 71752 [1)]
7 Lock nut [1)]
8 Operating rod (optional)
9 Eye bolt for mechanical operating the parking brake
10 Base plate (e.g. cabin) [1)]

[1)] Not included in the scope of supply



NOTE!

- Valve and pedal with operating rod must be mounted in one line!

Adjustment instructions

Assembly

It is important for low friction operation that the valve and pedal are correctly aligned. When looking in the plan view the valve axis, operating rod, (**8**) and pedal (**1**) must be aligned! In the side view the operating rod can have an off set angle of up to a maximum 10° in relation to the valve. The angle and height of the pedal have a influence on the operating angle and force.

If, due to space requirements, the control has to be fitted with a longer actuating unit then this has to be so designed that it is resistant to buckling (see actuating force).

Adjusting the pedal

The lock nut and fork head are screwed onto the operating rod (**8**) the fork head (**6**) is, after the valve and pedal have been fitted, connected to the changeover plate (**5**) via the axis bolt.

Pedal (1) not actuated

The operating rod (**8**) is so adjusted that the play between the ball end and the valve operator is at its minimum.

CAUTION! The valve operator must not be under tension. The operating rod must be able to slightly move backwards and forwards. The setting is secured via the locknut (**7**).

Pedal (1) actuated

The maximum brake pressure can be adjusted, as required, via the adjustment screw (**3**) and then locked using the lock nut. When the pedal is released only the tank pressure must be applied.

Option – pedal with detent (2)

The lock nut (**7**) and fork head (**6**) are screwed onto the operating rod (**8**). The fork head is connected to the changeover plate (**5**) via the axis bolt. Move the pedal into the detent position. So adjust the operating rod (**8**) that the valve reaches the required maximum operating pressure. The pressure setting is locked using the lock nut (**7**).

Release the detent

With the pedal (**1**) not actuated, adjust the pedal adjustment screw (**4**) until the smallest amount of play is achieved.

Design: LT 12 with mechanical operation (Dimensions in mm)

Parking brake adjustment, version M

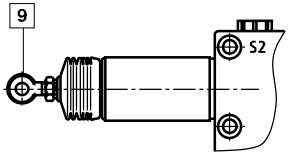
The parking brake is factory pre-set to the required pressure. When the parking brake is not pulled then the parking brake pressure is the factory pre-set pressure. The bowden cable must be so set that, in the non-actuated condition, no pulling force is applied to the eye bolt (**9**).

With an increase in operation (pulling) of the hand brake, the brake pressure falls to tank pressure. The entire force of the spring accumulator cylinder is then applied to the wheel brake. The bowden cable must, for this purpose, make possible a minimum stroke of 10 mm. The holding force relates to the application force and is a maximum of 1100 N. The bowden cable should be so fitted that low friction operation is possible.

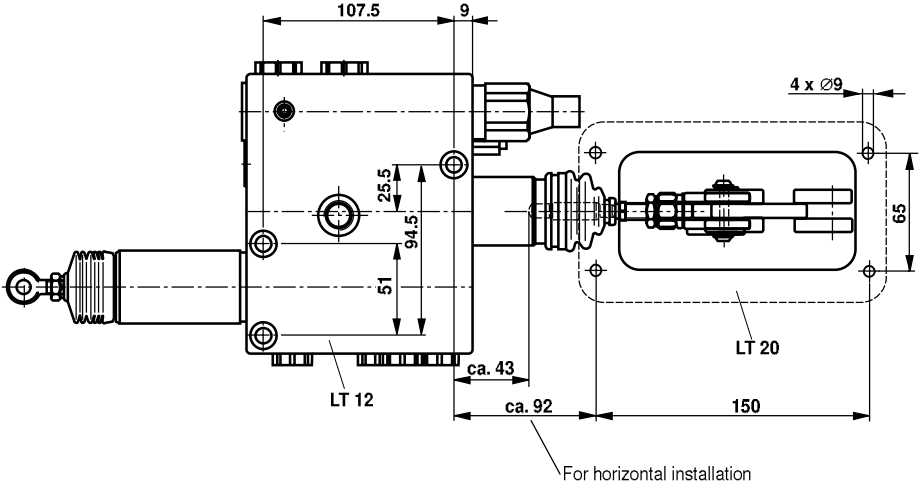
Parking brake, version E

Cannot be adjusted.

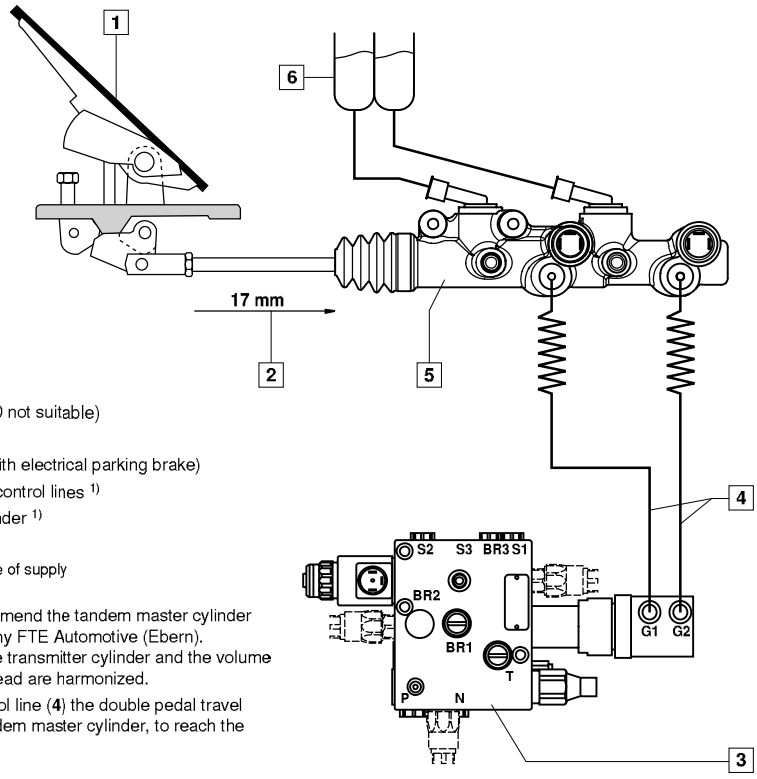
When a voltage is applied to the solenoid (12 or 24 volts) then the accumulator pressure is switched onto the parking brake. The minimum lifting pressure relates to the switch-on pressure of the charging valve. If a voltage is not being applied then the outlet pressure is the same as the tank pressure.



9 Eye bolt for operating the parking brake



Design: LT 12 with hydraulic operation



1 Brake pedal [1] (LT 20 not suitable)
2 Pedal travel 17 mm
3 LT 12 H (Example with electrical parking brake)
4 Flexible dual-circuit control lines [1]
5 Tandem master cylinder [1]
6 Tank [1]

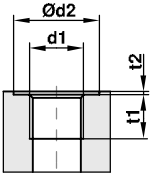
[1] Not included in the scope of supply

For actuation, we recommend the tandem master cylinder MH17861.2.1 of company FTE Automotive (Ebern).
The swept volume of the transmitter cylinder and the volume of the LT 13 H pickup-head are harmonized.

With failure of one control line (**4**) the double pedal travel is necessary for the tandem master cylinder, to reach the brake pressure.

Line connections

Port	d_1	Ød_2	t_1	t_2	Designation
P	M18x1.5	28	12	1.5	Pump
N					Subsequent consumers
T	M16x1.5	26	12	1	Tank
BR1					Service brake
BR3					Parking brake
S1					Accumulator service brake
S2					Accumulator parking brake
G1, G2	M12x1.5	20	12	1	Hydraulic actuation of service brake
X	M12x1.5	18	12	1	Load Sensing (LS)
DS1	M12x1.5	18	12	0.5	Pressure switch brake light
DS3					Pressure switch parking brake
DS2	M10x1	–	6	–	Pressure switch accumulator pressure



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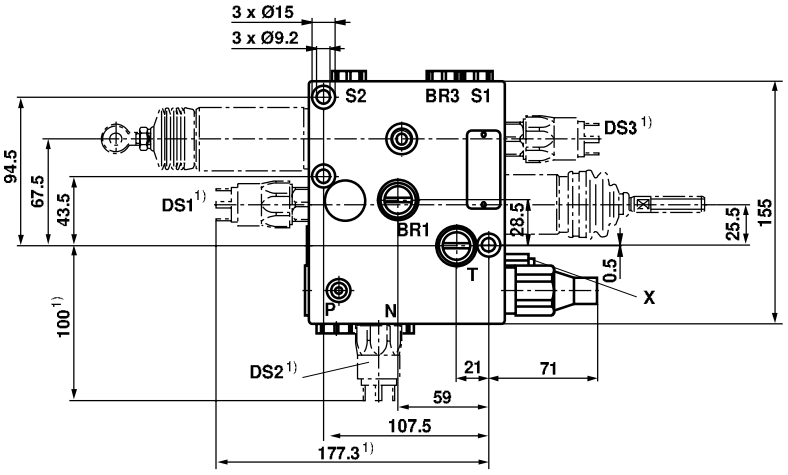
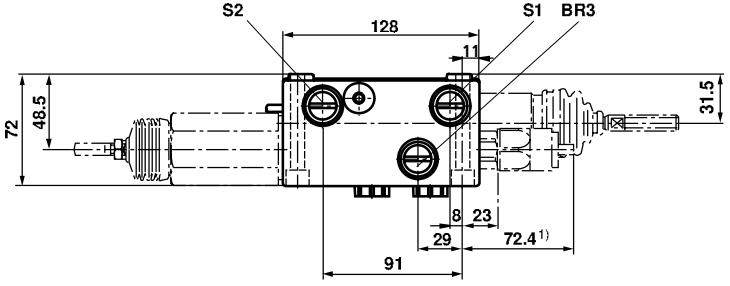
Unit dimensions LT 12 (Dimensions in mm)



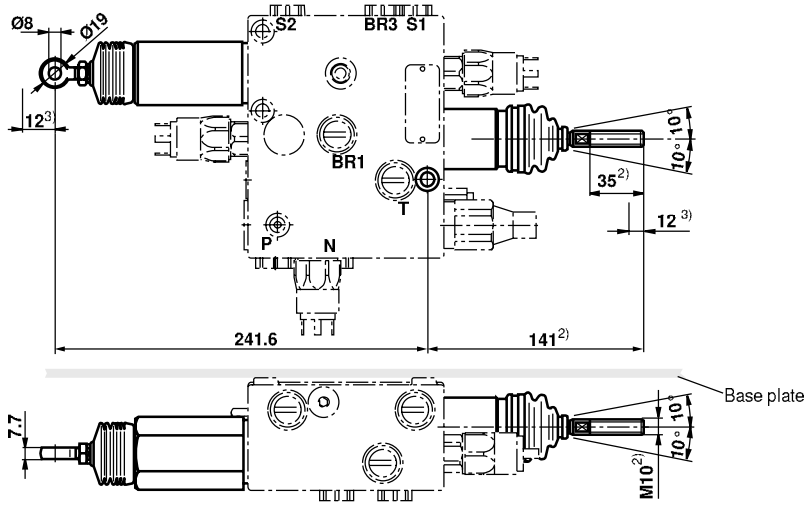


1) Version with pressure switch (optional)

5

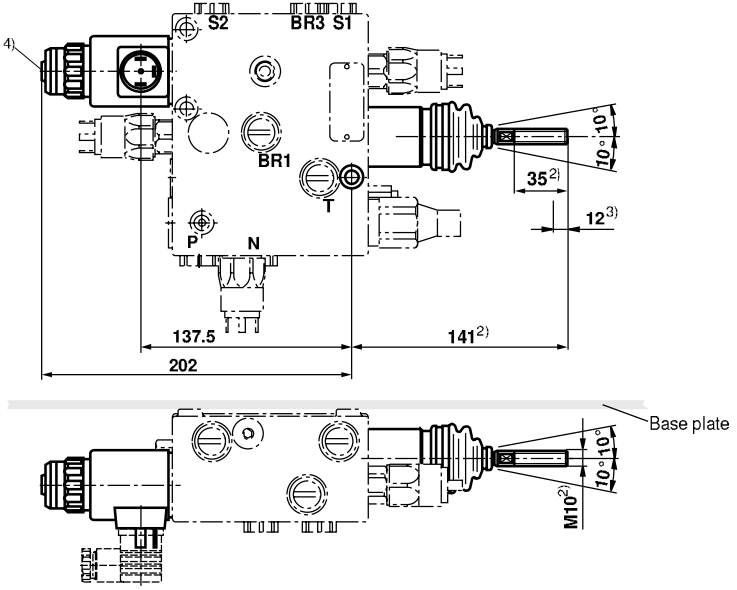
Unit dimensions – Actuation (Dimensions in mm)

Version | LT 12 | M | 3X/... | M | ... |



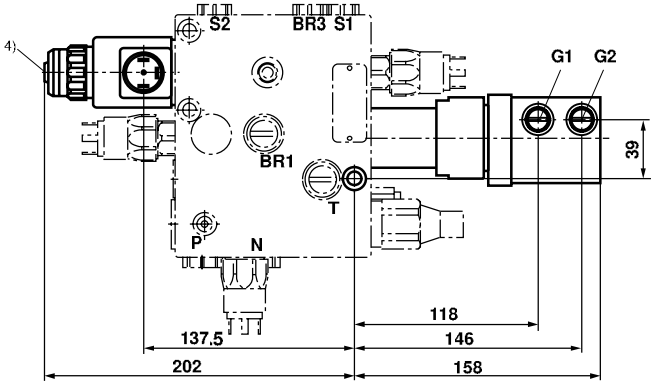
Version | LT 12 | M | 3X/... | E | ... |

2) Version with operating rod
3) Maximum stroke
4) Manual override

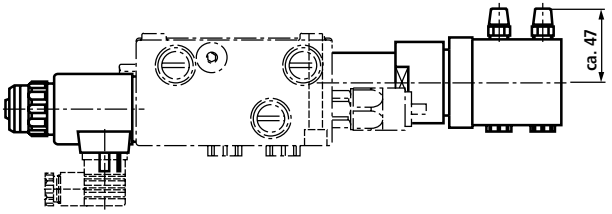


Unit dimensions – Actuation (Dimensions in mm)

Version | LT 12 | H | 3X/... | E | ... |



4) Manual override



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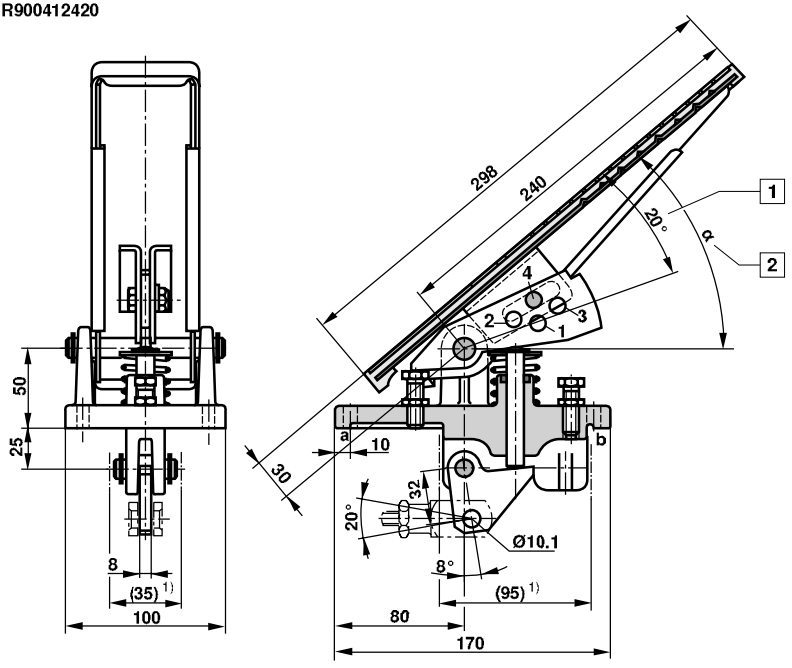
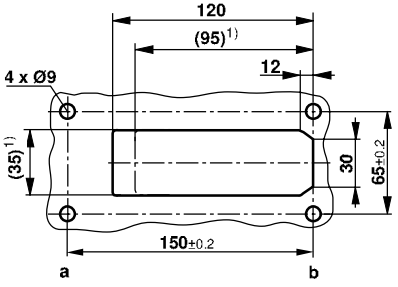
Brake pedal LT 20 – Standard version (Dimensions in mm)

Standard version
LT 20 MKA-1X/000H/00-
Material no. R900412420



Recommended connection interface in the base plate



1 Operating angle approx. 20°

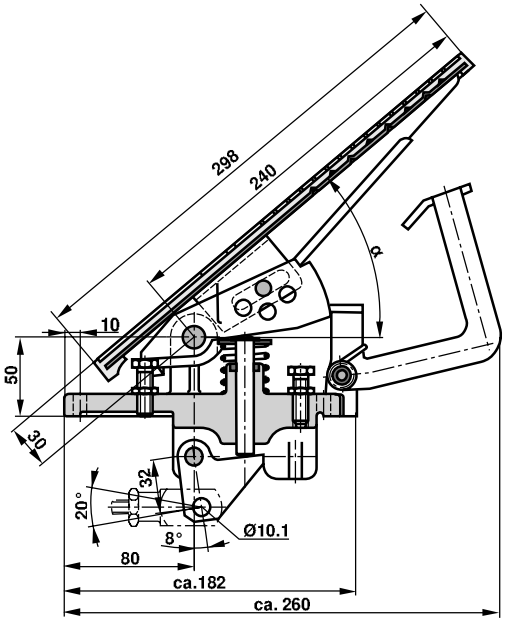
2 Setting angle α may be adjusted in 5° increments

Hole	α
1	25°
2	30°
3	35°
4	40° 2)

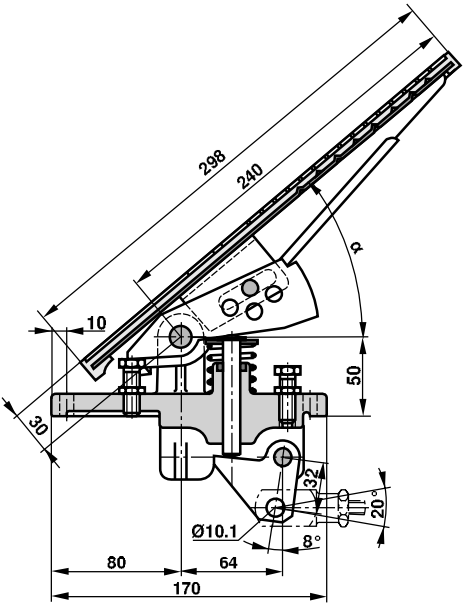
1) Minimum dimensions in the base plate for installing the pedals
2) Standard version

Brake pedal variants LT 20 – Versions for mechanical actuation (Dimensions in mm)

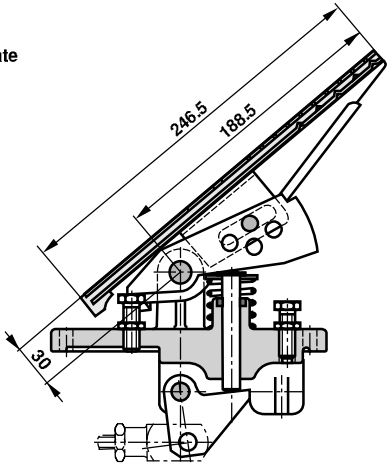
Version with detent hook
LT 20 MKA-1X/000H/00-SO1
Material no. R900328536



Version with the operating rod to the front
LT 20 MKA-1X/000H/00-SO2
Material no. R900412421



Version with shortened foot plate
LT 20 MKA-1X/000H/00-SO9
Material no. R901056192



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Accessories

				Material no.
Pressure switch	**DS1**	Brake light	5 bar	**R961007359**
	DS2	Accumulator pressure	100 bar	**R900014525**
		Accumulator pressure	115 bar	**R900026566**
	DS3	Parking brake	25 bar	**R961007360**
Pedal LT 20	Standard version			**R900412420**
	Version with detent hook			**R900328536**
	Version with the operating rod to the front			**R900412421**
	Version with shortened foot plate			**R901056192**

Mating connectors see data sheet RE 08006.

Rexroth recommends the use of the following components:

Tandem cylinder	**MH17861.2.1** of company FTE Automotive, Ebern	**Not available from Rexroth!**
Bowden cable (remote park brake operation)	Company MFB GmbH, Mühlheim a. d. Ruhr	
Fork head	Connecting the parking brake axis , fork head acc. to DIN 71752 G8 x 16/32	
	Connecting the service brake axis , fork head acc. to DIN 71752 G10 x 20/40	
Accumulator	**NOTE:** For brake accumulators use ECO membranes (for extended temperature range!)	

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Rexroth
Bosch Group

Dual-circuit power brake valve of compact design LT 13

RE 66221/06.2012 1/18
Replaces: 11.2011
English

Data sheet

Component series 3X

Maximum braking pressure 125 bar

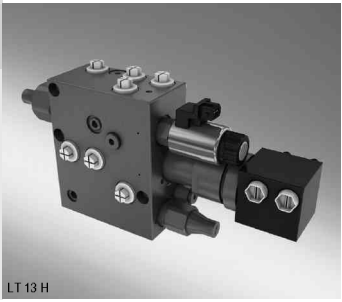

LT 13 H

Table of contents

Features

Advantages of a compact remotely powered braking system:

- Simple and quick installation
- Piping is reduced to a minimum
- Small space requirement
- Integration into existing hydraulic systems is possible
- Quickly ready-for-operation
- Fast response times
- Sensitive metering
- Minimum number of components

Application areas:

- Earth moving machines
- Fork lift trucks
- Forestry and agricultural machines
- Municipal vehicles
- Special vehicles

Function

The LT 13 is a dual-circuit brake valve in compact design, which combines all necessary functions in one housing.

The function of the accumulator charging valve (1)

The accumulator charging valve loads, as a priority, the accumulator. When the accumulator pressure falls below the switch-on pressure of the charging valve, the accumulators are loaded until the switch-off pressure is reached. The accumulators are loaded with a flow of e.g. 17 l/min (version B40). If the pump supplies more than e.g. 17 l/min, then the subsequent actuators are supplied with the difference.

Note: If subsequent consumers (**N**) generate a higher pressure than the cut-off pressure of the accumulator charging valve, the pressure of the accumulator circuit is raised to this level.

Circuit separation

The valve supplies two separate braking circuits. These are separated by an inverted shuttle valve (**2**).

The function of the dual-circuit brake valve

The dual-circuit brake valve comprises of two tandem design 3-way pressure reducing valves (pressure increase: the pressure increases in relation to the actuating force). The valve of the 1st circuit (**4.1**) is directly operated. The pressure of the 2nd brake circuit (**4.2**) is controlled by the 1st brake valve. If the hydraulic supply to the 1st brake circuit fails, then the 2nd brake circuit is directly actuated.

With hydraulic operation, the tandem master cylinder is operated by an appropriate pedal. The pressure fluid feeded by the tank is piped to the pickup-head of the LT 13 proportional to the pedal travel. The tandem master cylinder as well as the pickup-head of the LT 13 have two separate chambers.

The pickup-spools steer in line proportional to the feeded pressure fluid and charge the main brake spools via the brake pressure control springs.

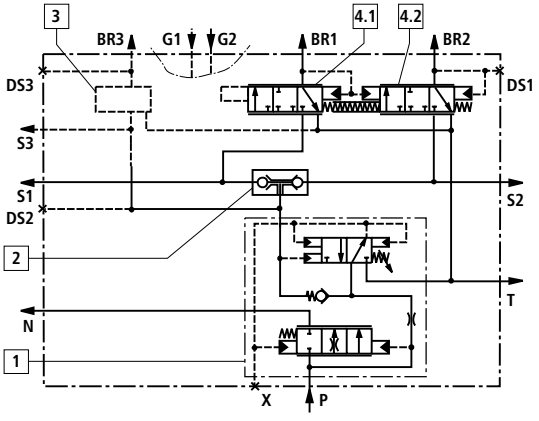
The function of the mechanical operated parking brake/ auxiliary brake (3)

The parking brake valve is a direct operated 3-way pressure reducing valve. When the valve is actuated, the pressure falls in proportion to the actuation. The valve controls the pressure sensitively. Therefore the function “auxiliary brake” can also be operated.

The function of the electrical operated parking brake (3)

The electrically switched parking brake is a 3/2-way directional valve. When the valve is switched with a voltage, then the parking brake is released with the accumulator pressure from accumulator **S3**. The auxiliary brake function cannot be performed.

Symbol



1	Accumulator charging valve
2	Shuttle valve
3	Parking brake (optional)
4	Dual-circuit brake valve

P	Pump
T	Tank
N	Drain or subsequent consumers
BR1	Service brake (BBA 1st brake circuit)
BR2	Service brake (BBA 2nd brake circuit)
BR3	Parking brake (FBA)
S…	Accumulator line and accumulators
DS…	Pressure switch for monitoring
G…	Hydraulic operation of the service brake (alternative)
X	Load Sensing (LS)

Technical data (For applications outside these parameters, please consult us!)

General			
Line connections			Metric threads
Weight		kg	8.5
Installation position			Horizontal (preferred)
Ambient temperature range		°C	–20 to +80
Coating			Single-coat varnish RAL 5010

Hydraulic			
Accumulator pressure, max.		bar	200
Operating brake pressure, max.	• Service brake (BBA)	bar	125
	• Parking brake (FBA) Version **M**	bar	120 (proportional)
	• Parking brake (FBA) Version **E**	bar	Relates to the accumulator charging pressure / depending on the accumulator charging valve
	• Parking brake (FBA) Version **R**	bar	120
Pressure at port **S3**, max.	• Parking brake (FBA) Version **P**	bar	210
System pressure, max.		bar	210
Accumulator charging pressure, max. (Standard)	• Switch-off pressure	bar	200
	• Switch-onpressure	bar	approx. 20% below switch-off pressure
Flow, max.	• Accumulator charging flow	l/min l/min	approx. 17 l/min (Standard) B40 approx. 6 l/min B18
	• Pump flow	l/min	70
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 Bio-degradable hydraulic fluids on inquiry
Hydraulic fluid temperature range		°C	–20 to +80
Viscosity range		mm^2/s	2,8 to 380
Maximum permitted degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 20/18/15, for this we recommend a filter with a minimum retention rate of $\beta_{10} \geq 75$.

Electric		
Type of voltage		Direct current
Supply voltage	V	12 DC; 24 DC
Type of protection acc. to VDE 0470-1 (DIN EN 60529) DIN 40050-9	• Version **K4**	IP 65 with mating connector correctly mounted and locked [1]
	• Version **C4**	IP 66 with mating connector correctly mounted and locked [1]
		IP 69K with Rexroth mating connector (Mat. no. R901022127) [1]
	• Version **K40**	IP 69K with mating connector correctly mounted and locked [1]

[1] Mating connectors are not included in the scope of supply and need to be ordered separately, see data sheet RE 08006.

5

Ordering code

LT 13		3X/	…		…				/02	M		*

Dual-circuit-compact brake-block = LT13

Type of actuation (BBA)
Mechanical = M
Hydraulic = H

Series 30 to 39 = 3X
(30 to 39: unchanged installation and connection dimensions)

Characteristic curve
Linear = L
Progressive = P

Pressure of the service brake system (BBA)
40 bar = 040
60 bar = 060
80 bar = 080
100 bar = 100
125 bar = 125

Type of actuation parking brake (FBA)
Without FBA = –
Mechanical = M
Electrically switched = E [1]
Electrically switched, reduced = R
Electrically switched with external pressure supply = P [2]

Lifting pressure of parking brake (FBA) [1); 2)] = XXX
Without FBA = 000
20 bar = 020
40 bar = 040
60 bar = 060
80 bar = 080
100 bar = 100
120 bar = 120

Further details in clear text

Auxiliary equipment
16 = With operating rod

Sealing material
M = NBR seals, suitable for mineral oil (HL, HLP) acc. to DIN 51524

CAUTION!
Observe sealing compatibility of the hydraulic fluid used!

Line connections
02 = Metric threads
19 = UNF threads

Type of plug [3]
N K4 = Plug-in connector
N K40 = Deutsch plug
N C4 = Junior timer, 2-pin (AMP)
N = Standard with manual override

Voltage of solenoid
AG12 = 12 V
AG24 = 24 V

Accumulator charging flow
B40 = Approx. 17 l/min (Standard)
B18 = ca. 6 l/min

Accumulator charging pressure
A = 100 bar
B = 120 bar
C = (Standard) 150 bar
D = 165 bar
E = 185 bar
F = 200 bar

[1] With electrically switched FBA **E** the lifting pressure of the FBA relates to the accumulator charging pressure. Observe the hysteresis!
[2] With external pressure supply of the FBA **P** the lifting pressure of the FBA relates to the supplied pressure.
[3] Mating connectors are not included in the scope of supply and need to be ordered separately, see data sheet RE 08006.

General notes

Installation notes

- Rubber parts *must* ***not*** *be painted.*.
- Operating elements must not be directly exposed to high-pressure jet cleaning.
- The cross-sections of hydraulic transmission elements (pipes, hoses) must be selected so that at low operating temperatures the pressure drop between hydraulic accumulator and brake cylinder remains low.
- The tank pressure must not exceed the apply pressure of the brake.
- Ensure that the brake system is always vented.

Notes for the repair

- Damaged valves must be repaired, even if their function is not impaired.

Intended use

Brake vavles LT 13 are hydraulic components and are therefore either covered by the cope of the completely or the partly completed machinery in the sense of the EC machinery directive 2006/42/EC. The component is exclusively intended to be assembled together with other components to form partly completed or complete machinery. The component may only be commissioned if it has been integrated in the machine for which it is designed.

You may use the product as follows:

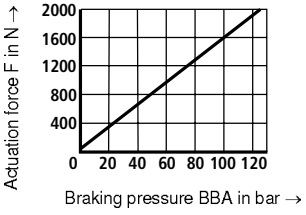
The brake valves LT 13 have been developed for the application in mobile working machinery.

▶ Comply with the technical data.

The product is only intended for professional use and not for private use.

Characteristic curve

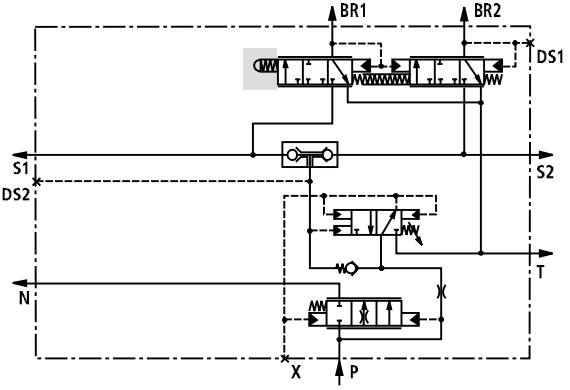
Actuation force, service brake directly operated (without pedal)



Circuit diagrams

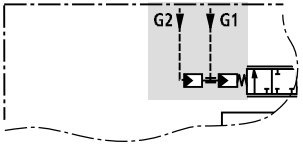
Version LT 13 | M | 3X/... | – | ...

- mechanical (foot operation)
- without parking brake



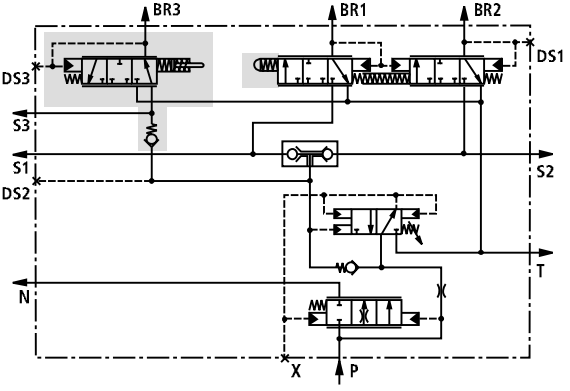
Version LT 13 | H | 3X/... | – | ...

- hydraulic (foot operation)
- without parking brake



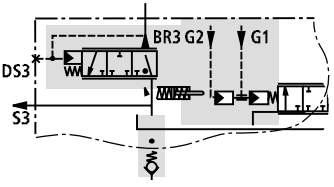
Version LT 13 | M | 3X/... | M | ...

- mechanical (foot operation)
- mechanical parking brake (hand operation)



Version LT 13 | H | 3X/... | M | ...

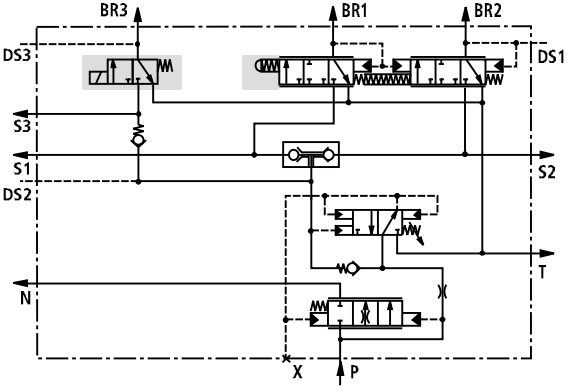
- hydraulic (foot operation)
- mechanical parking brake (hand operation)



Circuit diagrams

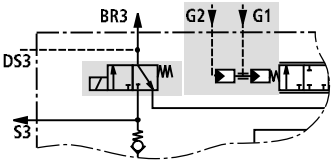
Version LT 13 | M | 3X/... | E | ...

- mechanical (foot operation)
- electric parking brake



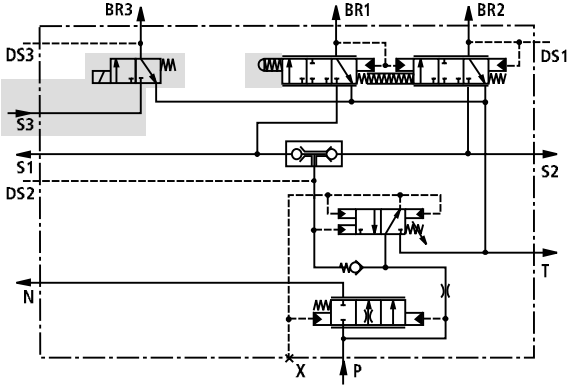
Version LT 13 | H | 3X/... | E | ...

- hydraulic (foot operation)
- electric parking brake



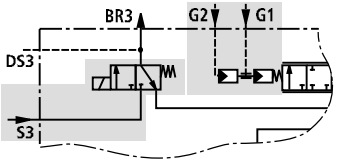
Version LT 13 | M | 3X/... | P | ...

- mechanical (foot operation)
- electric parking brake
- pilot oil port



Version LT 13 | H | 3X/... | P | ...

- hydraulic (foot operation)
- electric parking brake
- pilot oil port

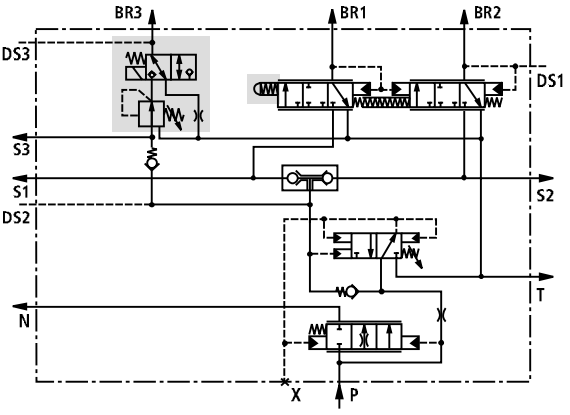


5

Circuit diagrams

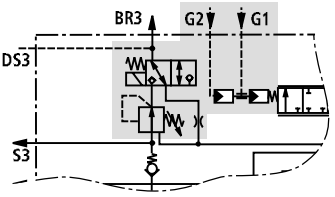
Version LT 13 | M | 3X/... | R | ...

- mechanical (foot operation)
- electric parking brake, reduced



Version LT 13 | H | 3X/... | R | ...

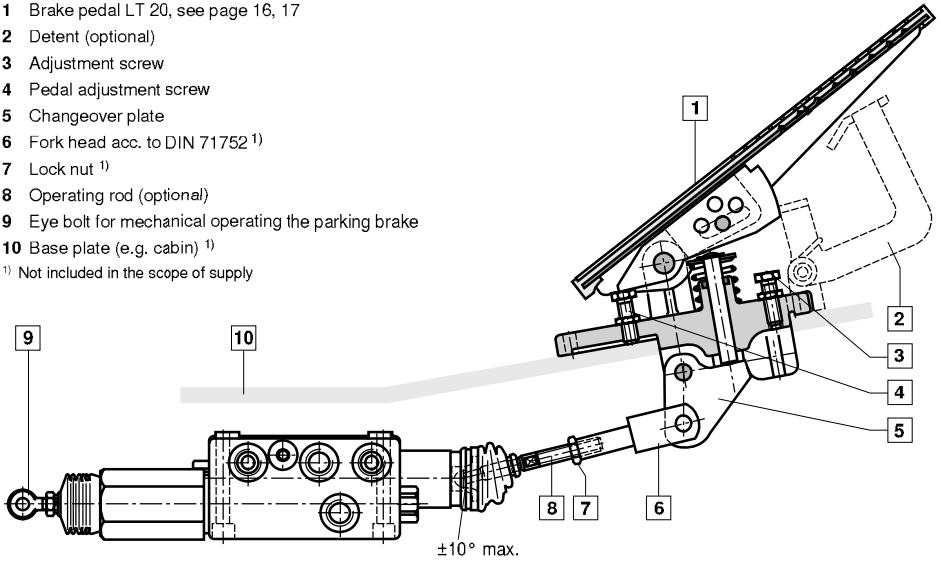
- hydraulic (foot operation)
- electric parking brake, reduce



Design: LT 13 with mechanical operation

1 Brake pedal LT 20, see page 16, 17
2 Detent (optional)
3 Adjustment screw
4 Pedal adjustment screw
5 Changeover plate
6 Fork head acc. to DIN 71752 [1)]
7 Lock nut [1)]
8 Operating rod (optional)
9 Eye bolt for mechanical operating the parking brake
10 Base plate (e.g. cabin) [1)]

[1)] Not included in the scope of supply



NOTE!

- Valve and pedal with operating rod must be mounted in one line!

Adjustment instructions

Assembly

It is important for low friction operation that the valve and pedal are correctly aligned. When looking in the plan view the valve axis, operating rod, (**8**) and pedal (**1**) must be aligned! In the side view the operating rod can have an off set angle of up to a maximum 10° in relation to the valve. The angle and height of the pedal have a influence on the operating angle and force.

If, due to space requirements, the control has to be fitted with a longer actuating unit then this has to be so designed that it is resistant to buckling (see actuating force).

Adjusting the pedal

The lock nut and fork head are screwed onto the operating rod (**8**) the fork head (**6**) is, after the valve and pedal have been fitted, connected to the changeover plate (**5**) via the axis bolt.

Pedal (1) unactuated

The operating rod (**8**) is so adjusted that the play between the ball end and the valve operator is at its minimum.

CAUTION! The valve operator must not be under tension. The operating rod must be able to slightly move backwards and forwards. The setting is secured via the locknut (**7**).

Pedal (1) actuated

The maximum brake pressure can be adjusted, as required, via the adjustment screw (**3**) and then locked using the lock nut. When the pedal is released only the tank pressure must be applied.

Option – pedal with detent (2)

The lock nut (**7**) and fork head (**6**) are screwed onto the operating rod (**8**). The fork head is connected to the changeover plate (**5**) via the axis bolt. Move the pedal into the detent position. So adjust the operating rod (**8**) that the valve reaches the required maximum operating pressure. The pressure setting is locked using the lock nut (**7**).

Release the detent

With the pedal (**1**) unactuated, adjust the pedal adjustment screw (**4**) until the smallest amount of play is achieved.

Design: LT 13 with mechanical operation (Dimensions in mm)

Parking brake adjustment, version M

The parking brake is factory pre-set to the required pressure. When the parking brake is not pulled then the parking brake pressure is the factory pre-set pressure. The bowden cable must be so set that, in the unactuated condition, no pulling force is applied to the eye bolt (**9**).

With an increase in operation (pulling) of the hand brake, the brake pressure falls to tank pressure. The entire force of the spring accumulator cylinder is then applied to the wheel brake. The bowden cable must, for this purpose, make possible a minimum stroke of 10 mm. The holding force relates to the application force and is a maximum of 1100 N. The bowden cable should be so fitted that low friction operation is possible.

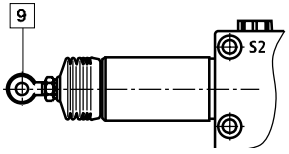
Parking brake, version E

Cannot be adjusted.

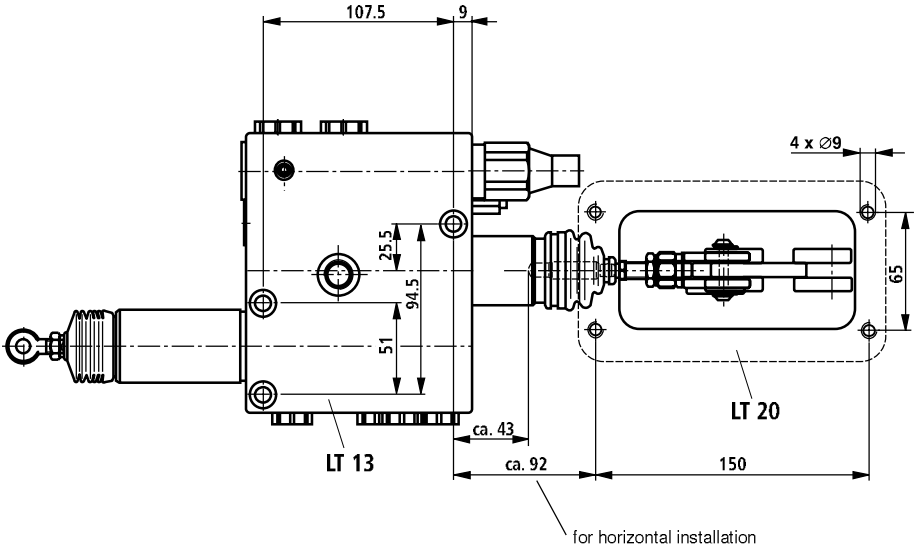
When a voltage is applied to the solenoid (12 or 24 volts) then the accumulator pressure is switched onto the parking brake. The minimum lifting pressure relates to the switch-on pressure of the charging valve. If a voltage is not being applied then the outlet pressure is the same as the tank pressure.

Parking brake, version R

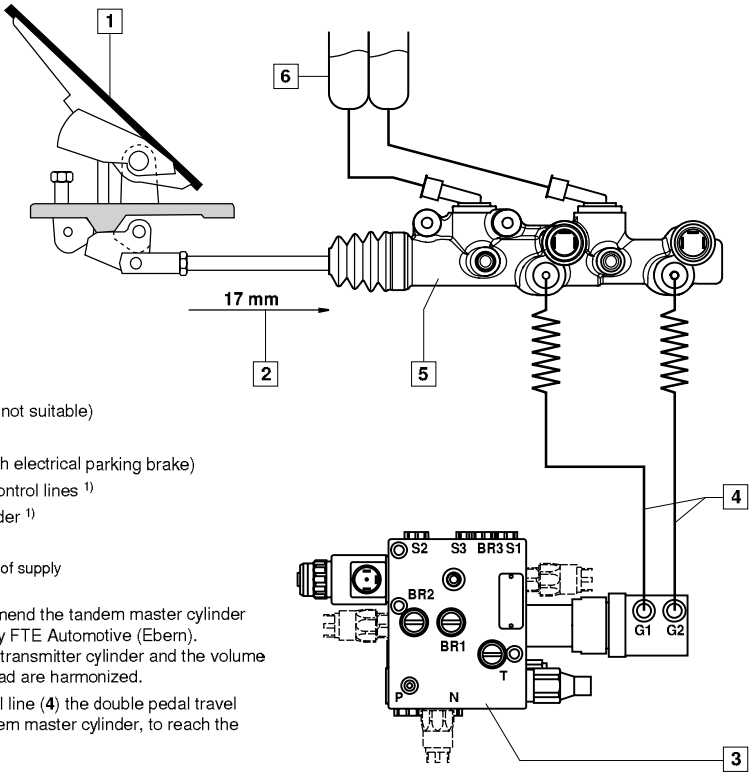
When a voltage is applied to the solenoid (12 or 24 volts) then the adjusted pressure is switched onto the parking pressure. If a voltage is not being applied then the outlet pressure is the same as the tank pressure.



9 Eye bolt for operating the parking brake



Design: LT 13 with hydraulic operation



1 Brake pedal [1] (LT 20 not suitable)
2 Pedal travel 17 mm
3 LT 13 H (Example with electrical parking brake)
4 Flexible dual-circuit control lines [1]
5 Tandem master cylinder [1]
6 Tank [1]

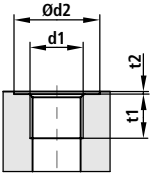
[1] Not included in the scope of supply

For actuation, we recommend the tandem master cylinder MH17861.2.1 of company FTE Automotive (Ebern).
The swept volume of the transmitter cylinder and the volume of the LT 13 H pickup-head are harmonized.

With failure of one control line (**4**) the double pedal travel is necessary for the tandem master cylinder, to reach the brake pressure.

Line connections

Port	d_1	Ød_2	t_1	t_2	Designation
P	M18x1.5	28	12	1.5	Pump
N					*Subsequent consumers*
T	M16x1.5	26	12	1	Tank
BR1, BR2					Service brake
BR3					Parking brake
S1, S2					Accumulator service brake
S3					Accumulator parking brake
G1, G2	M12x1.5	20	12	1	Hydraulic actuation of service brake
X	M12x1.5	18	12	1	Load Sensing (LS)
DS1	M12x1.5	18	12	0.5	Pressure switch brake light
DS3					Pressure switch parking brake
DS2	M10x1	–	6	–	Pressure switch accumulator pressure



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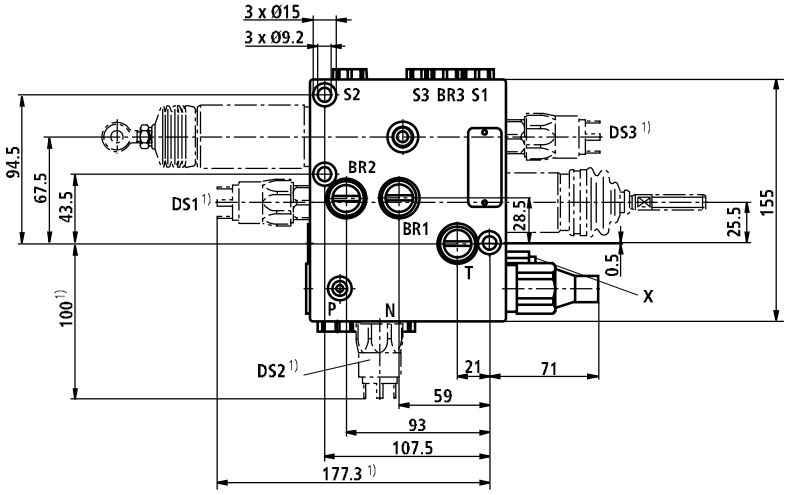
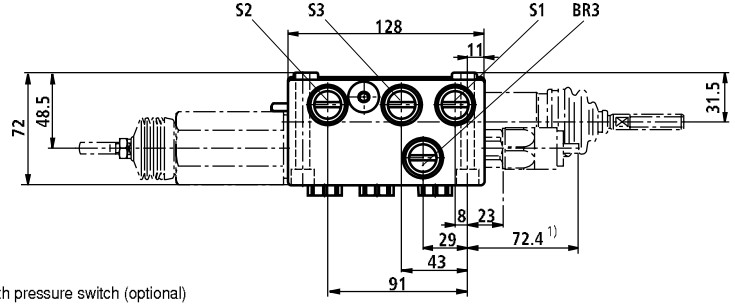
Unit dimensions LT 13 (Dimensions in mm)

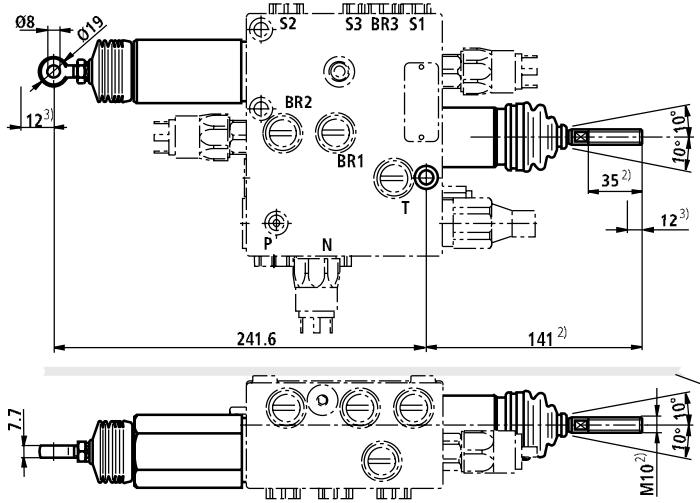




1) Version with pressure switch (optional)

Unit dimensions – Actuation (Dimensions in mm)

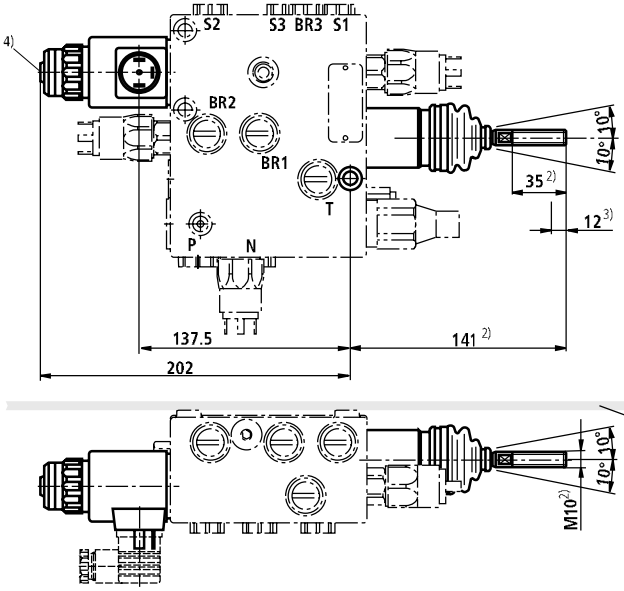
Version LT 13 | M | 3X/... | M | ...



Version LT 13 | M | 3X/... | E | ...

LT 13 | M | 3X/... | P | ...

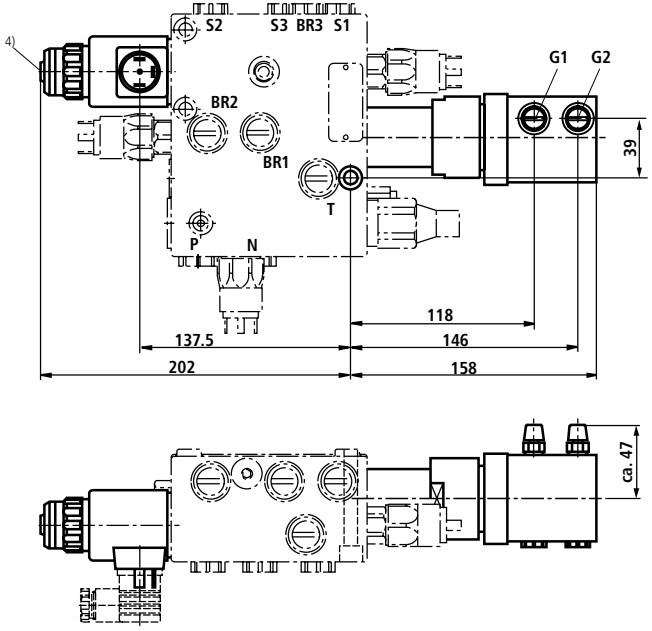
2) Version with operating rod
3) Maximum stroke
4) Manual override



Unit dimensions – Actuation (Dimensions in mm)

Version

LT 13	H	3X/...	E	...
LT 13	H	3X/...	P	...

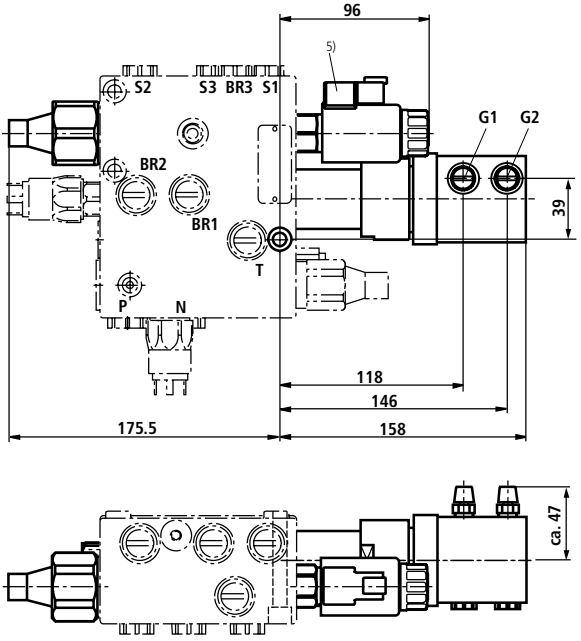


4) Manual override

Unit dimensions – Actuation (Dimensions in mm)

Version

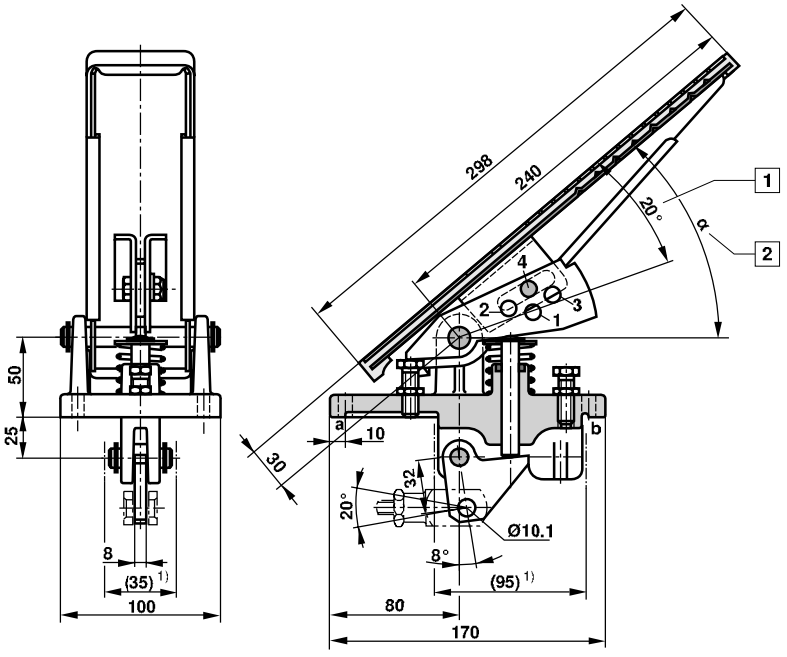
LT 13	H	3X/...	R	...



5) Depending on valve version with plug type C4 or K40

Brake pedal LT 20 – Standard for mechanical actuation (Dimensions in mm)

Standard version
LT 20 MKA-1X/000H/00-
Material no. R900412420

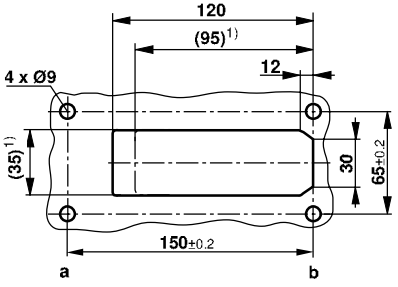


Recommended connection interface in the base plate

1 Operating angle approx. 20°

2 Setting angle α may be adjusted in 5° increments

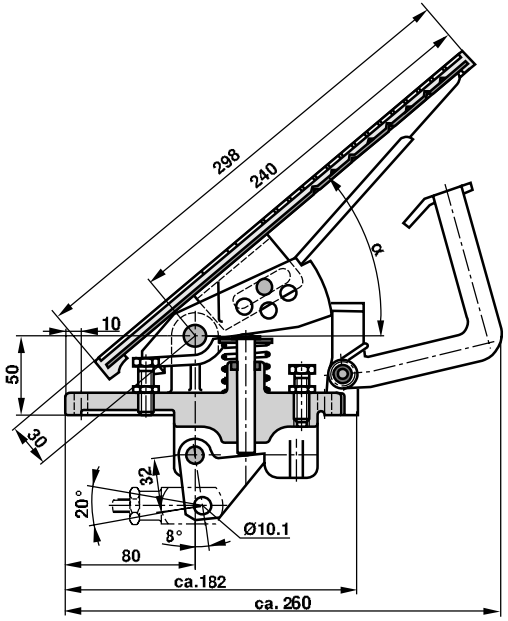
Hole	α
1	25°
2	30°
3	35°
4	40° 2)



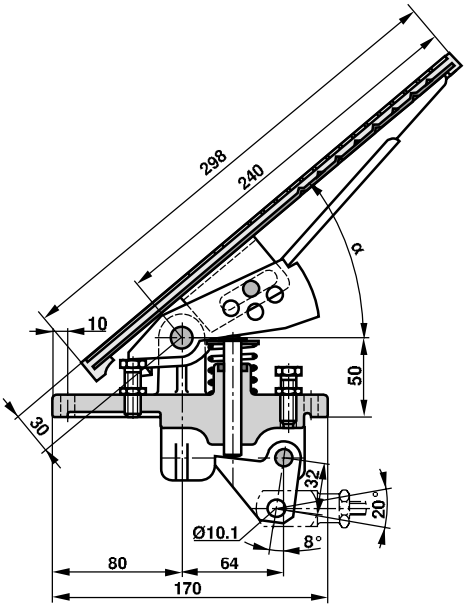
1) Minimum dimensions in the base plate for installing the pedals
2) Standard version

Brake pedal variants LT 20 – Versions for mechanical actuation (Dimensions in mm)

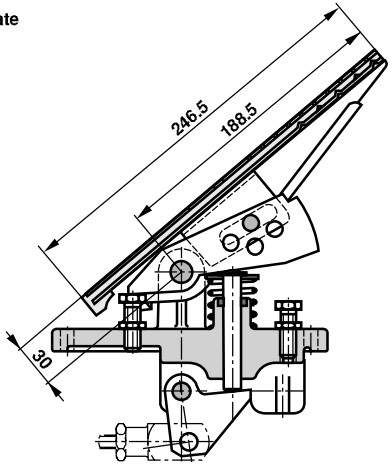
Version with detent hook
LT 20 MKA-1X/000H/00-SO1
Material no. R900328536



Version with the operating rod to the front
LT 20 MKA-1X/000H/00-SO2
Material no. R900412421



Version with shortened foot plate
LT 20 MKA-1X/000H/00-SO9
Material no. R901056192



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Accessories

				Material no.
Pressure switch	**DS1**	Brake light	5 bar	**R961007359**
	DS2	Accumulator pressure	100 bar	**R900014525**
		Accumulator pressure	115 bar	**R900026566**
	DS3	Parking brake	25 bar	**R961007360**
Pedal LT 20	Standard version			**R900412420**
	Version with detent hook			**R900328536**
	Version with the operating rod to the front			**R900412421**
	Version with shortened foot plate			**R901056192**

Mating connectors see data sheet RE 08006.

Rexroth recommends the use of the following components:

Tandem cylinder	**MH17861.2.1** of company FTE Automotive, Ebern
Bowden cable (remote park brake operation)	Company MFB GmbH, Mühlheim a. d. Ruhr
Fork head	Connecting the parking brake axis , fork head acc. to DIN 71752 G8 x 16/32
	Connecting the service brake axis , fork head acc. to DIN 71752 G10 x 20/40
Accumulator	**NOTE:** For brake accumulators use ECO membranes (for extended temperature range!)

Not available from Rexroth!

Bosch Rexroth AG
Mobile Applications
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
Fax +49 (0) 93 52 / 18-23 58
info.brm-mc@boschrexroth.de
www.boschrexroth.com

Rexroth
Bosch Group

Hydraulic remotely powered brake valve of compact design LT 17

RE 66228/04.09 1/10
Replaces: 05.08

Data sheet


H7110

Component series 4X
Brake pressures 40; 60; 80; 100; 125 bar

Overview of contents

Features

Hydraulic remotely powered braking systems are used in:

- Earth moving equipment
- Material handling vehicles
- Forestry and agricultural machines
- Special vehicles

The accumulator loading valve and the 2-circuit brake valve arecombined to form the compact brake valve LT17.

The advantages of the compact brake valve are:

- Simple and quick assembly
- Piping reduced to a minimum
- Low space requirement
- Integration into existing hydraulic systems is possible
- Integrated actuation pedal
- Direct connection of the pressure accumulator is possible (separate accumulator block is not required)
- Connection facility for separate parking brake valve
- Optional electrical on/off parking brake valve
- Quickly ready for operation
- Short response time
- Sensitive metering
- Minimum number of components
- Low in maintenance

Ordering code

LT 17	–4X/					FOE/	M		*

Remotely powered brake valve

Actuation
Foot pedal = **MFA**
Foot pedal, electrical parking brake = **MFEA**

Component series
Component series 40 to 49 (40 to 49: unchanged installation and connection dimensions) = **4X**

Max. operating brake pressure
40 bar = **040**
60 bar = **060**
80 bar = **080**
100 bar = **100**
Loading function set to 150 bar
125 bar = **125**
Loading function set to 210 bar
Please consult us for other settings

Parking brake system nominal pressure (MFEA)
Loading function set to 150 bar = **–150**
Loading function set to 210 bar = **–210**
Please consult us for other settings

Accumulator loading flow
Approx. 4,5 l/min (standard B18) = **No code**
Approx. 17 l/min = **B40**

Switching solenoid for parking brake (MFEA)
AG12C4 = 12 Volt solenoid
AG24C4 = 24 Volt solenoid
both with plug-in connector

Check valve
No code = Without check valve
R = With check valve (optional with type MFA - connection S3)
R = With check valve (standard with (standard with type MFEA - connection S3)

Connection threads
02 = Metric thread
40 = Metric thread, reduced

Seals
M = NBR seals, suitable for mineral oil (HL, HLP) to DIN 51524

Accessories
14 = With pressure switch

Further detail in clear text

Function, legal requirements, installation guidelines

The valve is connected immediately downstream of the pump. Via an orifice approx. 4.5 l/min are made available to the integrated accumulator loading valve, the remaining flow is passed on to the subsequent actuators via port N (e.g. steering).

When the loading pressure of 150 bar is reached, the entire flow is passed to port N. If the accumulator pressure falls 18% below the switch-off pressure then the accumulator loading process is repeated. The brake circuits are separated by check valves.

Note:

If downstream consumers (N) generate a higher pressure than the cut-off pressure of the accumulator charging valve, the pressure of the accumulator circuit is raised to this level.

Function of the 2-circuit brake valve

The 2-circuit brake valve comprises of 2 tandem 3-way pressure reducing valves (pressure increase: the pressure increases in relation to the actuation force). The valve contained within the first brake circuit is directly actuated. The pressure of the second brake circuit is controlled by the first brake valve. If the hydraulic supply to the first brake circuit fails then the second brake circuit is directly actuated.

Function of the parking brake system (FBA)

The parking brake is applied via a spring accumulator cylinder.

Version MFA

A hydraulic parking brake valve can be connected to port S3 for loading an FBA.

Version MFEA

When the electrical parking brake valve is switched to „release", the pressure fluid flows from the hydraulic accumulator into the spring accumulator cylinder and releases the parking brake.

☞Legal requirements

The general content of all legal regulations is the demand that a vehicle must be road-safe in all operating conditions. The current valid national and international regulations are the basis when projecting a braking system. Furthermore, the braking system must correspond to the current level of technology.

Braking systems must be tested to the valid national and international regulations.

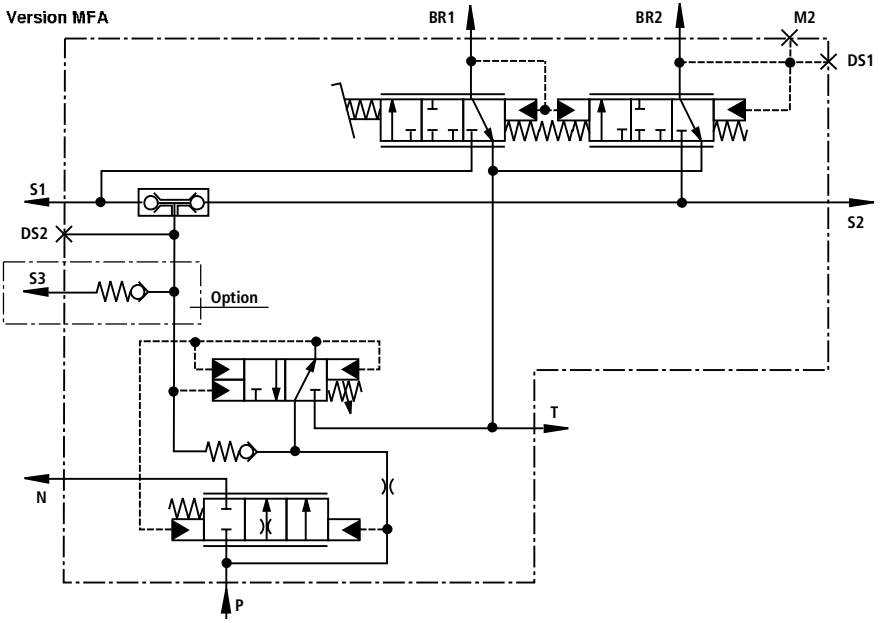
The responsibility lies with the vehicle manufacturer.

☞ Installation guidelines

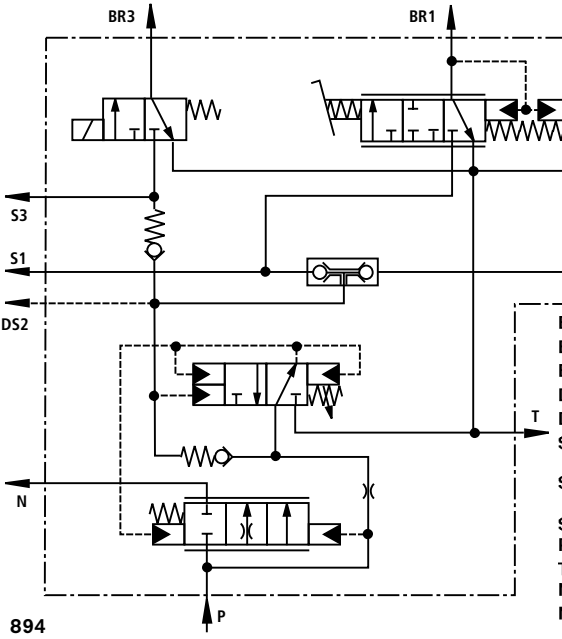
- Rubber parts must not be painted
- Actuating elements must **not** be subjected to direct high pressure cleaning.
- Damaged seals must be immediately replaced.
- The cross-sections of the hydraulic transfer elements (pipes, hoses) are to be so selected, that at low temperatures the pressure drop between the hydraulic accumulator and brake cylinder remains low.
- The tank pressure must not exceed the pressure at which the brakes are applied.
- When fitted below the base plate, care must be taken to ensure that the movement of the pedal cannot be affected by contamination.
- The foot mat must be so designed that there is always sufficient free space when the pedal is not actuated.
- Please take into account when applying the remotely powered brake valve the relevant social insurance for occupational accidents or TÜV requirements!

Circuit version MFA and MFEA

Version MFA



Version MFEA



894

BR1 = Operating brake (brake circuit I)
BR2 = Operating brake (brake circuit II)
BR3 = Parking brake
DS1 = Brake light pressure switch
DS2 = Accumulator pressure switch
S1 = Operating brake accumulator (operating cicuit I)
S2 = Operating brake accumulator (operating circuit II)
S3 = Parking brake accumulator (for MFEA)
P = Pump
T = Tank
N = Subsequent actuators
M2 = Brake light pressure switch (alternative to DS1)

Technical data (for applications outside these parameters, please consult us!)

General

Installation			Optional
Weight		kg	11,5

Hydraulic

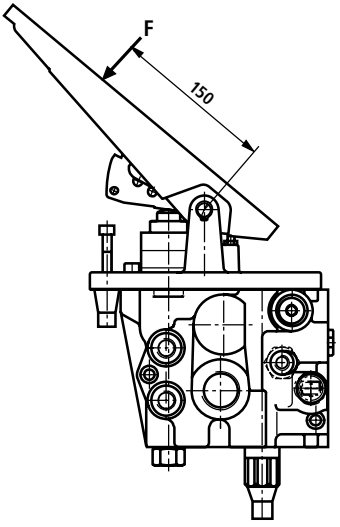
Max. nominal pressure		bar	40; 60; 80; 100; 125
Max. pump pressure		bar	210
Max. flow	P – S	l/min	Approx. 4,5 standard (B18) - approx. 17 l/min (B40)
	P – N	l/min	70
Max. actuation volume per brake circuit		cm^3	60 (with the accumulator fitted)
Pressure fluid			Mineral oil (HL, HLP) to DIN 51524
Pressure fluid temperature range		°C	–20 to +80
Viscosity range		mm^2/s	2,8 to 380
Max. permissible degree of contamination of the hydraulic fluid, cleanliness class to ISO 4406 (c)			class 20/18/15 We, therefore, recommend a filter with a minimum retention rate of $\beta_{10} \geq 75$.

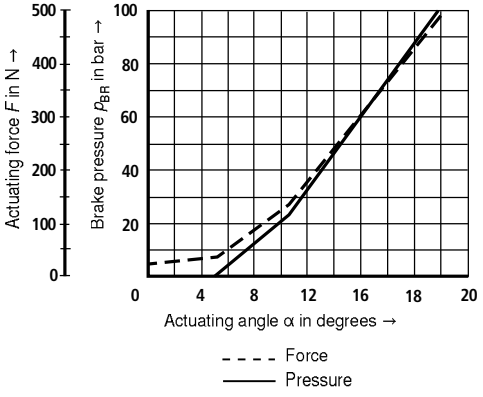
Electrical [1] (version .. MFEA ..)

Power consumption at 20 °C		W	14,4
Duty		%	100
Protection to DIN 40050			IP6K5

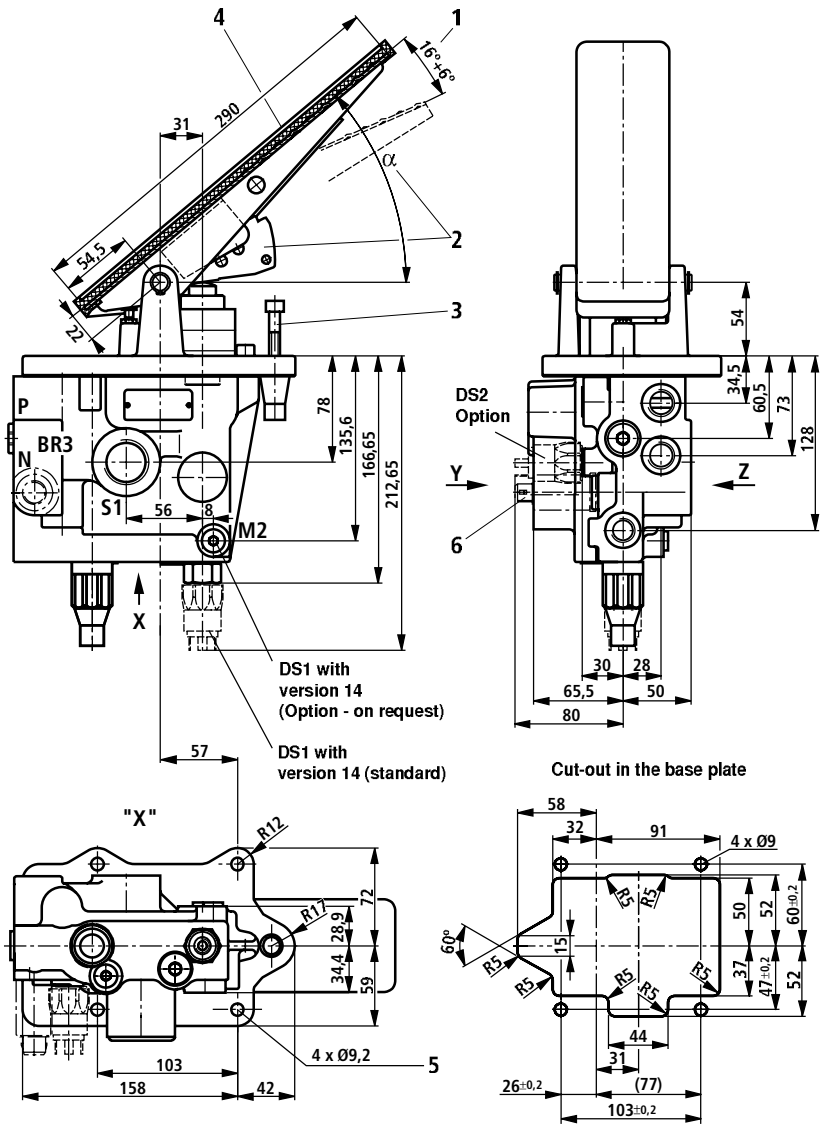
[1] For futher details see catalogue sheet RE 58007

Actuating force at lever 150 mm, 100 bar (standard)

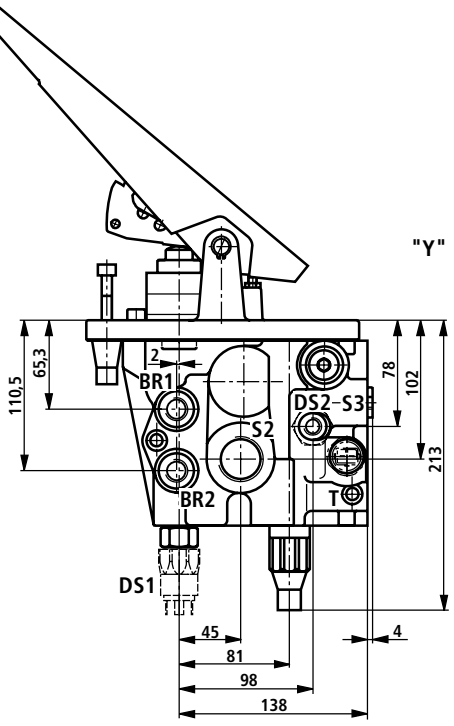


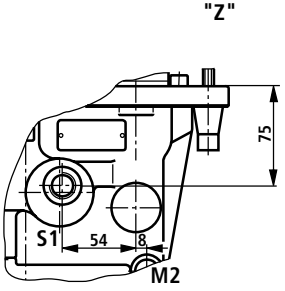


Unit dimensions: Standard version MFA (Dimensions in mm)



Unit dimensions: Standard version MFEA (Dimensions in mm)





Dimensions for threaded version „40“

1 Pedal deflection

2 Setting angle, adjustable in 5° increments:

	Hole	α
	1	25° 1)
	2	30° 1)
	3	35° 1)
Standard =	4	40°

3 Adjustable stop

4 Anti-slip foot rest (rubber on pedal

5 Fixing holes

6 solenoid operated 2/3-way directional valves for electrical parking brake (version MFEA)

For connection dimensions see table on page 11

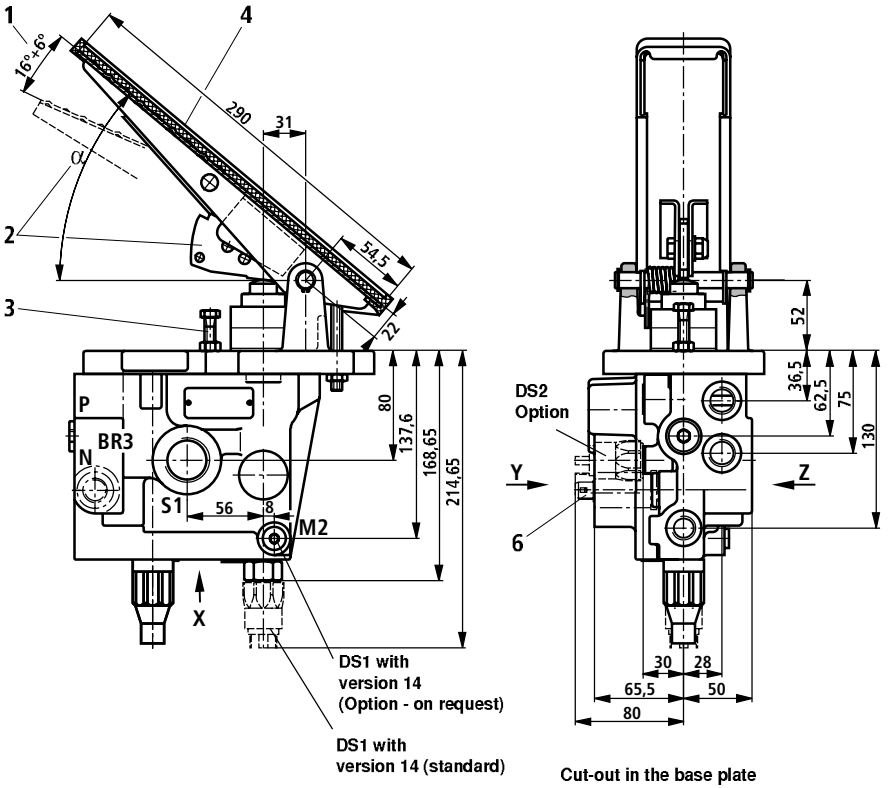
2-pin plug for solenoid: AMP Junior Timer

DS1 = Brake light pressure switch

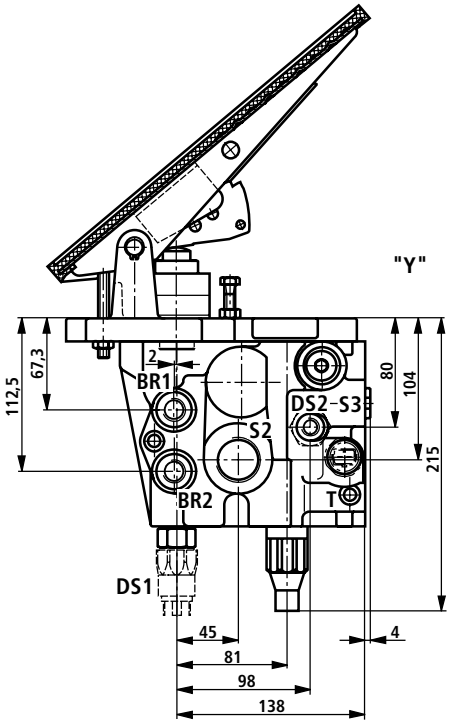
DS2 = Accumulator pressure, pressure switch

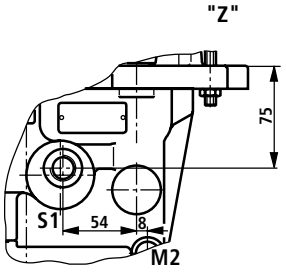
1) Possible as a special version

Unit dimensions: MFA...SO6 – Replaces for series 3X (Dimensions in mm)



Unit dimensions: MFEA...SO6 – Replaces for series 3X (Dimensions in mm)





Dimensions for threaded version „40“

1 Pedal deflection

2 Setting angle, adjustable in 5° increments:

	Hole	α
	1	25° 1)
	2	30° 1)
	3	35° 1)
Standard =	4	40°

3 Adjustable stop

4 Anti-slip foot rest (rubber on pedal

5 Fixing holes

6 solenoid operated 2/3-way directional valves for electrical parking brake (version MFEA)

For connection dimensions see table on page 10

1) Possible as a special version

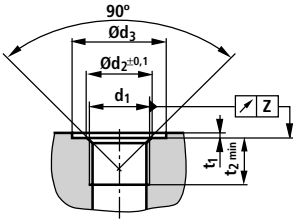
2-pin plug for solenoid: AMP Junior Timer

DS1 = Brake light pressure switch
DS2 = Accumulator pressure, pressure switch

Table unit dimensions (Dimensions in mm)

Threaded Version **02**

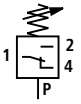
port	d_1	Ø $d_2^{\pm 0,1}$	Ø d_3	t_1	$t_{2\ min}$	z
BR1, BR2, BR3	M16 x 1,5	16,4	26	1,4	12	0,1
DS1	M12x1,5	12,4	20	0,9	11	0,1
DS2	M12x1,5	12,4	–	–	12	0,05
S1, S2	M33 x 1,5	33,5	–	–	20	0,1
S3[1)]	M16x1,5	16,4	26	1	12	0,1
M2	M12x1,5	12,4	–	–	12	0,05
P, N	M18 x 1,5	18,4	28	1,5	12	0,1
T	M16 x 1,5	16,4	26	1	12	0,1



Threaded Version 40

port	d_1	Ø $d_2^{\pm 0,1}$	Ø d_3	t_1	$t_{2\ min}$	z
BR1, BR2	M16 x 1,5	16,4	26	1,4	12	0,1
DS1	M12x1,5	12,4	20	0,9	11	0,1
DS2	M12x1,5	12,4	–	–	12	0,05
S1, S2	M18 x 1,5	18,4	28	1,6	12	0,1
S3[1)]	M16x1,5	16,4	26	1	12	0,1
M2	M12x1,5	12,4	–	–	12	0,05
P, N	M18 x 1,5	18,4	28	1,5	12	0,1
T	M16 x 1,5	16,4	26	1	12	0,1

Switching symbol DS2



[1)] Not for version MFEA

Pressure switch (Accessory „14“):

Position	for funktion	Switch pressure	Material no.	SUCO-designation	electrical funktion
DS1	light pressure switch	5 bar	R900014524	0166-407-02-1-070	Make-contact
DS2	accumulator pressure	100 bar	R900026372	0171-460-02-1-020	Changeover-contact

Rexroth Hydraulics uses pressure switches manufactured by SUCO / Bietigheim-Bissingen.
You can obtain the required pressure switch directly from the manufacturer using the above stated Material No.

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Rexroth
Bosch Group

Inching-remotely powered brake valve LT 31

RE 66227/06.06 1/4
Replaces: 04.02

Data sheet


H5793

Component series 1X
Brake pressures 60; 80; 100 bar
Inching pressure 25 bar

Overview of contents

Features

- Line mounting
- All of the connections are on one side
- Integrated inching valve
- Inching and braking pressures are proportional to the actuating
- Low hysteresis

Ordering details

LT 31	MKA – 1X /	– 25 – 02	M		*

Inching-braking valve = **LT 31**

Operator = **MKA**

Component series 10 to 19 = **1X**
(10 to 19: unchanged installation and connection dimensions)

Maximum operating brake pressure
60 bar = **060**
80 bar = **080**
100 bar = **100**

Inching pressure
25 bar = **25**

Connection thread
02 = Metric thread

Seals
M = NBR seals, suitable for mineral oil (HL, HLP) to DIN 51524

12 = **with** pedal
No code = **without** pedal (brake pressure is set)

Further details in clear text

5

Function, symbol

The inching-remotely powered brake valve is a combination of a single circuit brake valve (3-way pressure reducing valve) and an inching valve (2-way pressure reducing valve) with stepless operation.

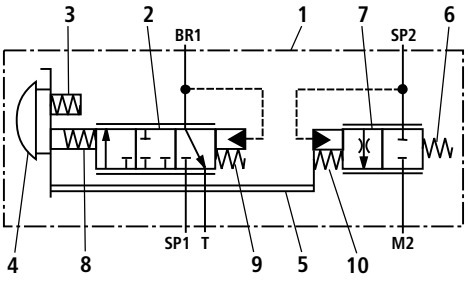
The valve basically comprises of the housing (1), brake control spool (2), inching spool (7), force spring (3), compression spring (8), plunger (4), inching pressure limiting spring (6) and inching pressure control spring (10).

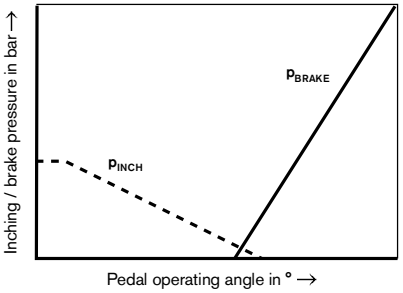
The valve is normally operated via a foot pedal which moves the plunger (4). This pushes against the force spring (3) and acts via the rod (5) on the inching pressure control spring (10) together with the inching pressure against the inching pressure control spring (6).

An increase in operation causes the control pressure to fall, the travel pump swivels back and hydro-statically brakes the vehicle.

From a specific point the plunger acts on the compression spring (8). This moves the brake control spool (2) and the connection to tank is closed. The flow from the accumulator to the brake cylinder is enabled. The increasing brake pressure acts on the reverse side of the brake spool (2). The control spool controls the brake pressure in relation to the operation.

A pedal travel limitation acts as a maximum pressure limiter for the secondary circuit (brake pressure).





Technical data (for applications outside these parameters, please consult us!)

General

Weight	kg	5.5
Installation		Optional

Hydraulic

Maximum brake pressure	bar	Up to 60; up to 80; up to 100
Maximum system pressure	bar	210
Maximum inching pressure	bar	30
Brake cylinder volume (brake valve)	cm^3	Up to 120
Nominal flow (inching valve)	l/min	12
Pressure fluid		Mineral oil (HL, HLP) to DIN 51524
Pressure fluid temperature range	°C	–20 to +80
Viscosity range	mm^2/s	2,8 to 380
Max. permissible degree of contamination of the hydraulic fluid, cleanliness class to ISO 4406 (c)		Class 20/18/15 We, therefore, recommend a filter with a minimum retention rate of $\beta_{10} \geq 75$.

Engineering guidline

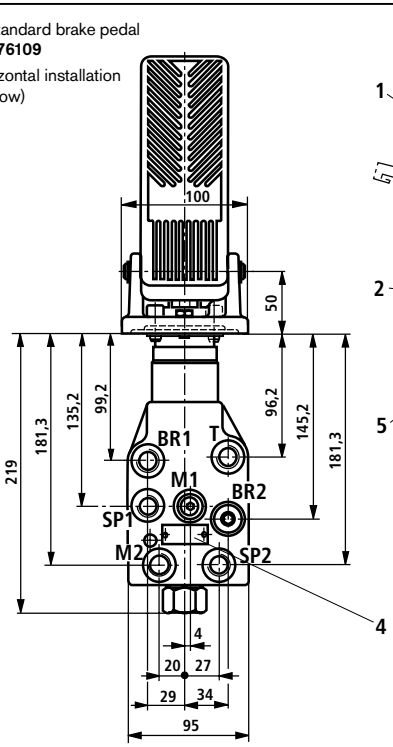
☞ **Please note:** §41 StVZO „Directive for vehicles with a hydro-static drives“
Technical report no. KO 9015 (RWTÜV)

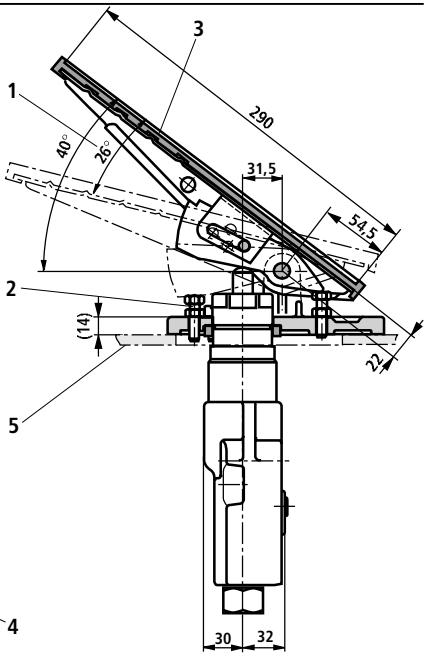
902

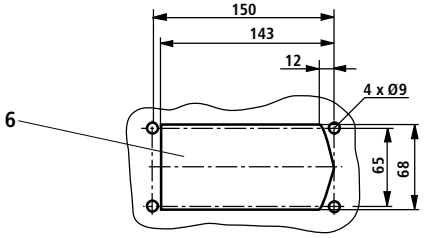
Unit dimensions (Dimensions in mm)

LT 31 fitted with a standard brake pedal
Material No. **R900976109**

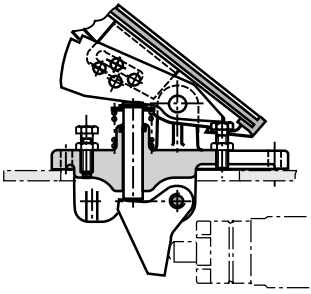
(Option: for the horizontal installation of the LT 31, see below)





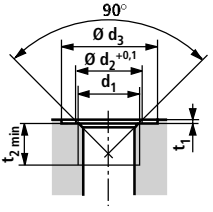


Brake pedal for horizontal installation of the LT 31
Type **LT 20 MKA-1X/000H/00-S05**, Material No. **R900517761**



1 Pedal travel
2 Pedal travel limiter
3 Anti-slip surface
4 Name plate
5 Base plate
6 Assembly pattern for the base plate

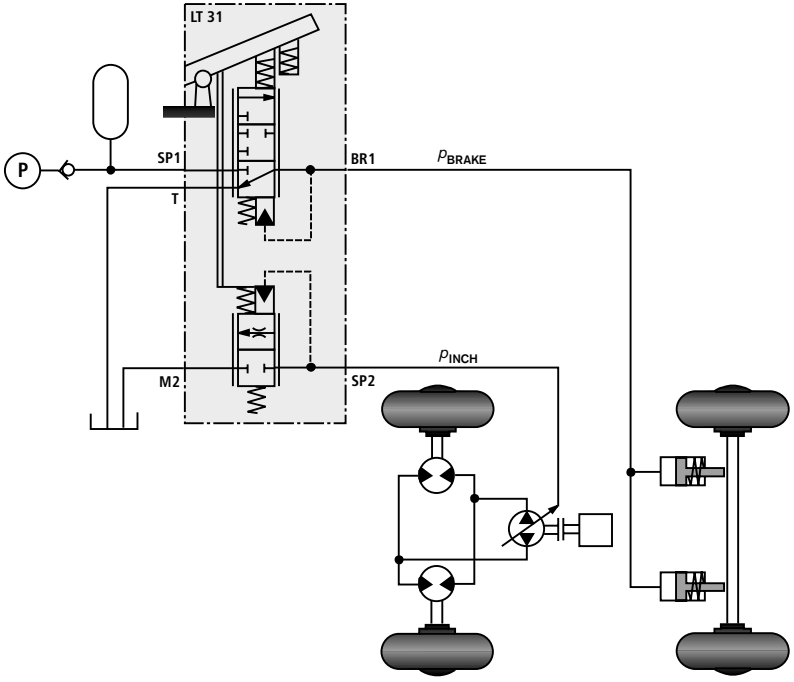
Connection	d_1	Ød_2 $^{+0,1}$	Ød_3	t_1	$t_{2\ min}$
BR1	M16 x 1,5	16,4	26	1,5	12
BR2	Connection plugged				
SP1	M16 x 1,5	16,4	26	1,5	12
SP2	M16 x 1,5	16,4	26	1,5	12
T	M16 x 1,5	16,4	26	1,5	12
M1	Connection plugged				
M2	M16 x 1,5	–	26	1,5	12



Similar to DIN 3852, part 1

SP1 Accumulator, operating brake (1. brake circuit)
SP2 Inlet control pressure
T Tank, drain oil
BR1 Operating brake (1. brake circuit)
M2 Tank, travel operation

Application example



Installations and maintenance guidelines

- The cross-section of the hydraulic pipe lines are to be so selected that the function can also be maintained at low temperatures.
- Connect ports T and M2 separately to tank.
- The tank pressure T must not exceed the applied brake pressure.
- A pedal travel limiter is required.
- During assembly care has to be taken to ensure that contamination cannot affect the movement of the pedal.
- Rubber components must not be painted.
- Damaged seals must be replaced.
- The operation element must not have direct contact with high pressure cleaning.
- When applying the inching-remotely powered brake valve the relevant Trade Union or TÜV regulations must be taken into account.

☞ **Assembly guidelines:**

When mounted under the base plate care has to be taken to ensure that contamination cannot affect the movement of the pedal!

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Rexroth
Bosch Group

Steering brake valve LT 10

RE 66154/03.08 1/4

Data sheet

Component series 2X
Nominal braking pressure 60, 90 and 100 bar

Table of contents

Features

- Small installation dimensions
- Identical braking pressure at both rear wheels while the brake pedal is coupled

Application of the steering brake valve:

- Earth-moving machines
- Forestry and agricultural machines
- Tractors

5

Function

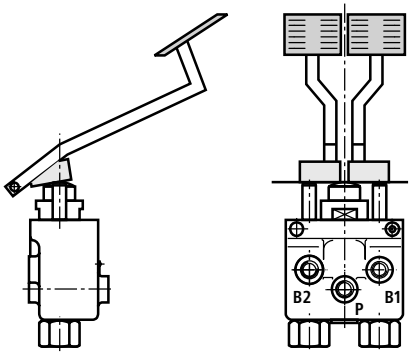
Steering power assistance for tractors and similar vehicles with remotely powered braking system by braking optionally the right or left rear wheel.

When both brake pedals are actuated while the vehicle is traveling on the road, it is ensured that the braking pressure is identical in B1 and B2 (straight traveling).

⚠ Attention!

When traveling on the road, the pedals must be coupled!

For steering braking (not on public roads) only one pedal is actuated and the braking pressure applied only in B1 or B2.



Ordering code

LT	10	MK	A	2X	/	/	02	M	*

Type of actuation
Mechanical with push-button = **MK**

Type of connection
Attachment = **A**

Component series 20 to 29 (20 to 29: unchanged connection and installation dimensions) = **2X**

Nominal braking pressure 60 bar = **060**
Nominal braking pressure 90 bar = **090**
Nominal braking pressure 100 bar = **100**

02 = Metric thread

Pipe connections

M = NBR seals, suitable for mineral oil (HL, HLP) to DIN 51524

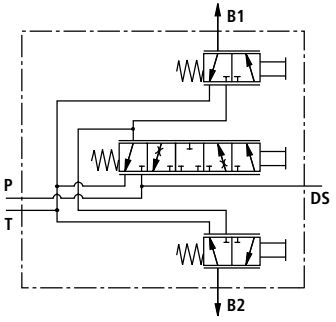
Seal material

Further details in clear text

Symbol

Pipe connections

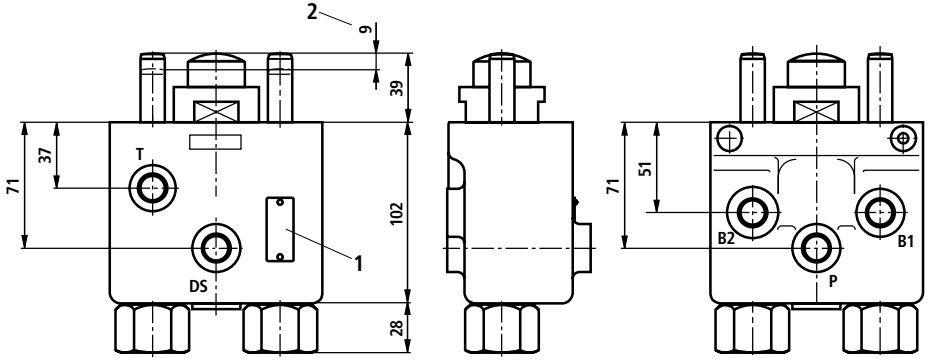
B1, B2	Brake line to wheel brakes
P	Accumulator line and accumulator (diaphragm-type accumulator)
T	Leakage line
DS	Pressure switch accumulator pressure

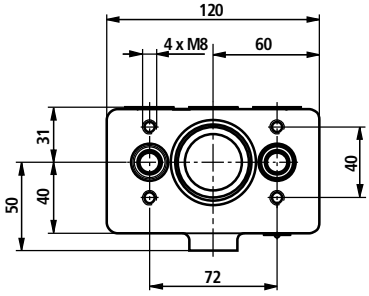


Technical data

Weight	(Valve without pedal)	kg	2.7
Braking pressure	Foot brake (BBA)	bar	Up to 100 (for pressure rating, see ordering code)
Accumulator pressure max.		bar	200
Hydraulic fluid			Mineral oil (HL, HLP) to DIN 51524; bio-degradable hydraulic fluids on request
Hydraulic fluid temperature range	ϑ	°C	– 20 to + 80
Viscosity range	ν	mm²/s	2.8 to 380
Max. permissible degree of contamination of the hydraulic fluid Cleanliness class to ISO 4406 (c)			Class 20/18/15

Unit dimensions: Without pedal (dimensions in mm)

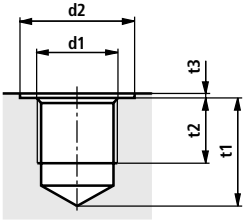




1 Nameplate
2 Actuating stroke

Pipe ports

P = Operating brake accumulator
T = Tank
B1 = Operating brake
B2 = Operating brake
DS = Pressure switch accumulator pressure



Port	d1	Ød2	t1	t2	t3
P	M16x1.5	–	17.5	13	–
DS					
B1					
B2					
T		Ø26			1.5

Legal stipulations

A requirement that all legal stipulations have in common is that a vehicle must be road safe in all operating conditions. The currently valid national and international regulations form the basis for engineering a braking system. In addition, the braking system must be designed in accordance with state of the art. Braking systems must be approved in accordance with valid national and international regulations

☞ **The responsibility for this lies with the manufacturer of the vehicle.**

⚠ Safety notes

- When the vehicle is driving on roads, the two brake pedals must be connected to each other.
- Damaged seals must be immediately replaced.
- Damaged valves must be repaired, even if they function properly.

Notes on the installation

- Rubber parts must not be painted.
- Operating elements must not be directly exposed to high-pressure jet cleaning.
- The cross-sections of hydraulic transmission elements (pipes, hoses) must be selected so that at low operating temperatures the pressure drop between the hydraulic accumulator and the brake cylinder remains low.
- Maximum tank pressure 0.5 bar (the tank must be mounted above the valve!)
- For the max. permissible degree of contamination, see technical data.
- Damaged seals must be immediately replaced.
- The tank pressure must not exceed the brake application pressure.

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Steering Units

Designation	Type	Size	Data sheet	Page
Steering unit	LAGC	50…630	RE 14365	911
Steering unit	LAGL	500…1000	RE 11872	923
Steering unit	LAGU	125…320	RE 11867	933
Steering unit	LAGZ	160…300	RE 11868	945
Bypass priority valve	LPD	120	RE 27549	957
Priority valve	LPS	40…160	RE 27548	963
Steering column and sensor	LAB		RE 11874	973

For the latest information on power steering units, please visit our website:
www.boschrexroth.com/power-steerings

Rexroth
Bosch Group

Steering unit LAGC

RE 14365/03.2012 1/12
Replaces: 10.2007

Data sheet

H6211_d

Nominal sizes 50 to 630
Component series 1X and 2X
Nominal pressure 175 bar
Maximum flow 63 l/min

Table of contents

Features

- LAGC steering units are used in hydraulic steering circuits of vehicles and mobile machines with large axle loads and travel speeds not exceeding 50 km/h.
- With the aid of a steering unit even heavy vehicles can easily be steered. The absence of a mechanical connection between the steering unit and steering axle allows the designer to realize solutions, which would be impossible with conventional steering systems.
- The steering unit includes all valves required in the hydraulic steering circuit for the protection of the steering unit and the steering cylinder. This eliminates the need for additional pipework.
- If the hydraulic pump fails, vehicles can also be steered manually with the help of the LAGC; in this case, the LAGC acts as hand pump for the steering cylinder.

Ordering code

LAG	C			/		–	M		*

Steering unit

Design
with integrated valves = C

Displacement (cm^3/rev)

Nom. size	OC; LD	R[1]; LDA[2]	
50	●	●	= 50
63	●	●	= 63
80	●	●	= 80
100	●	●	= 100
125	●	●	= 125
160	●	●	= 160
200	●	●	= 200
250	●		= 250
320	●		= 320
400	●		= 400
500	●		= 500
630	●		= 630

Noise characteristics
Standard [3] = –
Low [4] = N

Series
Series 10 to 19 (10 to 19: Unchanged installation and connection dimensions) = 1X
Series 20 to 29 (20 to 29: Unchanged installation and connection dimensions) = 2X [5]

Special specifications
Please consult our sales organization

[6] **Pipe ports P, T, L, R / LD**
01 = ● Pipe thread to DIN 3852
06 = ◑ Metric ISO thread to DIN 3852
12 = ◑ UNF thread to SAE
40 = ◑ Metric ISO thread to DIN 3852

Seals
M = Suitable for mineral oil (HL, HLP) to DIN 51524 and fast bio-degradable hydraulic fluids (HETG, rape seed oil) to VDMA 24568 (see RE 90221)

[7] **Pressure relief valve setting** (pressure differential)
90 = 90 bar
140 = 140 bar
175 = 175 bar

[7] **Shock valve setting** (pressure differential)
150 = 150 bar
200 = 200 bar
240 = 240 bar

Reaction
No code = Without reaction
R = With reaction

Load Sensing
No code = Without load signal in Open Center (OC) variant
LD = Dynamic load signal
LDA = Dynamic load signal, can be flanged on

● = Standard product range
◑ = Extended product range

1) With reaction
2) Dynamic load signal, can be flanged on
3) To be specified for LD variant
4) To be specified for Open Center (OC) variant
5) Only Open Center design (extended flow: see Technical data - page 7)
6) For thread dimensions, see Unit dimensions on pages 11 and 12
7) The response pressure of shock valves must be 50 bar higher than the setting of the pressure relief valve, but not exceed 2.2 times the setting of the latter (see §38 StVZO, German Road Traffic Licensing Regulation).
Preferably: 150 to 90; 200 to 140; 240 to 175.

Order example:

LAGC 200 -1X/LD150-90M01
- Steering unit with integrated valves
- Size 200, dynamic load signal
- Shock valves 150 bar, pressure relief function 90 bar
- Pipe ports P, T, L, R in G 1/2 , LD in G 1/4

LAGC 200 N1X/150-90M01
- Steering unit with integrated valves
- Size 200, low noise characteristics
- Shock valves 150 bar, pressure relief function 90 bar
- Pipe ports P, T, L, R in G 1/2

Function, section

Pilot spool (**1**) of the control valve is rotated via the steering column in relation to control sleeve (**2**). This opens a cross-section between the spool and the sleeve. The pressure oil acts on rotor set (**3**) and sets the latter into motion. The oil is then fed via the rotor set to the steering cylinder. The rotation of the rotor acts on the sleeve, which then follows the rotary movement of the spool.

The size of the opened cross-section depends on the turning speed of the steering wheel and on the steering pressure; on Load-Sensing variants, it depends exclusively on the turning speed.

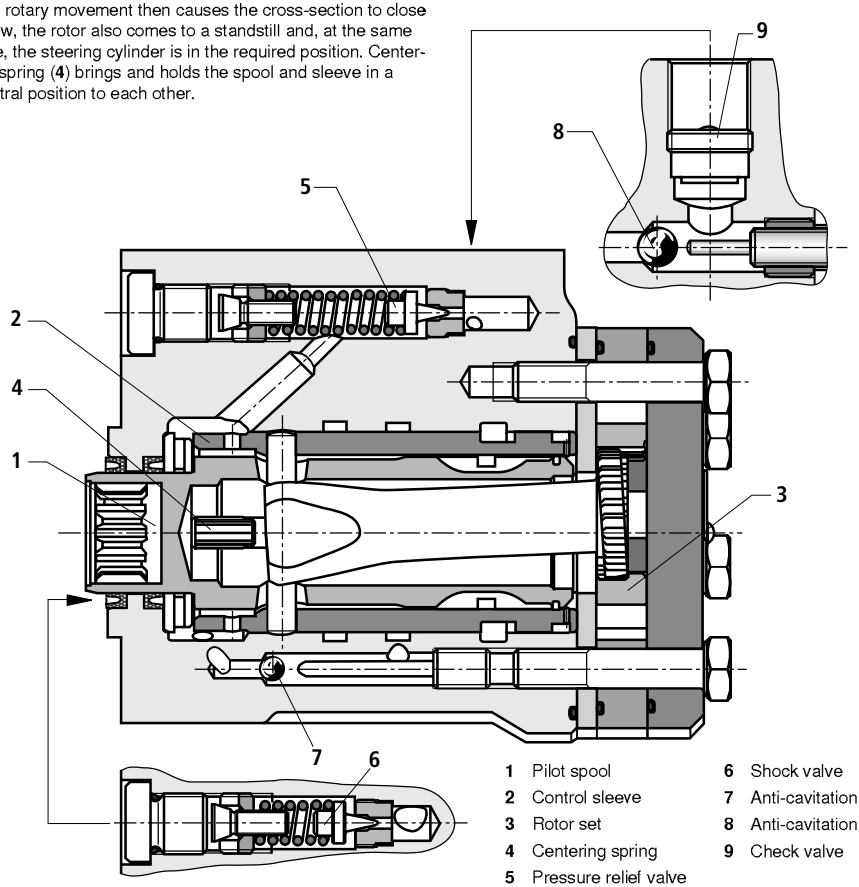
If the steering movement is interrupted and the spool is at a standstill, the oil, which still flows through the open cross-section to the rotor, causes the rotor and hence the sleeve to continue to rotate.

The rotary movement then causes the cross-section to close - now, the rotor also comes to a standstill and, at the same time, the steering cylinder is in the required position. Centering spring (**4**) brings and holds the spool and sleeve in a neutral position to each other.

Pressure relief valve (**5**) limits the system pressure of the steering circuit. On the Load-Sensing variants, the pilot valve for the load signal is installed instead (see sectional drawing).

Two shock valves (**6**) protect ports **L** and **R** to the steering cylinder. If one of the shock valve responds, the discharged oil is fed via anti-cavitation valve (**7**) to the opposite side, or missing leak-oil aspired from the tank.

In the event of an oil supply failure, the LAGC operates as hand pump. In this operational state, oil can be withdrawn from the tank via anti-cavitation valve (**8**), with check valve (**9**) preventing air to be aspired via the pump port (P). During normal operation, this valve prevents shocks on the steering wheel caused by excessive external steering forces.



1	Pilot spool	**6**	Shock valve
2	Control sleeve	**7**	Anti-cavitation valve
3	Rotor set	**8**	Anti-cavitation valve
4	Centering spring	**9**	Check valve
5	Pressure relief valve		

913

Device variants

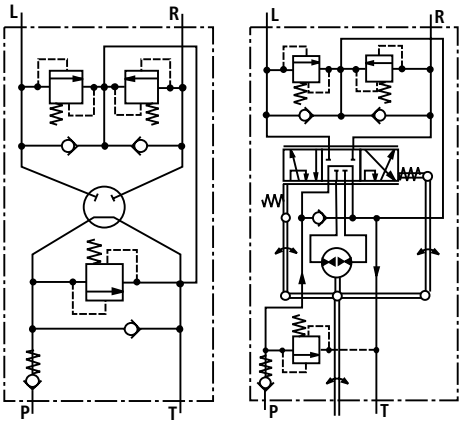
Standard variant

Open **C**enter with **N**on **R**eaction = **OC** / **NR**

Mainly used in steering systems with fixed displacement hydraulic pumps.

When no steering movement is performed, the connection between pump port (**P**) and tank port (**T**) is open (**OC**), and the pump flow is directed to the tank almost at zero pressure. Ports L[1)] (left) and R[1)] (right) are blocked in the neutral position. In this way, external forces acting via the steering cylinder are supported without the driver perceiving any resulting reaction forces on the steering wheel (Non Reaction).

1) Contrary to standardization, the actuator lines in steering systems are usually designated “L” and “R”, not “A” and “B“.

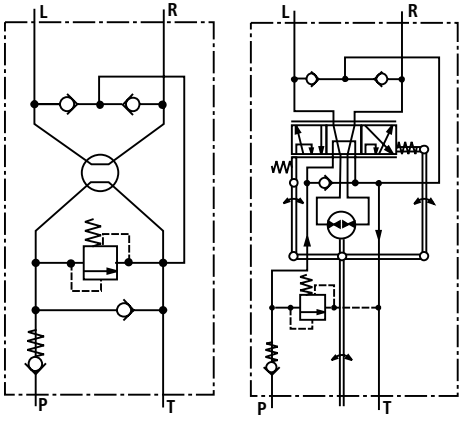


Standard variant

Open **C**enter with **R**eaction = **OC** / **R**

In the neutral position, the cylinder ports are connected with each other. External forces acting via the steering cylinder are perceived as reaction force by the driver on the steering wheel (Reaction).

When the driver releases the steering wheel after the steering maneuver is completed, the wheels and the steering wheel automatically return to straight-ahead travel, provided that the steering geometry is suitable for this.

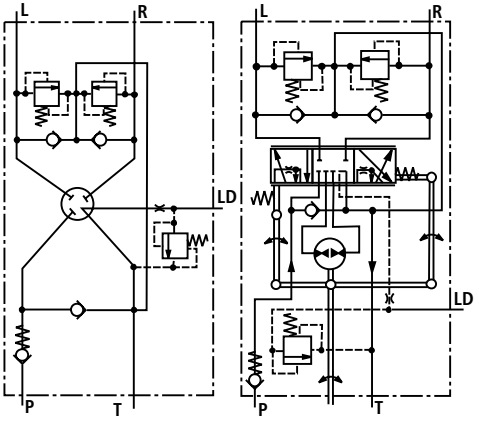


Device variants

Load-Sensing variants

Steering units with Load Sensing provide a load signal that can be used for controlling a priority valve and/or a pump. They are designed as Closed-Center steering systems, with the connection of pump port (**P**) to tank port (**T**) being closed in the neutral position.

If the steering system and working hydraulics are supplied by a common pump, a priority valve must be installed. This valve ensures the preferred supply of the steering unit with oil, with the valve being controlled by the load signal of the steering unit. If no steering movement is performed, the entire oil flow from the pump is available to the working hydraulics. Fixed or variable displacement pumps can be used as hydraulic pump.



Load signal, dynamic

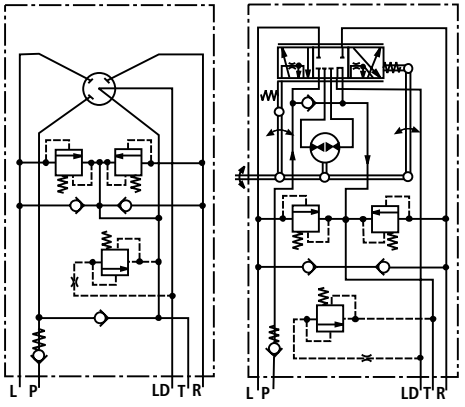
The oil flowing in the load signal line transmits the load signal, with the pilot oil flowing from the priority valve to the steering unit. Also in the neutral position, a continuous, low pilot oil flow of ca. 0.5 l/min is provided. Consequently, the steering unit has approximately the same temperature as the oil.

Thermal shocks are largely prevented.

The **LD** variant causes the priority valve to react faster. The hard point at the beginning of the steering movement is usually no longer perceivable- even under cold start conditions.

Flanged-on priority valve

Steering units with flanged-on priority valve significantly reduce the piping effort.



LAGC of LD variant for flanged-on priority valve

Low-noise variant

Steering units of the LAGC Open Center variant are generally delivered in the low-noise variant "N".

Functions in the steering circuit

Servo-operation

Steering units of type LAGC consist of a manually operated servo-valve of rotary spool design, a rotor set, which operates according to the gerotor principle, and the required valves for the steering circuit.

The size of the rotor set determines the oil volume, which flows per steering wheel turn to the steering cylinder. The size of the rotor set is selected so that with 3 to 5 turns of the steering wheel, it is possible to steer from one limit stop to the other.

Emergency operation

During normal operation of the steering unit, when the hydraulic oil displaces a sufficient amount of oil, the torque on the steering wheel is less than 5 Nm. In the event of a hydraulic pump failure, the steering unit operates in the emergency mode; the rotor set acts as hand pump, and the vehicle is steered manually, without power assistance. The pressure that can be generated manually depends on the size of the rotor set and the force applied to the steering wheel. The smaller the rotor set, the higher the pressure that can be built up manually.

During manual steering, the following pressures can be achieved in dependence upon the steering moment:

M_{steer}	Nom. size	050	063	080	100	125	160
120 Nm	p in bar	90	85	80	60	50	40
70 Nm	p in bar	52	50	46	35	30	23
M_{steer}	Nom. size	200	250	320	400	500	630
120 Nm	p in bar	30	25	20	15	12	10
70 Nm	p in bar	17	14	11	8	7	6

⚠ CAUTION!

The emergency operating mode is not intended for continuous operation!

- If a higher pressure is required for steering in emergency operation at 70 Nm, a steering unit with reduction gear, LAGU to RE 11867 or LAGZ to RE 11868, can be installed.

Pressure relief valve

The pressure relief valve for the hydraulic pump is available in three pressure settings:

- 90 bar
- 140 bar
- 175 bar

☞ NOTE!

The pressure in the T line increases the set pressure by the equivalent value.

Shock and anti-cavitation valves

The cylinder side valves that are built into the LAGZ unit is available in three pressure settings:

- 150 bar
- 200 bar
- 240 bar

Anti-cavitation valve

If the hydraulic pump fails then the spressure fluid is drawn from the reservoir via this valve, which is fitted between the P and T connections.

Check valve

This valve which is fitted in the P connection prevents:

- The return flow of oil from the steering cylinder into the hydraulic system when the cylinder pressure, due to travel obstructions, is greater than the system pressure. Steering shocks at the steering wheel are thereby suppressed.
- The sucking in of air via the P connection during emergency operation.

Technical data (for applications outside these parameters, please consult us!)

General			
Ambient temperature range	ϑ	°C	–20 to +80
Steering moment - standard [1]	M	Nm	≤ 5
Steering moment - emergency operation	M	Nm	≤ 160 permissible
Max. tightening torque M_A for the mounting screws		Nm	30 (see RE 11874 „steering column“)

Hydraulic			
Nominal pressure	p	bar	175
Pressure fluid			see page 8
Pressure fluid temperature range	ϑ	°C	–20 to +80
Viscosity range	ν	mm²/s	10 to 800
Maximum permissible degree of contamination of the pressure fluid is to ISO 4406 (c)			class 19/16/13 [2]

Steering unit type	Displacement volume servo operation cm3	Flow		Max. perm. pressure in port		
		Nom [3] l/min	Max. l/min	P bar	T bar	L and R bar
LAGC 050	50	5,0	15	175	20	240
LAGC 063	63	6,3	20	175	20	240
LAGC 080	80	8,0	25	175	20	240
LAGC 100	100	10,0	30	175	20	240
LAGC 125	125	12,5	35	175	20	240
LAGC 160	160	16,0	50	175	20	240
LAGC 200	200	20,0	50	175	20	240
LAGC 250	250	25,0	50	175	20	240
LAGC 320	320	32,0	50	175	20	240
LAGC 400	400	40,0	50	175	20	240
LAGC 500	500	50,0	50	175	20	240
LAGC 630	630	63,0	50	175	20	240

1) Other steering moment variants (e.g. low) on request
2) The cleanliness classes specified for components must be adhered to in hydraulic systems.
Effective filtration prevents malfunction and, at the same time, prolongs the service life of components.
For the selection of filters, see data sheets RE 50070, RE 50076, RE 50081, RE 50086, RE 50087 and RE 50088.
3) Related to the steering speed of 100 steering rotations/min.

Technical data of the hydraulic fluid

Pressure fluids

Before carrying out any engineering please refer to the extensive information regarding pressure fluid selection and application conditions in our catalogue sheets RE 90220 (mineral oil) and RE 90221 (environmentally compatible fluids). These catalogue sheets refer to axial piston units, however, the details can be analogously applied to the steering units. For pressure fluids that require FKM seals please contact ourselves.

Operating viscosity

We recommend that the operating viscosity (at operating temperature) for efficiency and service life, is selected within the optimum range of

ν_{opt} = optimum operating viscosity range 16 to 46 mm²/s

with reference to the temperature.

Limiting viscosity

For the limiting conditions the following values apply:

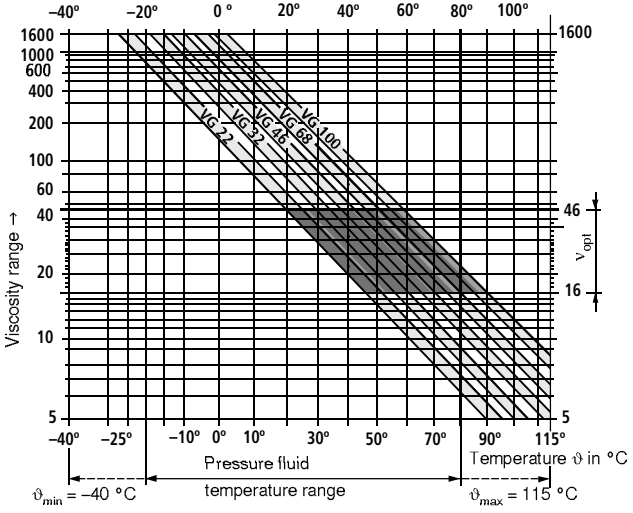
- ν_{min} = 10 mm²/s at a maximum permissible temperature of ϑ_{max} = +80 °C
- ν_{max} = 800 mm²/s

Temperature range: (see selection diagram)

- ϑ_{min} = –20 °C
- ϑ_{max} = +80 °C

If there is the possibility of there being a temperature difference of more than 20 °C between the steering unit and the pressure fluid, then either a LD or LDA version or an open center version for warming the steering unit should be fitted.

Selection diagram



Further on the selection of pressure fluids

A prerequisite to being able to select the correct pressure fluid is knowing the operating temperature and the ambient temperature.

The pressure fluid should be so selected that the operating viscosity at the working temperature lies within the optimum range (see selection diagram).

We recommend that the next higher viscosity class is selected.

Example:

For an ambient temperature of X °C the tank temperature stabilises at 60 °C. To achieve the optimum viscosity, this relates to the viscosity classes of VG 46 or VG 68; VG 68 should be selected.

Pressure fluid filtration

The finer the filtration the higher the cleanliness class of the pressure fluid is achieved and so the higher the service life of the entire hydraulic system.

NOTE!

To ensure the functionability of the steering pump a minimum pressure fluid cleanliness class of 19/16/13 to ISO 4406 is necessary.

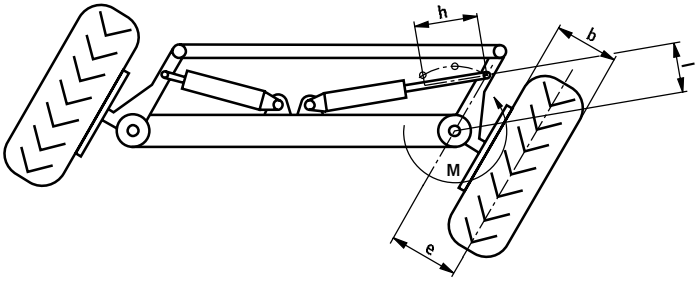
CAUTION!

Operating the unit with contaminated hydraulic fluid may lead to the steering system failing.

Calculating the steering moment

Steering moment $M = 0.05 \cdot F_A \cdot \frac{1}{1+\frac{e}{b}} \cdot \frac{b}{200} \cdot \frac{\mu}{0.7}$ [Nm]

Steering force $F = \frac{M}{l} \cdot 10^3$ [N]



Formula symbols

Formula symbol	Designation	Unit	Formula symbol	Designation	Unit
A	Required cylinder area	mm^2	***l***	Smallest, effective steering lever	mm
A_1	Cylinder piston area, differential cylinder	mm^2	***M***	Steering moment	Nm
A_2	Cylinder ring area, differential cylinder	mm^2	***n***	Steering wheel rotational speed	min^{-1}
b	Tyre width	mm	n_{Ider}	Motor idling RPM	min^{-1}
d	Piston rod diameter	mm	n_{Motor}	Motor operating RPM	min^{-1}
D	Cylinder diameter	mm	***p***	Steering pressure	bar
e	Distance of swivel bearing to center of tyre	mm	q_{vp}	Pump flow	l/min
F	Steering force	N	***V***	Steering unit displacement	cm^3/U
F_A	Steering axle force	N	V_p	Steering pump displacement	cm^3/U
h	Cylinder stroke length	mm	V_{ZYL}	Cylinder volume	cm^3
i	No. of steering wheel turns		μ	Co-efficient of friction	

Defining the steering cylinder and steering pump

Steering cylinder

Required cylinder area $A = \frac{F}{p} \cdot 10$ [mm²]

Cylinder area (piston side) $A_1 = \frac{\pi}{4} \cdot D^2$ [mm²]

Cylinder area (rod side) $A_2 = \frac{\pi}{4} \cdot (D^2 - d^2)$ [mm²]

When using a differential or double roded cylinder, A_2 must be greater than the required cylinder area.

If two cross connected differential cylinders are to be used, then $A_1 + A_2$ must be greater thant the required cylinder area.

The nominal size of steering unit results from the cylinder volume and the required number of steering wheel turns.

Cylinder volume

$$V_{ZYL} = \frac{A \cdot h}{10^3} \quad [cm^3]$$

Displacement volume LAGU

$$V = \frac{V_{ZYL}}{i} \quad [cm^3/U]$$

Normally there are 3 to 5 turns of the steering wheel from end stop to end stop.

NOTE!

Further information is availabe here:

- Suitable steering columns RE 11874
- associated priority valves for steering systems contained in load signal circuits: RE 27548
- General information: RE 64020-B1
- Product-specific applications: RE 07015-B2

Steering pump

The pump should be so selected that when the motor is idling, a steering velocity of approx. 50 min^{-1} can still be achieved. The maximum steering speed, which is dependent on the steering wheel diameter, is approx. 100 to 150 min^{-1}.

Pump flow $q_{VP} = V \cdot (n + 10) \cdot 10^{-3}$ l/min.

The pump displacement (≙ nominal size) required for steering at idling speed and at operating speed of the vehicle must be calculated.

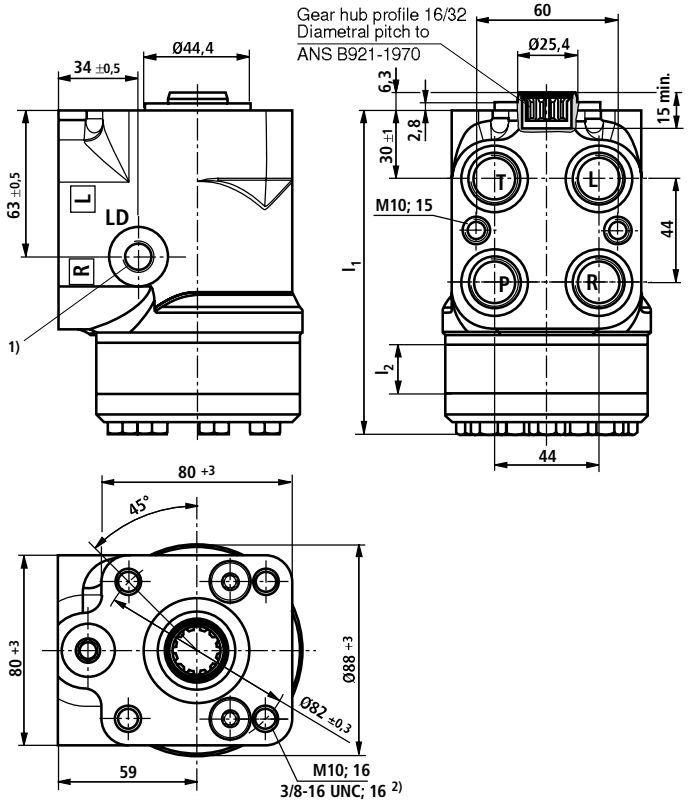
Pump size at idling speed

$$V_P = \frac{q_{VP} \cdot 10^3}{n_{leer}} \quad [cm^3/U]$$

Pump size at operating speed

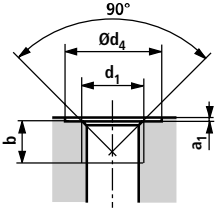
$$V_P = \frac{q_{VP} \cdot 10^3}{n_{Motor}} \quad [cm^3/U]$$

Unit dimensions: Type LAGC... / LAGC...LD... (dimensions in mm)

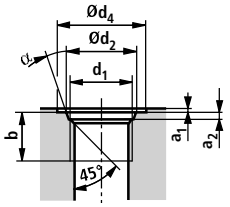


Nom. size	l_1	l_2
050	125	6.8
063	127	8.3
080	129	10.5
100	132	13.2
125	135	16.5
160	139	21.1
200	145	26.4
250	151	33.0
320	161	42.3
400	172	52.9
500	186	68.0
630	202	83.3

Imperial, metric thread

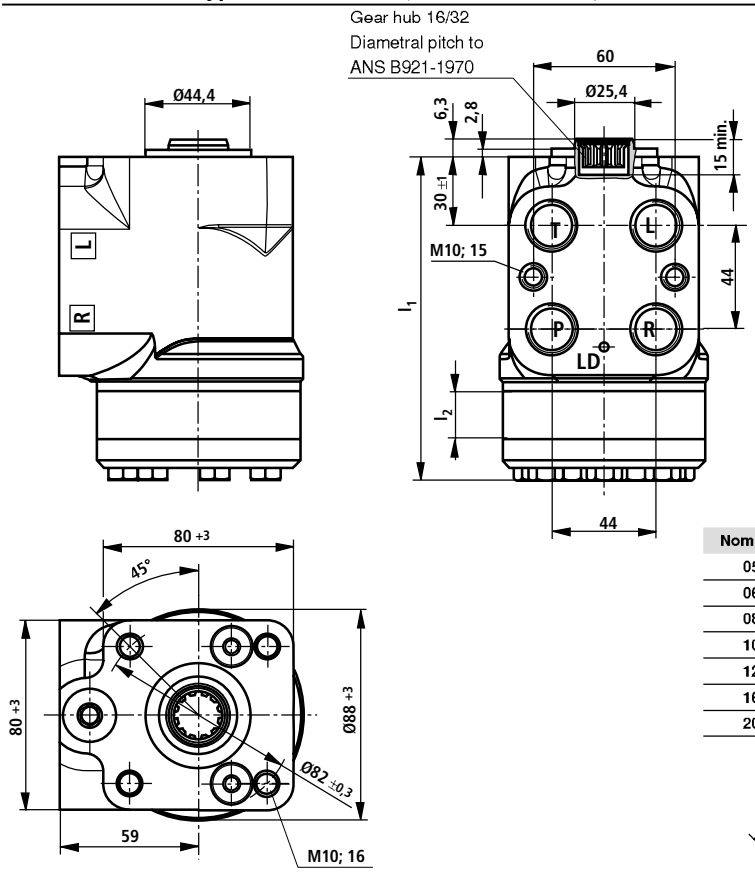


UNF, metric - thread



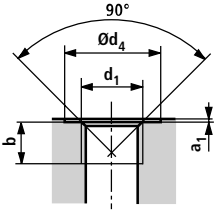
1) LD bore on variant LAGC...**LD**...
2) Only with variant **12** (see pipe ports)

Unit dimensions: Type LAGC…LDA.. (dimensions in mm)



Nom. size	l_1	l_2
050	125	6.8
063	127	8.3
080	129	10.5
100	132	13.2
125	135	16.5
160	139	21.1
200	145	26.4

Metric thread



Port	Variant	d_1	Ød_2	Ød_4	$b_{min.}$	a_1
P, T, L, R	40	M18x1.5	–	–	12	–

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Rexroth
Bosch Group

Steering unit LAGL

RE 11872/03.2012 1/10
Replaces: 05.2006

Data sheet


H7375

Nominal sizes 500 to 1000
Component series 1X
Maximum flow 80 l/min

Table of contents

Features

- LAGL steering units are used in hydraulic steering circuits of vehicles and mobile machinery with great axle loads and travel speeds up to max. 50 km/h.
- With the help of a steering unit, even heavy vehicles can be easily steered. The absence of a mechanical connection between the steering unit and the steering axle allows the designer the implementation of solutions that would not be feasible with conventional steering systems.
- The steering unit includes all valves that are required in the hydraulic steering circuit for the protection of the steering unit and steering cylinders, which renders additional pipe-work unnecessary.
- The control valve is optimised for large nominal sizes. When compared with type LAGC, pressure losses were reduced.

Ordering code

LAG	L			1X/	–	M		*

Steering unit

Design
Large (for large nom. sizes) = L

Displacement (cm3/U)

Nom. size	OC	LD	
500	●	●	= 500
630	●	●	= 630
800	●	●	= 800
1000	●	●	= 1000

Noise characteristics
Standard [1] = –
Low [2] = N

Component series
Component series 10 to19 (10 to19 unchanged installation and connection dimensions) = 1X

Load Sensing
Without load signal in Open Center (OC) version = No code
Dynamic load signal = LD

Special specifications
Please consult or sales organization

[4] **Pipe connections P, T, L, R/LD**
01 = ● Pipe threads (mounting bores to DIN 3852–2)
02 = ◑ Metric ISO threads (mounting bores to DIN 3852–1)

Seal material
M = NBR seals

[3] **Pressure relief valve setting** (pressure differential)
140 = 140 bar
175 = 175 bar
210 = 210 bar

[3] **Shock valve setting** (pressure differential)
200 = 200 bar
240 = 240 bar
260 = 260 bar

● = Standard programme
◑ = Extended programme

1) Specify for LD version
2) Indicate for Open Center (OC) version
3) The response pressure of the shock valves must be set 50 bar higher, but not more than 2.2 times higher, than the pressure relief valve of the hydraulic pump (see §38 StVZO (German road traffic licensing regulations)).
Preferably 200 to 140; 240 to 175; 260 to 210
4) For thread dimensions, see unit dimensions on page 10

Order example:

LAGL 800-1X/LD200-140M01

- Steering unit with integrated valves, size 800,
- dynamic load signal, shock valves 200 bar,
- pressure relief valve 140 bar,
- pipe connections P, T, L, R in G1/2; LD in G1/4

LAGL 800N1X/240-175M01

- Steering unit with integrated valves,
- size 800, Open Center, low noise,
- shock valves 240 bar, pressure relief valve 175 bar,
- pipe connections P, T, L, R in G1/2

Function, section

Control spool (**1**) of the control valve is rotated via the steering column in relation to control bush (**2**). This results in the opening of a cross-section between the spool and the bush. The hydraulic oil acts on rotor set (**3**) and sets it into motion. The oil is fed via the rotor set to the steering cylinder. The rotation of the rotor acts on the bush and causes it to follow the rotary movement of the spool.

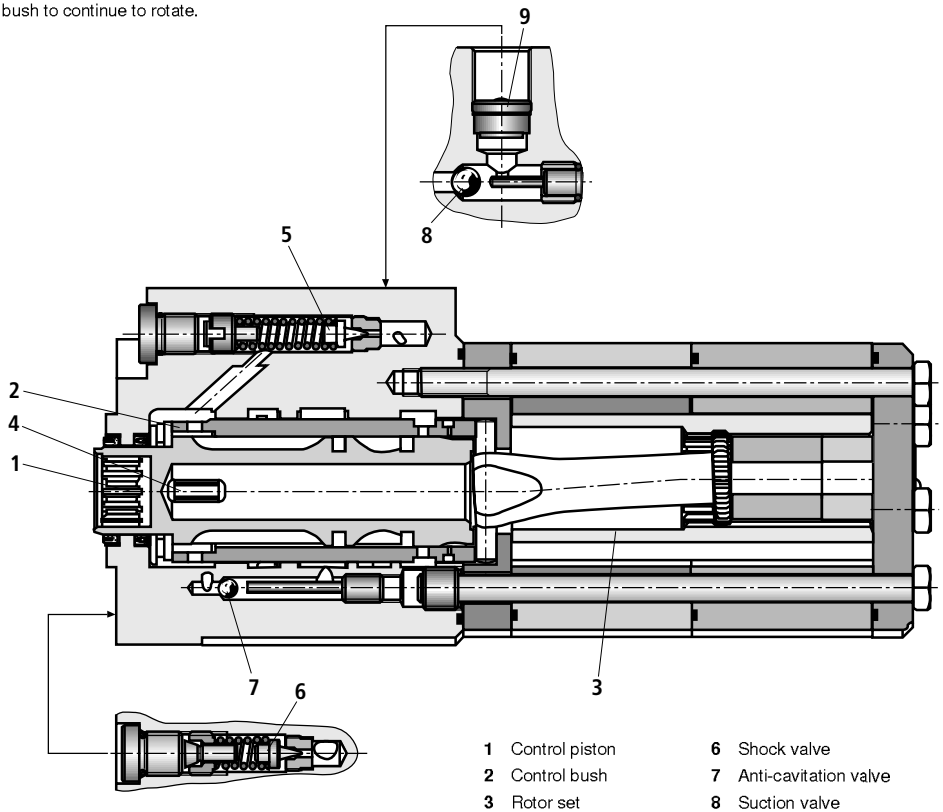
The size of the opened cross-section depends on the turning speed of the steering wheel and on the steering pressure; in the case of load-sensing versions, it depends exclusively on the turning speed.

When the steering movement is stopped and the spool comes to a standstill, the oil flowing through the still open cross-section to the rotor causes the rotor and hence the bush to continue to rotate.

The cross-section is then closed via the rotary movement - the rotor now also comes to a standstill; and together with it, the steering cylinder stops at the requested position. Centring spring (**4**) returns and holds the spool and bush in a neutral position to each other.

The system pressure of the steering circuit is limited by pressure relief valve (**5**). In the case of load-sensing versions (see section), a pilot valve for the load signal is installed instead of the pressure relief valve.

The two shock valves (**6**) protect ports L and R to the steering cylinder. When one of the shock valves responds, the discharging oil is fed by anti-cavitation valve (**7**) to the opposite side or missing leak-oil is re-aspired from the tank. (For the functional description of items 8 and 9, see also page 6).



1	Control piston	**6**	Shock valve
2	Control bush	**7**	Anti-cavitation valve
3	Rotor set	**8**	Suction valve
4	Centring spring	**9**	Check valve
5	Pressure relief valve		

Device version: Open Center, symbols

Low-noise version

Open **C**enter with **N**on **R**eaction = **OC** / **NR**

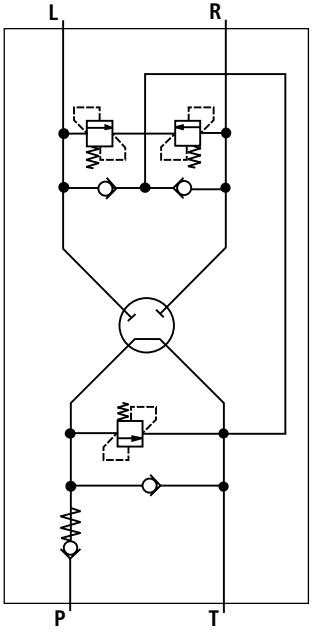
Mainly used in steering systems with fixed displacement hydraulic pump.

When no steering movement is performed, the connection between pump port (**P**) and tank port (**T**) is open (**OC**), and the pump flow is directed to the tank almost at zero pressure. Ports L[1)] (left) and R[1)] (right) are closed in the neutral position. In this way, external forces are supported, which act via the steering cylinder, without the driver perceiving any reaction forces at the steering wheel (**N**on **R**eaction).

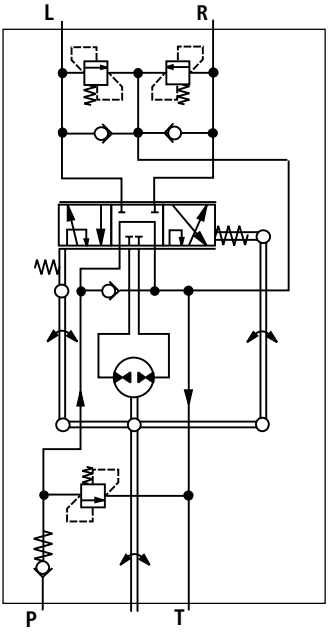
Steering units of type LAGL Open Center are generally shipped in the low-noise version "N".

1) In contrast to standard designations A and B, the working lines in steering systems are usually identified with L and R.

Open Center version



Simplified representation



Detailed representation

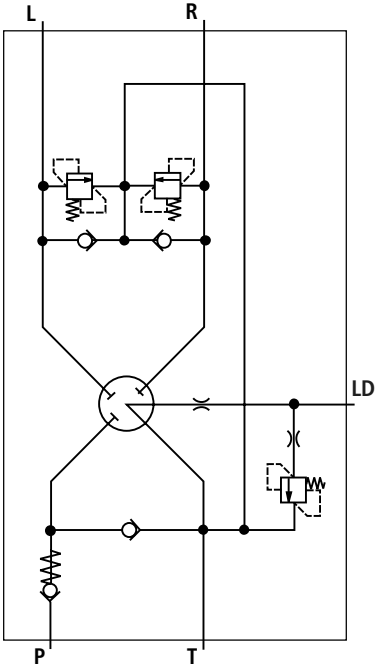
Device version: Load Sensing, symbols

Load-Sensing version

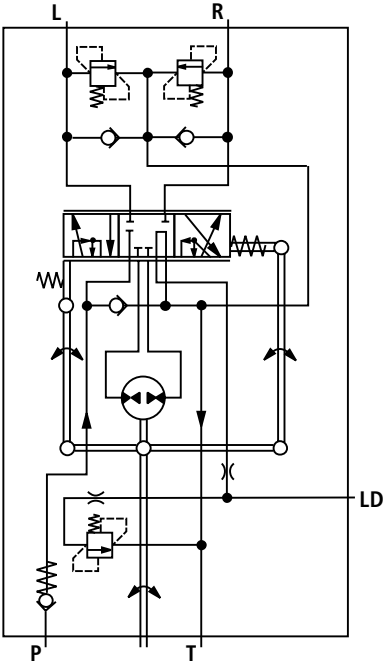
Steering units with load-sensing feature provide a load signal, which can be used for controlling a priority valve and/or a pump. They are designed as Closed-Center steering units, with the connection of pump port (**P**) to tank port (**T**) being closed in the neutral position.

If the steering system and the working hydraulics are supplied by a common pump, a priority valve must be used. This valve ensures the priority supply of the steering unit with oil, with the valve being controlled with the help of the load signal from the steering unit. When no steering movement is performed, the entire amount of oil from the pump is made available to the working hydraulics. The hydraulic pump can be a fixed or a variable displacement pump.

Load-Sensing version



Simplified representation



Detailed representation

Load signal, dynamic

The oil flowing in the load signal line transmits the load signal, with the pilot oil flowing from the priority valve to the steering unit. A small pilot oil flow of approx. 1.0 l/min flows continuously also in the neutral position. Consequently, the steering unit has almost the same temperature as the oil.

Temperature shocks can largely be ruled out.

The LD version causes a faster reaction of the priority valve. The hard point when starting to steer - also under cold start conditions - is usually no longer perceivable.

Functions in the steering circuit

Power-assisted mode

Steering units of type LAGL consist of a manually operated servo-valve of rotary spool design, a rotor set operating according to the gerotor principle, and the valves required for the steering circuit.

The size of the rotor set determines the oil volume that flows to the steering cylinder per turn of the steering wheel. The size of the rotor set is to be selected so that it is possible to steer from one limit stop to the other with 3 to 5 turns of the steering wheel.

Pressure relief valve

The pressure relief valve for the hydraulic pump is available in three pressure settings:

- 140 bar
- 175 bar
- 210 bar

NOTE!

The pressure in the T line increases the set pressure by the equivalent value.

Shock and anti-cavitation valve

The cylinder side valves that are built into the LAGL unit is available in three pressure settings:

- 200 bar
- 240 bar
- 260 bar

Anti-cavitation valve

If the hydraulic pump fails then the spressure fluid is drawn from the reservoir via this valve, which is fitted between the P and T connections.

Check valve

This valve which is fitted in the P connection prevents:

- The return flow of oil from the steering cylinder into the hydraulic system when the cylinder pressure, due to travel obstructions, is greater than the system pressure. Steering shocks at the steering wheel are thereby suppressed.
- The sucking in of air via the P connection during emergency operation.

Technical data (for applications outside these parameters, please consult us!)

General			
Ambient temperature range	ϑ	°C	–20 to +80
Steering moment - standard	M	Nm	≤ 5
Max. tightening torque M_A for the mounting screws		Nm	30 (see RE 11874 „steering column")

Hydraulic			
Nominal pressure	p	bar	175
Pressure fluid			see page 7
Pressure fluid temperature range	ϑ	°C	–20 to +80
Viscosity range	ν	mm²/s	10 to 800
Maximum permissible degree of contamination of the pressure fluid is to ISO 4406 (c)			Class 19/16/13; for this, we recommend a filter with a minimum retention rate of $\beta_{x0} \geq 100$ to ISO 16889.

Nom. size	Displacement volume cm³	Max. flow l/min [1]	Max. perm. pressure in port		
			P bar	T bar	L and R bar
500	500	80	210	20	260
630	630	80	210	20	260
800	800	80	210	20	260
1000	1000	80	210	20	260

[1] Values for centering spring package, standard (2.5 to 4 Nm)

Pressure fluid technical data

Pressure fluids

Before carrying out any engineering please refer to the extensive information regarding pressure fluid selection and application conditions in our catalogue sheets RE 90220 (mineral oil) and RE 90221 (environmentally compatible fluids). These catalogue sheets refer to axial piston units, however, the details can be analogously applied to the steering units. For pressure fluids that require FKM seals please contact ourselves.

Operating viscosity

We recommend that the operating viscosity (at operating temperature) for efficiency and service life, is selected within the optimum range of

ν_{opt} = optimum operating viscosity range 16 to 46 mm²/s

with reference to the temperature.

Limiting viscosity

For the limiting conditions the following values apply:

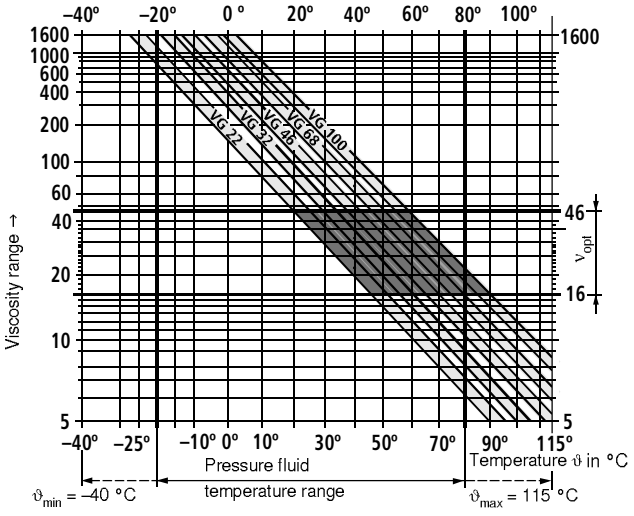
- ν_{min} = 10 mm²/s at a maximum permissible temperature of ϑ_{max} = +80 °C
- ν_{max} = 800 mm²/s

Temperature range: (see selection diagram)

- ϑ_{min} = –20 °C
- ϑ_{max} = +80 °C

If there is the possibility of there being a temperature difference of more than 20 °C between the steering unit and the pressure fluid, then either a LD or LDA version or an open center version for warming the steering unit should be fitted.

Selection diagram



Further on the selection of pressure fluids

A prerequisite to being able to select the correct pressure fluid is knowing the operating temperature and the ambient temperature.

The pressure fluid should be so selected that the operating viscosity at the working temperature lies within the optimum range (see selection diagram).

We recommend that the next higher viscosity class is selected.

Example:

For an ambient temperature of X °C the tank temperature stabilises at 60 °C. To achieve the optimum viscosity, this relates to the viscosity classes of VG 46 or VG 68; VG 68 should be selected.

Pressure fluid filtration

The finer the filtration the higher the cleanliness class of the pressure fluid is achieved and so the higher the service life of the entire hydraulic system.

☞ **NOTE!**

To ensure the functionability of the steering pump a minimum pressure fluid cleanliness class of 19/16/13 to ISO 4406 is necessary.

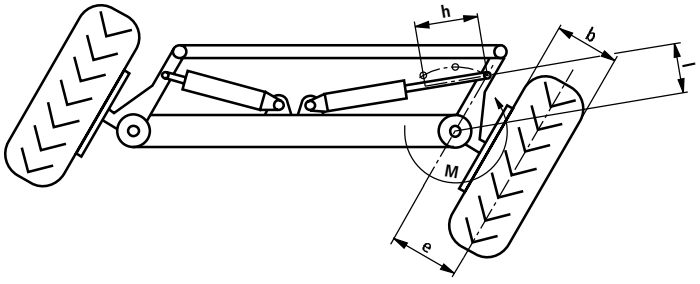
⚠ **CAUTION!**

Operating the unit with contaminated hydraulic fluid may lead to the steering system failing.

Calculating the steering moment

Steering moment $M = 0.05 \cdot F_A \cdot \frac{1}{1+\frac{e}{b}} \cdot \frac{b}{200} \cdot \frac{\mu}{0.7}$ [Nm]

Steering force $F = \frac{M}{l} \cdot 10^3$ [N]



Formula symbols

Formula symbol	Designation	Unit	Formula symbol	Designation	Unit
A	Required cylinder area	mm^2	l	Smallest, effective steering lever	mm
A_1	Cylinder piston area, differential cylinder	mm^2	M	Steering moment	Nm
A_2	Cylinder ring area, differential cylinder	mm^2	n	Steering wheel rotational speed	min^{-1}
b	Tyre width	mm	n_{Ileer}	Motor idling RPM	min^{-1}
d	Piston rod diameter	mm	n_{Motor}	Motor operating RPM	min^{-1}
D	Cylinder diameter	mm	p	Steering pressure	bar
e	Distance of swivel bearing to center of tyre	mm	q_{vp}	Pump flow	l/min
F	Steering force	N	V	Steering unit displacement	cm^3/U
F_A	Steering axle force	N	V_P	Steering pump displacement	cm^3/U
h	Cylinder stroke length	mm	V_{ZYL}	Cylinder volume	cm^3
i	No. of steering wheel turns		μ	Co-efficient of friction	

Defining the steering cylinder and steering pump

Steering cylinder

Required cylinder area $A = \frac{F}{p} \cdot 10$ [mm²]

Cylinder area (piston side) $A_1 = \frac{\pi}{4} \cdot D^2$ [mm²]

Cylinder area (rod side) $A_2 = \frac{\pi}{4} \cdot (D^2 - d^2)$ [mm²]

When using a differential or double roded cylinder, A_2 must be greater than the required cylinder area.

If two cross connected differential cylinders are to be used, then $A_1 + A_2$ must be greater thant the required cylinder area.

The nominal size of steering unit results from the cylinder volume and the required number of steering wheel turns.

Cylinder volume

$$V_{ZYL} = \frac{A \cdot h}{10^3} \quad [cm^3]$$

Displacement volume LAGU

$$V = \frac{V_{ZYL}}{i} \quad [cm^3/U]$$

Normally there are 3 to 5 turns of the steering wheel from end stop to end stop.

☞ **NOTE!**

Further information is availabe here:

- Suitable steering columns RE 11874
- associated priority valves for steering systems contained in load signal circuits: RE 27548
- General information: RE 64020-B1
- Product-specific applications: RE 07015-B2

Steering pump

The pump should be so selected that when the motor is idling, a steering velocity of approx. 50 min^{-1} can still be achieved. The maximum steering speed, which is dependent on the steering wheel diameter, is approx. 100 to 150 min^{-1}.

Pump flow $q_{VP} = V \cdot (n + 10) \cdot 10^{-3}$ l/min.

The pump displacement (≙ nominal size) required for steering at idling speed and at operating speed of the vehicle must be calculated.

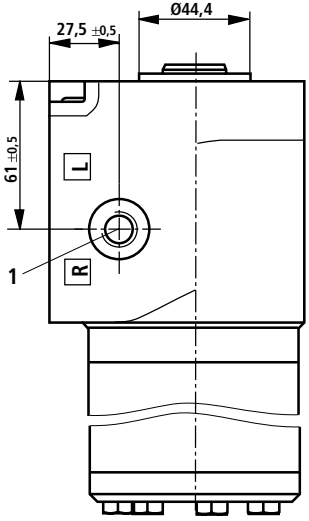
Pump size at idling speed

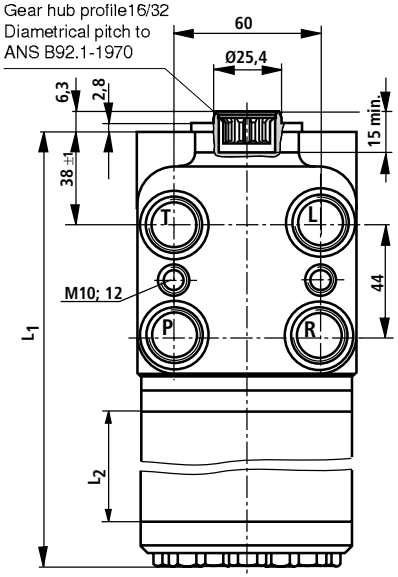
$$V_P = \frac{q_{VP} \cdot 10^3}{n_{leer}} \quad [cm^3/U]$$

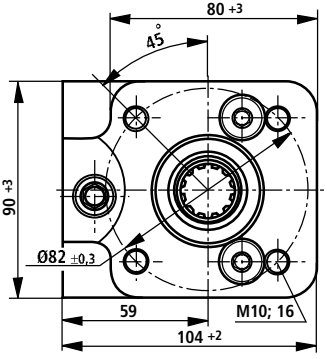
Pump size at operating speed

$$V_P = \frac{q_{VP} \cdot 10^3}{n_{Motor}} \quad [cm^3/U]$$

Unit dimensions LAGL... /LAGL...LD... (nominal dimensions in mm)

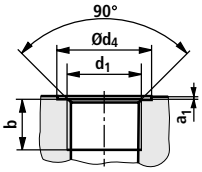






1 LD bore on version LAGL...LD

Bore, inch thread and metric thread
for ports P, T, R, L, LD



Nom. size	L_1	L_2
500	202	68.0
630	218	83.3
800	239	105.8
1000	269	136.0

Port	Variant	d_1	$Ød_4$ [1]	b min.	a_1
P, T, R, L	01	G 1/2	28 $^{+0.4}$	14	max. 0.3
	02	M22x1.5	28 $^{+0.4}$	14	max. 0.3
LD	01	G 1/4	25 $^{+0.4}$	12	1 $^{\pm 0.5}$
	02	M12x1.5	25 $^{+0.4}$	12	1 $^{\pm 0.5}$

[1] Differing from DIN 3852–1 and DIN 3852–2

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Rexroth
Bosch Group

Steering unit LAGU

RE 11867/03.2012 1/12
Replaces: 01.2009

Data sheet

H6213_d

Nominal sizes 125 to 320
Series 1X
Nominal pressure 175 bar
Maximum flow 50 l/min.

Table of contents

Features

- The LAGU steering unit is used in hydraulic steering circuits on vehicles and mobile machines that have high axial loads and maximum travel speeds of 50 km/h.
- With the aid of a steering unit even heavey vehicles can be easily steered. By not having a mechanical connection between the steering unit and axle which is to be steered, the designer has opportunities that are not possible with convential steering.
- Vehicles fitted with a LAGU unit can also be manually steered if the servo system fails. The required force is reduced by changing the ratio. Only due to this, in many cases, are the permissible limiting values complied with. In many applications a second steering pump is no longer necessary.
- The LAGU unit works on the principle of switching off chambers. In servo, the mode the steering acts as a fully hydraulic steering without any changes to the ratios.

Ordering details

LAG	U			1X/		–	M		*

Steering unit

Design
With step-down ratio = **U**

Displacement volume (cm^3/U)
Servo operation / emergency operation

Nom. size	OC; LD	R[1]; LDA[2]	U = 2:1
125/60	●	●	= 125/60
160/80	●	●	= 160/80
200/100	●	●	= 200/100
250/125	●		= 250/125
320/160	●		= 320/160

Noise characteristics
Standard = –
Low [3] = **N**

Component series
Series 10 bis 19 = **1X**
(10 bis 19: unchanged installation and connection dimensions)

Load Sensing
Without load signal in open center (OC) version ● = **No code**
Dynamic load signal ● = **LD**
Dynamic load signal, priority valve can be flanged on ● = **LDA**

Reaction
No code = Without reaction
R = With reaction

[4] Shock valve setting (pressure differential)
150 = 150 bar
200 = 200 bar
240 = 240 bar

[4] Pressure relief valve setting (pressure differential)
90 = 90 bar
140 = 140 bar
175 = 175 bar

Seals
M = NBR seals, suitable for mineral oil (HL, HLP) to DIN 51524

[5] Pipe connections P, T, L, R / LD
01 = ● Pipe thread to DIN 3852
06 = ◑ Metric ISO thread to DIN 3852
12 = ◑ UNF thread to SAE
40 = ◑ Metric ISO thread to DIN 3852

Special specifications
Please clarify with our sales organization

● = Standard programme
◑ = Extended programme

1) With reaction
2) Dynamic load signal, can be flanged on
3) Only with the open center (OC) version
4) The response pressure of the shock valves must be 50 bar higher, however a maximum of 2.2 times that of the hydraulic pump pressure relief valves. (see §38 StVZO) Preferrably 150 to 90; 200 to 140; 240 to 175 bar.
5) For thread dimensions see unit dimensions on pages 11and 12

Ordering example:

LAGU 200/100 -1X/LD150-90M01

- Steering unit with integrated valves
- Nom. size 200/100, dynamic load signal
- Shock valves 150 bar, pressure limitation 90 bar
- Pipe connections P, T, L, R are G 1/2 , LD is G 1/4

LAGU 200/100 N1X/150-90M01

- Steering unit with integrated valves
- Nom. size 200/100, low noise characteristics
- Shock valves 150 bar, pressure limitation 90 bar
- Pipe connections P, T, L, R in G 1/2

Function, section

Via the steering column the control spool (**1**) of the control valve is rotated in relation to the control bush (**2**). Thereby a cross-section is opened between the piston and the bush. The pressure fluid acts on the rotor set (**3**) and causes this to move. The oil flows via the rotor set to the steering cylinder. The rotation of the rotor acts on the bush which causes it to follow the rotary movement of the spool.

The size of the cross-section opened is dependent on the rotational speed of the steering wheel and the steering pressure, and for the load sensoring version on the rotational speed.

If the steering movement is stopped then the spool also stops, oil however, continues to flow via the open cross-section to the rotor, the rotor and bush, therefore, continue to rotate.

The cross-section then closes due to the rotary movement, the rotor is now also stationary and the steering cylinder is therefore, in the required position. The centralising spring (**4**) brings and then holds the piston and bush into the neutral position.

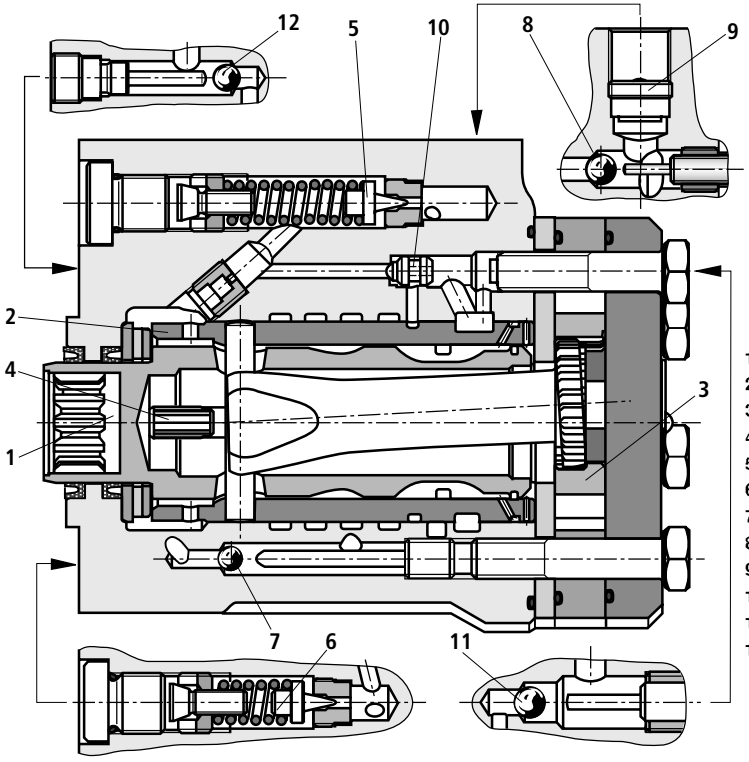
The system pressure is limited in the steering circuit via the pressure relief valve (**5**). At this location, for the load sensing version (see section), the pilot valve for the load signal is fitted.

The two shock valves (**6**) provide a safety function for the connections L and R to the steering cylinder. If a shock valve reacts then the displaced oil is passed to the opposite side via the anti-cavitation valve (**7**), or missing leakage fluid is drawn from the reservoir.

If the hydraulic pump fails then the LAGU unit acts as a hand pump. In this case, via the cylinder pressure, the cut-off valve (**10**) opens and a specific number of displacement chambers are connected with the return (switched off). The check valves (**11**) and (**12**) prevents a connection from taking place between the switched off and the switched on displacement chambers.

The displacement volume of the rotor set is therefore, reduced by the volume of the switched off chambers.

Via the anti-cavitation valve (**8**) it is possible to draw oil from the tank line, the check valve (**9**) however, prevents air from being sucked in via the pump connection (**P**). In normal operation the same valve prevents high external load forces from causing shocks at the steering wheel.



1 Control spool
2 Control bush
3 Rotor set
4 Centralising spring
5 Pressure relief valve
6 Shock valve
7 Anti-cavitation valve
8 Anti-cavitation valve
9 Check valve
10 Cut-off valve
11 Check valve
12 Check valve

Versions

Standard version: OC / NR

Open **C**enter with **N**on **R**eaction = **OC / NR**

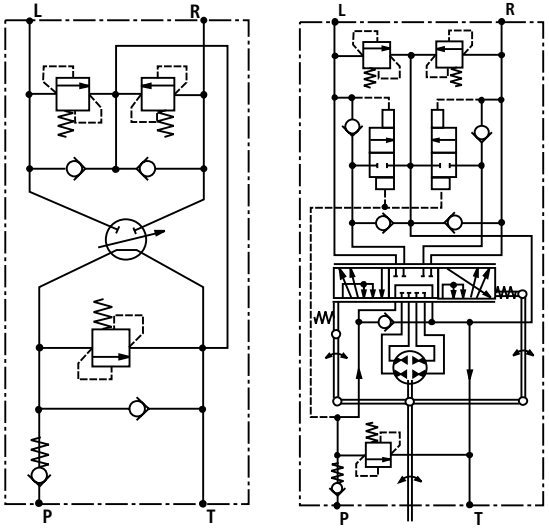
Mainly used in steering systems that utilise a fixed displacement hydraulic pump.

If steering is not taking place then the connection from pump (**P**) to the tank connection (**T**) is open (**OC**) and the pump displacement volume is passed at virtually zero pressure to tank. The connections L[1] (left) and R[1] (right) are closed in the neutral position. In this manor, external forces, that act on the steering cylinder, are taken up without the driver feeling any reaction forces via the steering wheel (**N**on **R**eaction).

[1] For steering systems the actuator lines are identified with L and R, not as is normal with A and B.

☞ **NOTE!**

Steering units for vehicles with a pivoting frame or with rear axial steering **must** always use the **NR** version.

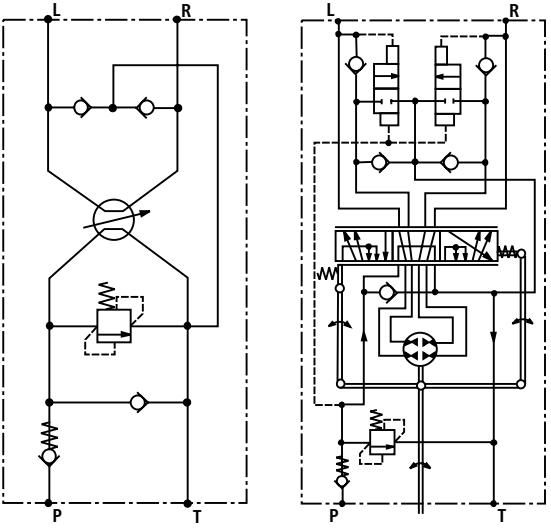


LAGU standard version: OC / NR

Standard version: OC / R

Open **C**enter with **R**eaction = **OC / R**

The cylinder connections are in the neutral condition connected with each other. External forces acting on the steering cylinders are noticed as reaction forces by the driver via the steering wheel (**R**eaction). If the driver releases the steering wheel after the steering manoeuvre (curved line) then the wheels and steering wheel, with the relevant steering geometry, straigthen up by themselves and the vehicle carries on *in* a straight line.



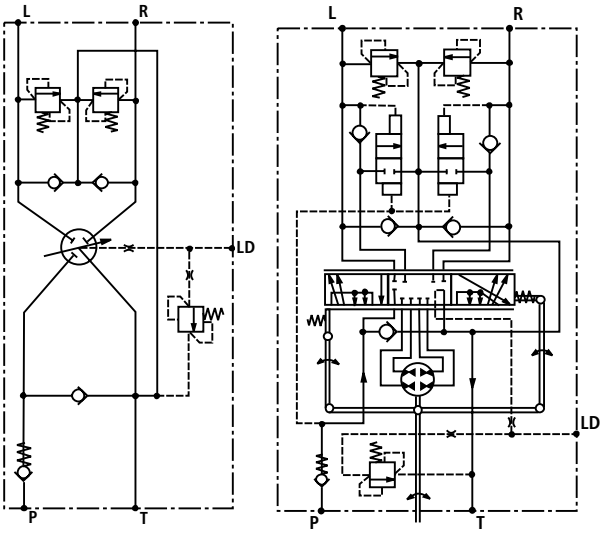
LAGU standard version: OC / R

Versions

Load sensing version

Steering units with load sensing provide a load signal that can be used to control a priority valve and/or a pump. They are designed as closed center steering systems whereby the connection: pump connection (**P**) to tank connection (**T**) is closed in the neutral position.

If the steering and actuator hydraulics are supplied by a common pump then the use of a priority valve is necessary. This valve ensures that the steering unit has a priority oil supply, whereby the control of the valve is via the steering unit load signal. When steering is not taking place then the entire oil flow from the pump is made available to the actuator hydraulics. Fixed or variable displacement pumps can be used.



LAGU in the LD version for a priority valve which is **not** flanged on

Load signal, dynamic

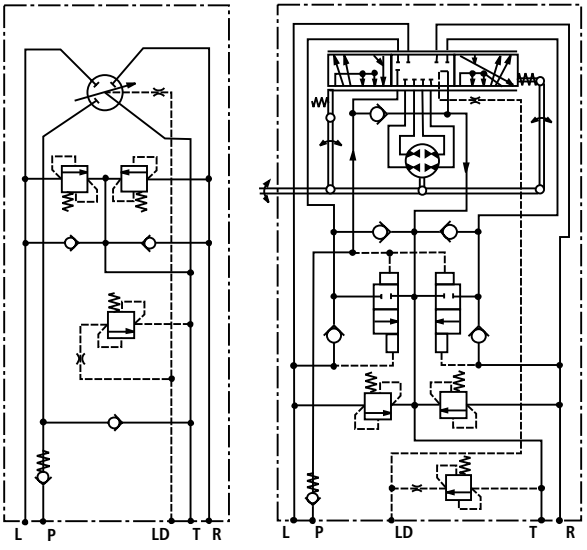
The pressure fluid flowing in the load signal line transmits the load signal, whereby the control oil from the priority valves flows to the steering unit. In the neutral position there is also a low continuous control oil flow of approx. 0.5 l/min. As a result the steering unit has virtually the same temperature as the oil.

Temperature shocks are virtually eliminated.

The **LD** version causes a faster reaction of the priority valve. The hard point when starting to steer, also with a cold start, is normally no longer noticeable.

Flanged on priority valve

Pipe work is reduced by a large amount with steering units that have a flanged on priority valve.



LAGU in the LD version for a priority valve which is flanged on

Versions

Noise reduced version

The OC/NR and OC/R variants of the type LAGC steering units are only available in the noise optimised versions. The noise generated by these units is, dependent on the flow and installation situation, between 3 and 10 dBA lower than the standard version of the LAGC.

Functions in the steering circuit

Servo operation

The LAGU series of steering units comprise of a hand operated servo valve of rotary spool design, a rotor set that works to the gerotor principle and the valves that are required for the steering circuit.

The nominal size of the rotor set defines the oil volume that passes to the steering cylinder per rotation of the steering wheel. The size of the dosing pump is so selected that with 3 to 5 turns of the steering wheel it is possible to steer from one end stop to the other.

Emergency operation

During normal operation of the steering unit and when the hydraulic pump is supplying an adequate flow of oil, the torque at the steering wheel is less than 5 Nm. If the hydraulic pump fails then the steering unit operates in an emergency mode, the rotor set acts as a hand pump and the vehicle is manually steered without servo assistance. The pressure achieved by hand is dependent on the size of the rotor set and the force at the steering wheel. The smaller the rotor set the higher is the pressure that can be manually built up.

With the LAGU unit it is possible, by switching off chambers (step-down ratio), to additionally reduce the displacement volume of the rotor set. The cut-off valve, that is closed during servo operation, is opened during emergency operation via the cylinder pressure and connects half of the displacement chambers to the return. The displacement volume of the rotor set is therefore, reduced by a volume of 2:1.

The manually generated pressure is doubled as is the number of turns of the steering wheel.

With a manual steering moment of 50 Nm and a rotational speed of 20 min^{-1} it is possible to achieve the following pressures:

M_{Lenk}	Nom. sizes	125/60	160/80	200/100	250/125	320/160
50 Nm	*p* in bar	40	30	24	19	15
70 Nm	*p* in bar		42	33	22	20

⚠ CAUTION!

The emergency operating mode is not intended for continuous operation!

- ▶ If, for steering during emergency operation, a higher pressure is required then an emergency steering pump must be fitted.

Pressure relief valve

The pressure relief valve for the hydraulic pump is available in three pressure settings:

- 90 bar
- 140 bar
- 175 bar

☞ NOTE!

The pressure in the T line increases the set pressure by the equivalent value.

Shock and anti-cavitation valves

The cylinder side valves that are built into the LAGU unit is available in three pressure settings:

- 150 bar
- 200 bar
- 240 bar

Anti-cavitation valve

If the hydraulic pump fails then the spressure fluid is drawn from the reservoir via this valve, which is fitted between the P and T connections.

Check valve

This valve which is fitted in the P connection prevents:

- The return flow of oil from the steering cylinder into the hydraulic system when the cylinder pressure, due to travel obstructions, is greater than the system pressure. Steering shocks at the steering wheel are thereby suppressed.
- The sucking in of air via the P connection during emergency operation.

Technical data (for applications outside these parameters, please consult us!)

General			
Ambient temperature range	ϑ	°C	–20 to +80
Steering moment - standard [1]	M	Nm	≤ 5
Steering moment - emergency operation	M	Nm	≤ 160 permissible
Max. tightening torque M_A for the mounting screws		Nm	30 (see RE 11874 „steering column“)

Hydraulic			
Nominal pressure	p	bar	175
Pressure fluid			see page 8
Pressure fluid temperature range	ϑ	°C	–20 to +80
Viscosity range	ν	mm²/s	10 to 800
Maximum permissible degree of contamination of the pressure fluid is to ISO 4406 (c)			class 19/16/13 [2]

Steering unit type	Displacement volume servo operation cm³	Displacement volume emergency operation cm³	Flow		Max. perm. pressure in port		
			Nom [3] l/min	Max. l/min	P bar	T bar	L and R bar
LAGU 125/60	125	60	12.5	35	175	20	240
LAGU 160/80	160	80	16	50	175	20	240
LAGU 200/100	200	100	20	50	175	20	240
LAGU 250/125	250	125	25	50	175	20	240
LAGU 320/160	320	160	32	50	175	20	240

1) other steering moment variants (e.g. low) on request
2) The cleanliness classes specified for components must be adhered to in hydraulic systems.
Effective filtration prevents malfunction and, at the same time, prolongs the service life of components.
For the selection of filters, see data sheets RE 50070, RE 50076, RE 50081, RE 50086, RE 50087 and RE 50088.
3) Related to the steering speed of 100 steering rotations/min.

Pressure fluid technical data

Pressure fluids

Before carrying out any engineering please refer to the extensive information regarding pressure fluid selection and application conditions in our catalogue sheets RE 90220 (mineral oil) and RE 90221 (environmentally compatible fluids). These catalogue sheets refer to axial piston units, however, the details can be analogously applied to the steering units. For pressure fluids that require FKM seals please contact ourselves.

Operating viscosity

We recommend that the operating viscosity (at operating temperature) for efficiency and service life, is selected within the optimum range of

ν_{opt} = optimum operating viscosity range 16 to 46 mm²/s

with reference to the temperature.

Limiting viscosity

For the limiting conditions the following values apply:

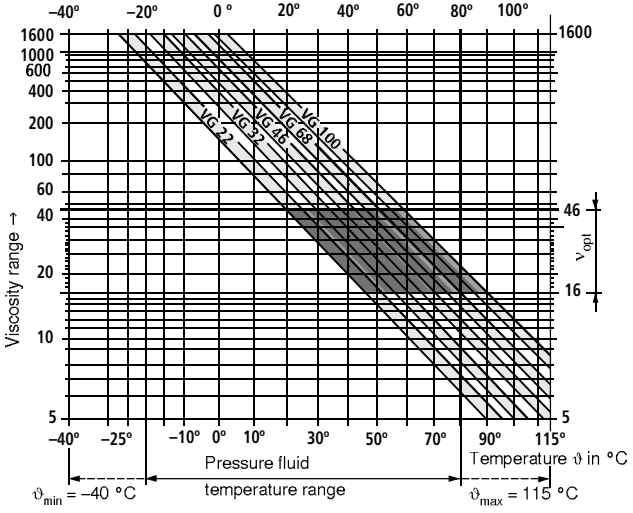
- ν_{min} = 10 mm²/s at a maximum permissible temperature of ϑ_{max} = +80 °C
- ν_{max} = 800 mm²/s

Temperature range: (see selection diagram)

- ϑ_{min} = –20 °C
- ϑ_{max} = +80 °C

If there is the possibility of there being a temperature difference of more than 20 °C between the steering unit and the pressure fluid, then either a LD or LDA version or an open center version for warming the steering unit should be fitted.

Selection diagram



Further on the selection of pressure fluids

A prerequisite to being able to select the correct pressure fluid is knowing the operating temperature and the ambient temperature.

The pressure fluid should be so selected that the operating viscosity at the working temperature lies within the optimum range (see selection diagram).

We recommend that the next higher viscosity class is selected.

Example:

For an ambient temperature of X °C the tank temperature stabilises at 60 °C. To achieve the optimum viscosity, this relates to the viscosity classes of VG 46 or VG 68; VG 68 should be selected.

Pressure fluid filtration

The finer the filtration the higher the cleanliness class of the pressure fluid is achieved and so the higher the service life of the entire hydraulic system.

☞ NOTE!

To ensure the functionability of the steering pump a minimum pressure fluid cleanliness class of 19/16/13 to ISO 4406 is necessary.

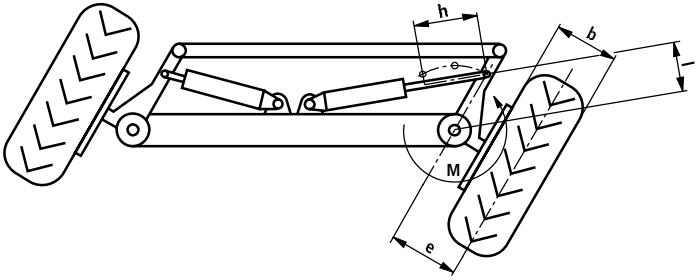
⚠ CAUTION!

Operating the unit with contaminated hydraulic fluid may lead to the steering system failing.

Calculating the steering moment

Steering moment $M = 0.05 \cdot F_A \cdot \frac{1}{1+\frac{e}{b}} \cdot \frac{b}{200} \cdot \frac{\mu}{0.7}$ [Nm]

Steering force $F = \frac{M}{l} \cdot 10^3$ [N]



Formula symbols

Formula symbol	Designation	Unit	Formula symbol	Designation	Unit
A	Required cylinder area	mm^2	l	Smallest, effective steering lever	mm
A_1	Cylinder piston area, differential cylinder	mm^2	M	Steering moment	Nm
A_2	Cylinder ring area, differential cylinder	mm^2	n	Steering wheel rotational speed	min^{-1}
b	Tyre width	mm	n_{Ileer}	Motor idling RPM	min^{-1}
d	Piston rod diameter	mm	n_{Motor}	Motor operating RPM	min^{-1}
D	Cylinder diameter	mm	p	Steering pressure	bar
e	Distance of swivel bearing to center of tyre	mm	q_{vp}	Pump flow	l/min
F	Steering force	N	V	Steering unit displacement	cm^3/U
F_A	Steering axle force	N	V_p	Steering pump displacement	cm^3/U
h	Cylinder stroke length	mm	V_{ZYL}	Cylinder volume	cm^3
i	No. of steering wheel turns		μ	Co-efficient of friction	

Defining the steering cylinder and steering pump

Steering cylinder

Required cylinder area $A = \frac{F}{p} \cdot 10$ [mm²]

Cylinder area (piston side) $A_1 = \frac{\pi}{4} \cdot D^2$ [mm²]

Cylinder area (rod side) $A_2 = \frac{\pi}{4} \cdot (D^2 - d^2)$ [mm²]

When using a differential or double roded cylinder, A_2 must be greater than the required cylinder area.

If two cross connected differential cylinders are to be used, then $A_1 + A_2$ must be greater thant the required cylinder area.

The nominal size of steering unit results from the cylinder volume and the required number of steering wheel turns.

Cylinder volume

$$V_{ZYL} = \frac{A \cdot h}{10^3} \quad [cm^3]$$

Displacement volume LAGU

$$V = \frac{V_{ZYL}}{i} \quad [cm^3/U]$$

Normally there are 3 to 5 turns of the steering wheel from end stop to end stop.

NOTE!

Further information is availabe here:

- Suitable steering columns RE 11874
- associated priority valves for steering systems contained in load signal circuits: RE 27548
- General information: RE 64020-B1
- Product-specific applications: RE 07015-B2

Steering pump

The pump should be so selected that when the motor is idling, a steering velocity of approx. 50 min^{-1} can still be achieved. The maximum steering speed, which is dependent on the steering wheel diameter, is approx. 100 to 150 min^{-1}.

Pump flow $q_{VP} = V \cdot (n + 10) \cdot 10^{-3}$ l/min.

The pump displacement (≙ nominal size) required for steering at idling speed and at operating speed of the vehicle must be calculated.

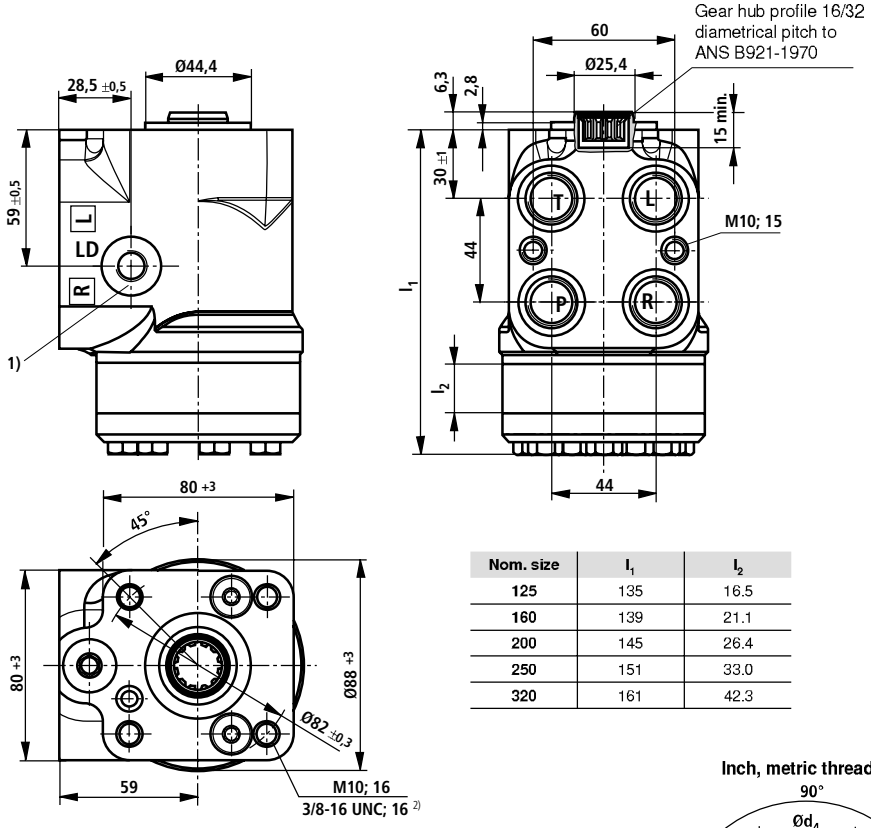
Pump size at idling speed

$$V_P = \frac{q_{VP} \cdot 10^3}{n_{leer}} \quad [cm^3/U]$$

Pump size at operating speed

$$V_P = \frac{q_{VP} \cdot 10^3}{n_{Motor}} \quad [cm^3/U]$$

Unit dimensions: types LAGU... / LAGU...LD... (dimensions in mm)

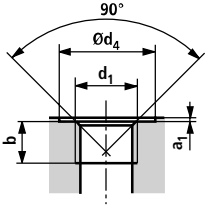


Nom. size	l_1	l_2
125	135	16.5
160	139	21.1
200	145	26.4
250	151	33.0
320	161	42.3

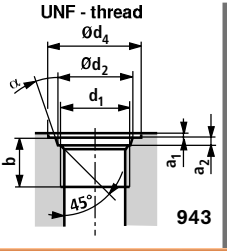
1) LD drilling with version LAGU...LD...
2) Only with version "**12**"

Connection	Version	d1	Ø d2	Ø d4	b min.	a1	a2	α
P, T, L, R	01	G 1/2	–	$28^{+0.4}$	14	max. 0.2	–	–
	06	M18x1.5	$19.8^{+0.1}$	$29^{+0.4}$	14.5	max. 0.2	$2.4^{+0.4}$	$15° \pm 1°$
	12	3/4-16 UNF	$20.6^{+0.1}$	$30^{+0.5}$	14.3	max. 0.2	$2.4^{+0.4}$	$15° \pm 1°$
	40	M18x1.5	–	$25^{+0.4}$	12	max. 0.2	–	–
LD	01	G 1/4	–	$25^{+0.4}$	12	$1^{\pm 0.5}$	–	–
	06	M12x1.5	$13.8^{+0.1}$	$25^{+0.4}$	11.5	$1^{\pm 0.5}$	$2.4^{+0.4}$	$15° \pm 1°$
	12	7/16-20 UNF	$12.4^{+0.1}$	$21^{+0.5}$	11.5	$1^{\pm 0.5}$	$2.3^{+0.4}$	$12° \pm 1°$
	40	M12x1.5	–	$25^{+0.4}$	12	$1^{\pm 0.5}$	–	–

Inch, metric thread



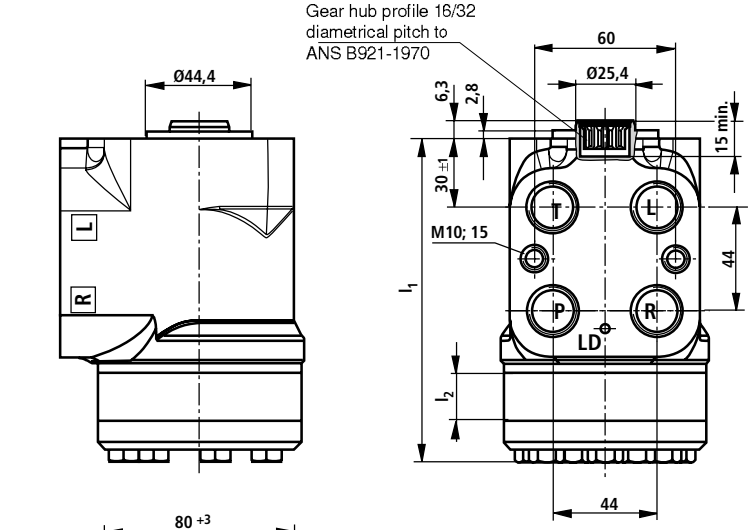
UNF - thread



NOTE!

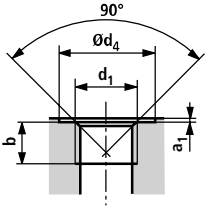
The LAGU...LDA.. version is not contained within the table, for further details see page 12.

Unit dimensions: type LAGU...LDA... (dimensions in mm)



Nom. size	l_1	l_2
125	135	16.5
160	139	21.1
200	145	26.4

Metric thread



Connection	Version	d_1	Ø d_2	Ø d_4	b min.	a_1
P, T, L, R	40	M18x1.5	–	–	12	–

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Rexroth
Bosch Group

Steering unit LAGZ

RE 11868/03.2012 1/12
Replaces: 09.2007

Data sheet


H6212_d

Nominal sizes 160 to 300
Component series 2X
Nominal pressure 175 bar
Maximum flow 50 l/min

Table of contents

Features

- LAGZ steering units are used in hydraulic steering circuits of vehicles and mobile machines with large axle loads and travel speeds not exceeding 50 km/h.
- With the aid of a steering unit even heavy vehicles can easily be steered. The absence of a mechanical connection between the steering unit and the steering axle allows the designer to realize solutions, which would be impossible with conventional steering systems.
- In the event of a failure of the power assistance, vehicles can also be steered manually with the LAGZ. The required force is reduced by changing the transmission ratio. In many cases, only this feature makes it possible to adhere to the permissible limit values. A second steering pump is in many cases superfluous.
- In the power-assisted mode, the LAGZ operates with two rotor sets. In emergency operation, one rotor set is switched off. This allows optional combinations (transmission ratios) within rotor set series.

Ordering code

LAG	Z			2X	/			–		M		*

Steering unit

Design
With transmission (2 rotor sets) = **Z**

Displacement (cm^3/rev)

Nom. size [2]	R [1]	Power-assisted op.	Emergency op.
160/60	●	160	60
160/80	●	160	80
200/60	●	200	60
200/80	●	200	80
200/100	●	200	100
220/60	●	220	60
220/80	●	220	80
220/100	●	220	100
240/80	●	240	80
240/100		240	100
300/100		300	100

Noise level
Standard [3] = **–**
Low [4] = **N**

Component series
20 to 29 = **2X**
(20 to 29: Unchanged installation and connection dimensions)

Special specifications
Please consult our sales organization

[6] **Pipe ports P, T, L, R/LD**
01 = ● Pipe thread to DIN 3852
06 = ◑ Metric ISO thread to DIN 3852
12 = ◑ UNF thread to SAE
40 = ◑ Metric ISO thread to DIN 3852

Seal material
M = Suitable for mineral oil (HL, HLP) to DIN 51524 and fast bio-degradable hydraulic fluids (HETG, rape seed oil) to VDMA 24568 (see RE 90221)

[5] **Pressure relief valve setting**
(pressure differential)
90 = 90 bar
140 = 140 bar
175 = 175 bar

[5] **Shock valve setting**
(pressure differential)
150 = 150 bar
200 = 200 bar
240 = 240 bar

Reaction
No code = Without reaction
R = With reaction

Load-sensing
No code = ● Without load signal in Open Center (OC) variant
LD = ● Dynamic load signal

● = Standard programme
◑ = Extended programme

1) Standard product range for LAGZ with reaction, OC and LD available in all sizes.
2) The specified sizes are part of a preferred series; other combinations with standard sizes 60, 80, 100, 120, 140, 160 and 200 are possible on request.
3) Specify for LD variant
4) Specify for Open Center (OC) variant
5) The response pressure of shock valves must be 50 bar higher than the setting of the pressure relief valve, but not exceed 2.2 times the setting of the latter (see §38 StVZO, German Road Traffic Licensing Regulation).
Preferably 150 to 90; 200 to 140; 240 to 175.
6) For thread dimensions: see Unit dimensions on page 11.

Order example:

LAGZ 200/100 -2X/LD150-90M01
- Steering unit with integrated valves
- Size 200/100, dynamic load signal
- Shock valves 150 bar, pressure relief valve 90 bar
- Pipe ports P, T, L, R of G 1/2 , LD of G 1/4

LAGZ 200/100 N2X/150-90M01
- Steering unit with integrated valves
- Size 200/100, low noise
- Shock valves 150 bar, pressure relief valve 90 bar
- Pipe ports P, T, L, R in G 1/2

Function, section

Pilot spool (**1**) of the control valve is rotated via the steering column in relation to control sleeve (**2**). This opens cross-sections between the spool and the sleeve. The pressure oil acts on rotor sets (**3** and **10**) and sets them into motion. The oil is then fed via the rotor set to the steering cylinder. The rotation of both rotors acts on the sleeve, which then follows the rotary movement of the spool.

The size of the opened cross-sections depends on the turning speed of the steering wheel and on the steering pressure; on Load-Sensing variants, it depends exclusively on the turning speed.

If the steering movement is interrupted and the spool is at a standstill, the oil, which still flows through the open cross-section to the rotor, causes the rotor and hence the sleeve to continue to rotate.

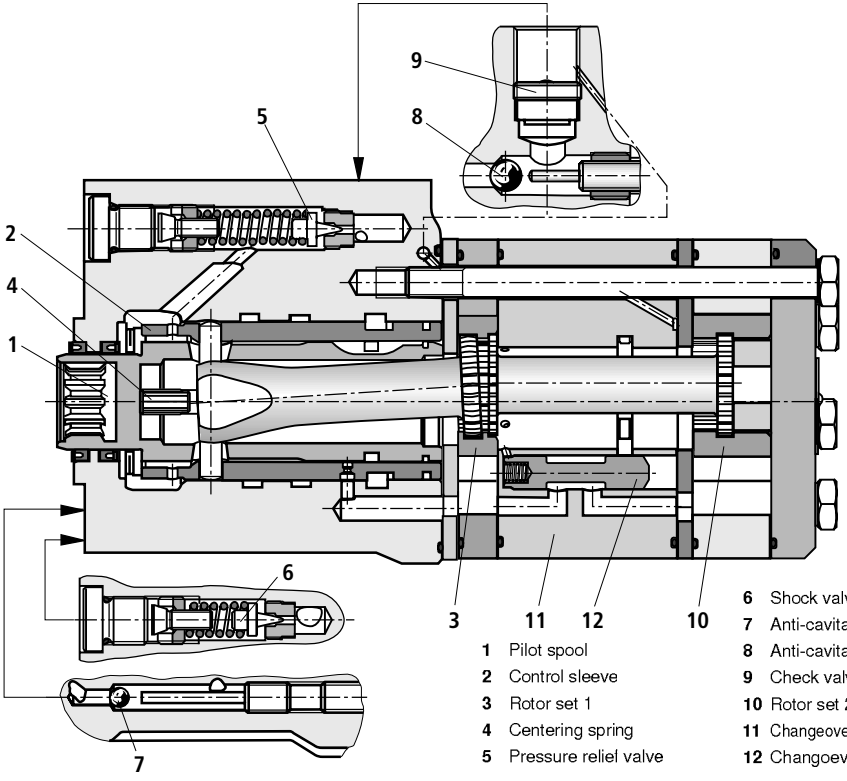
The rotary movement then causes the cross-section to close - now, the rotor also comes to a standstill and, at the same time, the steering cylinder is in the required position. Centering spring (**4**) brings and holds the spool and the sleeve in a neutral position to each other.

Pressure relief valve (**5**) limits the system pressure of the steering circuit. On the Load-Sensing variants, the pilot valve for the load signal is installed instead (see sectional drawing).

Two shock valves (**6**) protect ports **L** and **R** to the steering cylinder. If one of the shock valve responds, the discharged oil is fed via anti-cavitation valve (**7**) to the opposite side, or missing leak-oil is aspired from the tank.

In the event of an oil supply failure, the LAGZ operates as hand pump. In this case, the supply pressure (pilot pressure for the changeover spool) drops, too. Changeover spool (**12**) is moved to its starting position by the spring, so that all chambers of rotor set 2 (**10**) are connected to the internal chamber. At the same time, the connection between the two rotor sets is interrupted. The displacement of the steering unit is therefore reduced by the volume of rotor set 2 (**10**). Rotor set 1 (**3**) determines the displacement during emergency operation.

Oil can be taken from the tank via anti-cavitation valve (**8**), with check valve (**9**) preventing air to be aspired via the pump port (**P**). During normal operation, this valve prevents shocks on the steering wheel caused by excessive external steering forces.



1 Pilot spool
2 Control sleeve
3 Rotor set 1
4 Centering spring
5 Pressure relief valve
6 Shock valve
7 Anti-cavitation valve
8 Anti-cavitation valve
9 Check valve
10 Rotor set 2
11 Changeover housing
12 Changoever spool

Device variants

Standard variant

Open **C**enter with **N**on **R**eaction = **OC** / **NR**

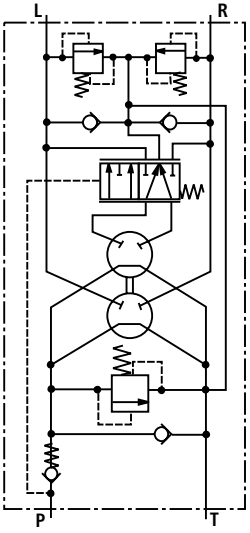
Mainly used in steering systems with fixed displacement hydraulic pumps.

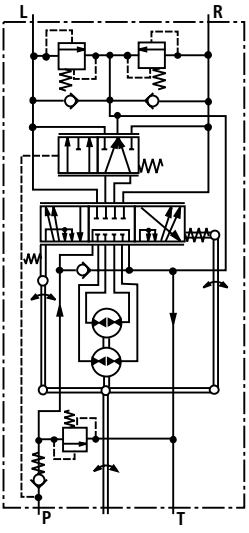
When no steering movement is performed, the connection between pump port (**P**) and tank port (**T**) is open (**OC**), and the pump flow is directed to the tank almost at zero pressure. Ports L[1] (left) and R[1] (right) are blocked in the neutral position. In this way, external forces acting via the steering cylinder are supported without the driver perceiving any resulting reaction forces on the steering wheel (**N**on **R**eaction).

[1] Contrary to standardization, the actuator lines in steering systems are usually designated "L" and "R", not "A" and "B".

☞ **Note!**

Steering units for vehicles with articulated chassis or rear-axle steering **must** always be selected in the **NR** variant.

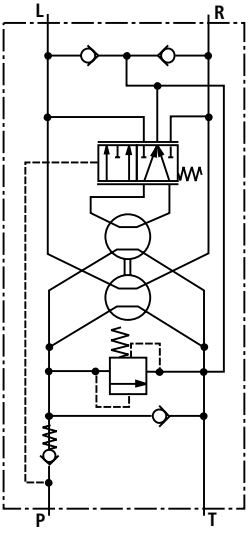


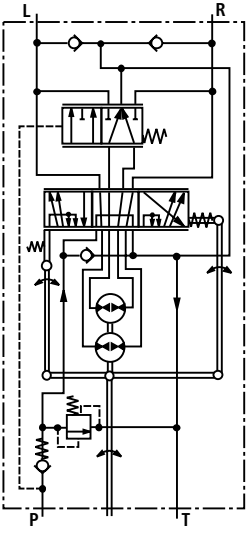


Standard variant

Open **C**enter with Reaction = **OC** / **R**

In the neutral position, the cylinder ports are connected with each other. External forces acting via the steering cylinder are perceived as reaction force by the driver on the steering wheel (**R**eaction). When the driver releases the steering wheel after the steering maneuver is completed, the wheels and the steering wheel automatically return to straight-ahead travel, provided that the steering geometry is suitable for this.



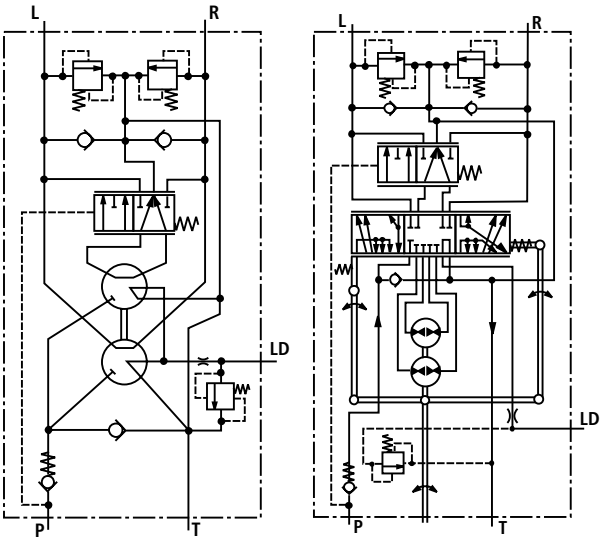


Device variants

Load-Sensing variant

Steering units with Load Sensing provide a load signal that can be used for controlling a priority valve and/or a pump. They are designed as Closed-Center steering systems, with the connection of pump port (**P**) to tank port (**T**) being closed in the neutral position.

If the steering system and working hydraulics are supplied by a common pump, a priority valve must be installed. This valve ensures the preferred supply of the steering unit with oil, with the valve being controlled by the load signal of the steering unit. When no steering movement is performed, the entire oil flow from the pump is available to the working hydraulics. Fixed or variable displacement pumps can be used as hydraulic pump.



Load signal, dynamic

The oil flowing in the load signal line transmits the load signal, with the pilot oil flowing from the priority valve to the steering unit. Also in the neutral position, a continuous, small pilot oil flow of ca. 0.5 l/min is provided. Consequently, the steering unit has approximately the same temperature as the oil.

Thermal shocks are largely prevented.

The **LD** variant causes the priority valve to react faster. The hard point at the beginning of the steering movement is usually no longer perceivable - even under cold start conditions.

Low-noise variant

Steering units of the LAGZ Open Center variant are generally delivered in the low-noise variant "N".

Functions in the steering circuit

Power-assisted mode

Steering units of type LAGZ consist of a manually operated rotary spool valve, two rotor sets, which operate according to the gerotor principle, and the required valves for the steering circuit.

The nominal size for the power-assisted mode results from the sum of the rotor set sizes. The size of the rotor set is to be selected so that with 3 to 5 turns of the steering wheel, it is possible to steer from one positive stop to the other.

Emergency operation

During normal operation of the steering unit, that is, when the hydraulic oil displaces a sufficient amount of oil, the torque required on the steering wheel is < 5 Nm. In the event of a hydraulic pump failure, the steering unit operates in the emergency mode. The required steering pressure must then be generated by manual force on the steering wheel.

With the LAGZ, the displacement can be reduced by switching one rotor set off. The pressure that can be generated manually depends on the size of rotor set 1 (see page 3) and the force applied to the steering wheel. The smaller the displacement, the higher the pressure that can be built up manually.

For emergency operation, the size must be selected so that legal stipulations with regard to the maximum manual force are complied with.

Taking account of the sizes for the displacement, certain combinations are possible for the relevant transmission ratio.

During manual steering, the following pressures can be achieved in dependence upon the steering moment:

M_{steer}	Size	.../60	.../80	.../100
50 Nm	p in bar	40	30	24
70 Nm	p in bar	56	42	33

⚠ CAUTION!

The emergency operating mode is not intended for continuous operation!

- If, for steering during emergency operation, a higher pressure is required then an emergency steering pump must be fitted.

Pressure relief valve

The pressure relief valve for the hydraulic pump is available in three pressure settings:

- 90 bar
- 140 bar
- 175 bar

☞ NOTE!

The pressure in the T line increases the set pressure by the equivalent value.

Shock and anti-cavitation valves

The cylinder side valves that are built into the LAGZ unit is available in three pressure settings:

- 150 bar
- 200 bar
- 240 bar

Anti-cavitation valve

If the hydraulic pump fails then the spressure fluid is drawn from the reservoir via this valve, which is fitted between the P and T connections.

Check valve

This valve which is fitted in the P connection prevents:

- The return flow of oil from the steering cylinder into the hydraulic system when the cylinder pressure, due to travel obstructions, is greater than the system pressure. Steering shocks at the steering wheel are thereby suppressed.
- The sucking in of air via the P connection during emergency operation.

Technical data (for applications outside these parameters, please consult us!)

General			
Ambient temperature range	ϑ	°C	–20 to +80
Steering moment - standard [1]	M	Nm	≤ 5
Steering moment - emergency operation	M	Nm	≤ 160 permissible
Max. tightening torque M_A for the mounting screws		Nm	30 (see RE 11874 „steering column“)

Hydraulic			
Nominal pressure	p	bar	175
Pressure fluid			see page 8
Pressure fluid temperature range	ϑ	°C	–20 to +80
Viscosity range	ν	mm²/s	10 to 800
Maximum permissible degree of contamination of the pressure fluid is to ISO 4406 (c)			class 19/16/13 [2]

Steering unit type	Displacement volume servo operation cm³	Displacement volume emergency operation cm³	Flow		Max. perm. pressure in port		
			Nom [3] l/min	Max. [4] l/min	P bar	T bar	L and R bar
LAGZ 160/60	160	60	16	50	175	20	240
LAGZ 160/80	160	80	16	50	175	20	240
LAGZ 200/60	200	60	20	50	175	20	240
LAGZ 200/80	200	80	20	50	175	20	240
LAGZ 200/100	200	100	20	50	175	20	240
LAGZ 220/60	220	60	22	50	175	20	240
LAGZ 220/80	220	80	22	50	175	20	240
LAGZ 220/100	220	100	22	50	175	20	240
LAGZ 240/80	240	80	24	50	175	20	240
LAGZ 240/100	240	100	24	50	175	20	240
LAGZ 300/100	300	100	30	50	175	20	240

1) other steering moment variants (e.g. low) on request
2) The cleanliness classes specified for components must be adhered to in hydraulic systems.
Effective filtration prevents malfunction and, at the same time, prolongs the service life of components.
For the selection of filters, see data sheets RE 50070, RE 50076, RE 50081, RE 50086, RE 50087 and RE 50088.
3) Related to the steering speed of 100 steering rotations/min.
4) Values for standard centering package

Technical data of the hydraulic fluid

Pressure fluids

Before carrying out any engineering please refer to the extensive information regarding pressure fluid selection and application conditions in our catalogue sheets RE 90220 (mineral oil) and RE 90221 (environmentally compatible fluids). These catalogue sheets refer to axial piston units, however, the details can be analogously applied to the steering units. For pressure fluids that require FKM seals please contact ourselves.

Operating viscosity

We recommend that the operating viscosity (at operating temperature) for efficiency and service life, is selected within the optimum range of

ν_{opt} = optimum operating viscosity range 16 to 46 mm²/s

with reference to the temperature.

Limiting viscosity

For the limiting conditions the following values apply:

- ν_{min} = 10 mm²/s at a maximum permissible temperature of ϑ_{max} = +80 °C
- ν_{max} = 800 mm²/s

Temperature range: (see selection diagram)

- ϑ_{min} = –20 °C
- ϑ_{max} = +80 °C

If there is the possibility of there being a temperature difference of more than 20 °C between the steering unit and the pressure fluid, then either a LD or LDA version or an open center version for warming the steering unit should be fitted.

Further on the selection of pressure fluids

A prerequisite to being able to select the correct pressure fluid is knowing the operating temperature and the ambient temperature.

The pressure fluid should be so selected that the operating viscosity at the working temperature lies within the optimum range (see selection diagram).

We recommend that the next higher viscosity class is selected.

Example:

For an ambient temperature of X °C the tank temperature stabilises at 60 °C. To achieve the optimum viscosity, this relates to the viscosity classes of VG 46 or VG 68; VG 68 should be selected.

Pressure fluid filtration

The finer the filtration the higher the cleanliness class of the pressure fluid is achieved and so the higher the service life of the entire hydraulic system.

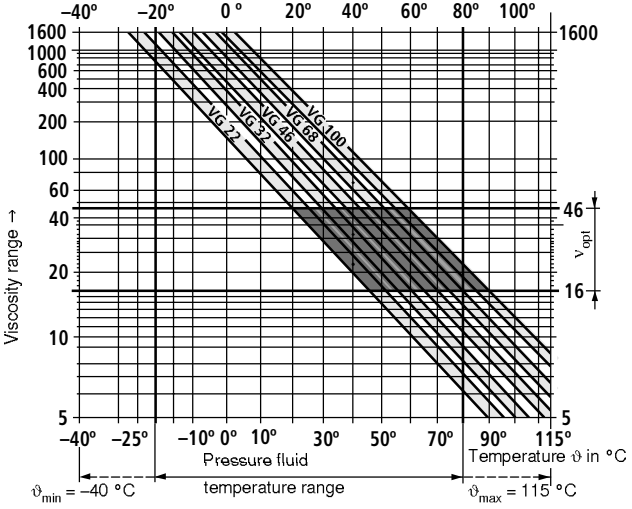
☞ **NOTE!**

To ensure the functionability of the steering pump a minimum pressure fluid cleanliness class of 19/16/13 to ISO 4406 is necessary.

⚠ **CAUTION!**

Operating the unit with contaminated hydraulic fluid may lead to the steering system failing.

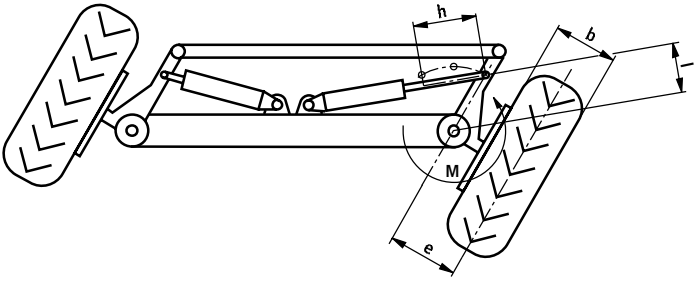
Selection diagram



Calculating the steering moment

Steering moment $M = 0{,}05 \cdot F_A \cdot \frac{1}{1+\frac{e}{b}} \cdot \frac{b}{200} \cdot \frac{\mu}{0{,}7}$ [Nm]

Steering force $F = \frac{M}{l} \cdot 10^3$ [N]



Formula symbols

Formula symbol	Designation	Unit	Formula symbol	Designation	Unit
A	Required cylinder area	mm^2	l	Smallest, effective steering lever	mm
A_1	Cylinder piston area, differential cylinder	mm^2	M	Steering moment	Nm
A_2	Cylinder ring area, differential cylinder	mm^2	n	Steering wheel rotational speed	min^{-1}
b	Tyre width	mm	n_{Ileer}	Motor idling RPM	min^{-1}
d	Piston rod diameter	mm	n_{Motor}	Motor operating RPM	min^{-1}
D	Cylinder diameter	mm	p	Steering pressure	bar
e	Distance of swivel bearing to center of tyre	mm	q_{vp}	Pump flow	l/min
F	Steering force	N	V	Steering unit displacement	cm^3/U
F_A	Steering axle force	N	V_p	Steering pump displacement	cm^3/U
h	Cylinder stroke length	mm	V_{ZYL}	Cylinder volume	cm^3
i	No. of steering wheel turns		μ	Co-efficient of friction	

Defining the steering cylinder and steering pump

Steering cylinder

Required cylinder area $A = \frac{F}{p} \cdot 10$ [mm²]

Cylinder area (piston side) $A_1 = \frac{\pi}{4} \cdot D^2$ [mm²]

Cylinder area (rod side) $A_2 = \frac{\pi}{4} \cdot (D^2 - d^2)$ [mm²]

When using a differential or double roded cylinder, A_2 must be greater than the required cylinder area.

If two cross connected differential cylinders are to be used, then $A_1 + A_2$ must be greater thant the required cylinder area.

The nominal size of steering unit results from the cylinder volume and the required number of steering wheel turns.

Cylinder volume

$$V_{ZYL} = \frac{A \cdot h}{10^3} \quad [cm^3]$$

Displacement volume LAGU

$$V = \frac{V_{ZYL}}{i} \quad [cm^3/U]$$

Normally there are 3 to 5 turns of the steering wheel from end stop to end stop.

NOTE!

Further information is availabe here:

- Suitable steering columns RE 11874
- associated priority valves for steering systems contained in load signal circuits: RE 27548
- General information: RE 64020-B1
- Product-specific applications: RE 07015-B2

Steering pump

The pump should be so selected that when the motor is idling, a steering velocity of approx. 50 min^{-1} can still be achieved. The maximum steering speed, which is dependent on the steering wheel diameter, is approx. 100 to 150 min^{-1}.

Pump flow $q_{VP} = V \cdot (n + 10) \cdot 10^{-3}$ l/min.

The pump displacement (≙ nominal size) required for steering at idling speed and at operating speed of the vehicle must be calculated.

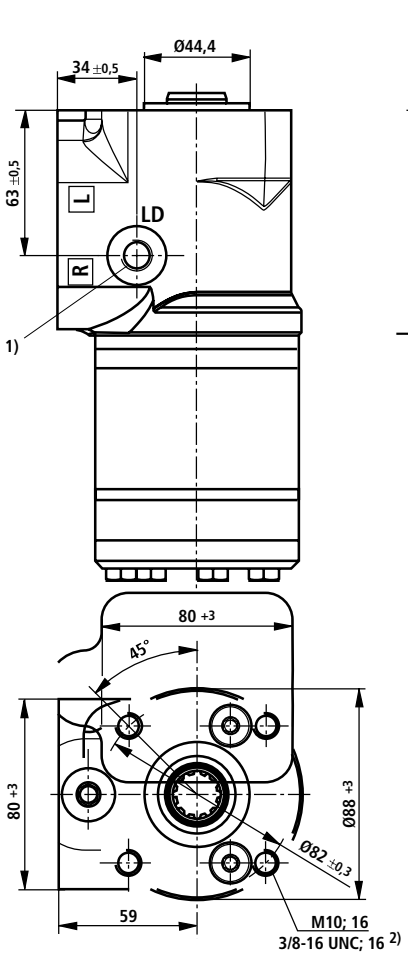
Pump size at idling speed

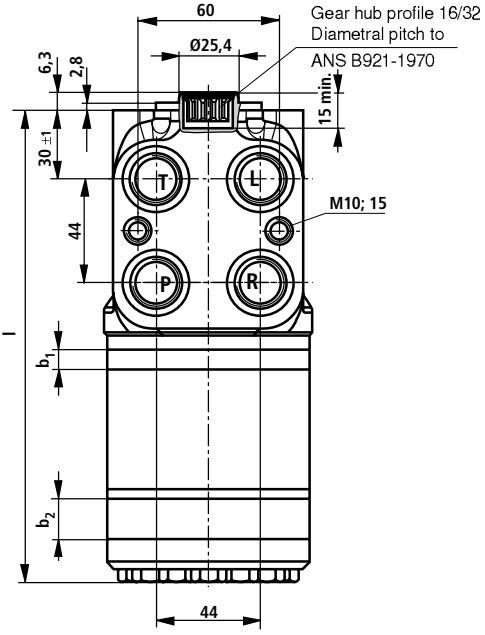
$$V_P = \frac{q_{VP} \cdot 10^3}{n_{leer}} \quad [cm^3/U]$$

Pump size at operating speed

$$V_P = \frac{q_{VP} \cdot 10^3}{n_{Motor}} \quad [cm^3/U]$$

Unit dimensions: Type LAGZ...; LAGZ...LD... (dimensions in mm)





Nom. size	l	b_1	b_2
160/60	192	8.3	13.2
160/80	192	10.5	10.5
200/60	197	8.3	18.5
200/80	197	10.5	16.5
200/100	197	13.2	13.2
220/60	200	8.3	21.1
220/80	200	10.5	18.5
220/100	200	13.2	16.5
240/80	202	10.5	21.1

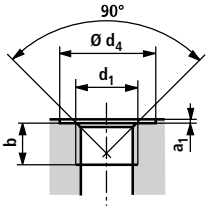
For ports, see page 11.

1) LD bore only on variant LAGZ...LD...
2) Only with variant "12"

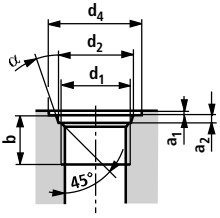
Unit diemensions: Typ LAGZ... / LAGZ...LD... (dimensions in mm)

Ports

Imperial, metric thread



UNF, metric thread



Port	Variant	d1	Ø d_2	Ø d_4	b min.	a_1	a_2	α
P, T, L, R	01	G 1/2	–	28 $^{+0.4}$	14	max. 0.2	–	–
	06	M18x1.5	19.8 $^{+0.1}$	29 $^{+0.4}$	14.5	max. 0.2	2.4 $^{+0.4}$	15° $^{\pm 1°}$
	12	3/4-16 UNF	20.6 $^{+0.1}$	30 $^{+0.5}$	14.3	max. 0.2	2.4 $^{+0.4}$	15° $^{\pm 1°}$
	40	M18x1.5	–	25 $^{+0.4}$	12	max. 0.2	–	–
LD	01	G 1/4	–	25 $^{+0.4}$	12	1 $^{\pm 0.5}$	–	–
	06	M12x1.5	13.8 $^{+0.1}$	25 $^{+0.4}$	11.5	1 $^{\pm 0.5}$	2.4 $^{+0.4}$	15° $^{\pm 1°}$
	12	7/16-20 UNF	12.4 $^{+0.1}$	21 $^{+0.5}$	11.5	1 $^{\pm 0.5}$	2.3 $^{+0.4}$	12° $^{\pm 1°}$
	40	M12x1.5	–	25 $^{+0.4}$	12	1 $^{\pm 0.5}$	–	–

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Rexroth
Bosch Group

Bypass priority valve LPD

RE 27549/05.2012 1/6

Data sheet

Nominal size 120
Component series 1X
Nominal pressure 350 bar
Maximum flow 120 l/min


LPD

Table of contents

Features

- For supplying the steering system and working hydraulics, only one pump is required
- The flow is available in parallel with working hydraulics and steering with low pressure losses
- The prioritization of the steering occurs indirectly via the pressure in the EF-connection which acts on the pressure compensators in the working hydraulics
- Energy saving in combination with variable pumps

System requirements / impacts

- Steering units with LS pressure relief in the steering circuit
- Flow-sharing (LUDV) control block
- Defined pump control pressure setting
- Consider line conditions (observe pressure drop Δp of CF line to steering and EF line to LUDV control block)

Function

Priority valves of type LPD are used in conjunction with steering systems of closed center - load sensing design and flow-sharing (LUDV) control blocks.

They distribute the pump flow between the steering and working hydraulics, whereby the steering supply has priority (see the sectional view in its initial position).

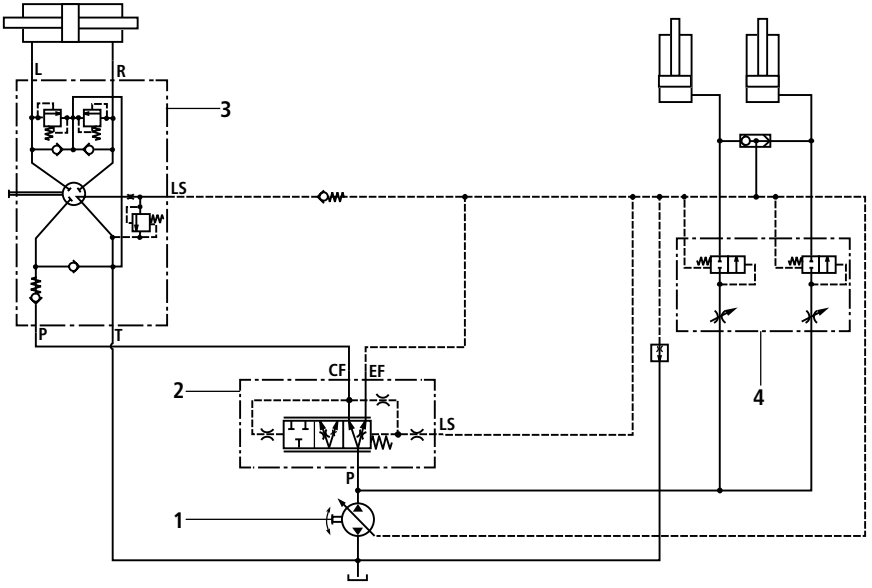
In conjunction with variable displacement pumps it is possible to create energy-saving hydraulic systems.

The priority valve works in the same way as a 3-way flow control valve. The controlled flow (**CF**) is made available to the steering and the control pressure (**EF**) is passed to the pressure compensator of the working hydraulics.

In contrast to the full flow priority valves, the full pump flow is available for the control block (if it is not steered) without additional pressure losses by using the bypass priority valve LPD.

If steered, the flow is distributed on the steering and control block. With the threat of undersaturation of the steering, the control pressure **EF** from the priority valve is reported via the bypass priority valve LPD to the pressure compensator of the LUDV control block. The pressure compensators of the control block throttle the hydraulic system so that the necessary flow rate is available for the steering system.

Steering system with LPD valve



1 Pump
2 Bypass priority valve LPD
3 Steering unit LAG
4 Control block

Function, Section

Neutral position depressurized

In the neutral position, the spool is kept on stop by the spring preload. The cross section from pump to steering is fully opened (**P → CF**).
The cross section from pump to LUDV pressure compensator is completely opened (**P → EF**).

Control position 1

In control position 1 (pump on, no steering) the spool is in a control position, in which the CF control edge (**P → CF**) is opened minimal. Here, the flushing flow is compensated for steering.

Control position 2

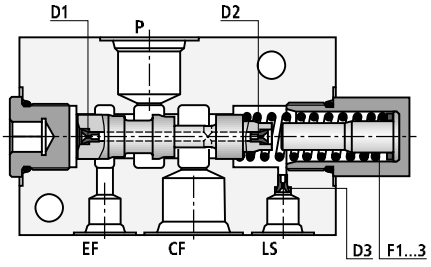
During operation (steering and active working hydraulics, the LPD is in the control position 2.

Depending on the required steering flow and the load signal (LS signal) the cross section to the steering (**P → CF**) is open. In parallel, the EF control geometry will be opened.

- **Case 1:** The load pressure of the working hydraulics is higher than the load pressure of the steering
  - No signal pressure from EF to the pressure compensator, as $p_{EF} < p_{Last\text{-}AH}$
  - The load pressure of the working hydraulics (higher load pressure) is reported at the pump.
  - The pump provides the required flow.

- **Case 2:** The load pressure of the working hydraulics is lower than the load pressure of the steering
  - Pump not fully swiveled out:
    → The LS signal of the steering (higher load pressure) is reported at the pump.
  - Pump fully swivelled out, flow is not sufficient for steering:
    → Undersaturation: $p_{EF} > p_{Last\text{-}AH}$
    The signal pressure p_{EF} is reported to the pressure compensators of the working hydraulics (AH) and regulates the working hydraulics.
    → The released flow is thus available to the steering and the steering is prioritized.

Control position 2



D1	PP damping orifice
D2	LD dynamic orifice
D3	LD damping orifice
F1…3	Preload (control pressure differential)

Ports

P	Pump
CF	Steering
LS	Load signal steering
EF	Control signal pressure compensator

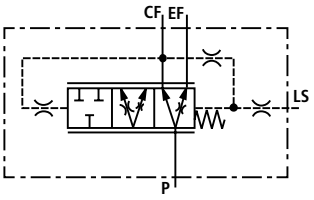
Differences between full-flow priority valve LPS (RE 27548) and bypass priority valve LPD (RE 27549)

	LPS	LPD
Size	Interpretation of the nominal size results by the flow from the priority valve to the control block	Interpretation of the nominal size results by the steering flow
Prioritization	Direct prioritization of the steering flow compared with the flow of working hydraulics	Indirect prioritization via signal pressure (EF) of LPD to the pressure compensator of the control block. Prioritization results by the pressure compensator in the control block.
Flow	Flow to steering and control block is conducted via the LPS	Only steering flow and signal flow are conducted via the LPD

Symbol

Standard version – line mounting

The LPD..R.. priority valve is a version suitable for line mounting. These priority valves are available with the nominal flow of 120 l/min. When using the type LPD..R.. care has to be taken that the pressure relief valve, for the load signal line, is integrated into the steering unit. If a LPD..R.. is used in conjunction with a steering unit without a pressure relief valve, then the load signal lines have to be externally protected.



Ordering code

LPD	120	R	1X/	LD	–		/50–		*

Nominal size
120 l/min = 120

Connection type
Line mounting = R

Component series 10 to 19 (10 to 19: unchanged installation and connection dimensions) = 1X

Load Sensing
Dynamic load signal = LD

Control pressure differential
5 bar = 05
10 bar = 10
15 bar = 15
20 bar = 20

Further details in clear text

Special specifications
XXX = Please clarify with our product management

Pipe connections
50 = Pipe thread to DIN ISO 6149-1

PP damping orifice	LD dynamic orifice	LD damping orifice	Orifice
	0		Without
3	3	3	0,6 mm
4	4	4	0,8 mm
6	6	6	1,0 mm

Preferred program

Technical data (for applications outside these parameters, please consult us!)

General				
Weight			kg	2,9
Installation position				Spool axis horizontal
Ambient temperature range		ϑ	°C	–20 to +80
Coating				RAL 5010

Hydraulic				
Nominal pressure		p	bar	350
Operating pressure, max. at port	• **P, EF**	p_{max}	bar	350
	• **CF, LS, R, L**	p_{max}	bar	200
Nom. flow	• **P → CF**	q_{nom}	l/min	120
Flow resistance, nominal	• **P → CF**	Δp	bar	< 5 at q_{nom}
	• **P → EF**	Δp	bar	< 2 at q_{EF} = 5 l/min
Pressure fluid				See below
Pressure fluid temperature range		ϑ	°C	–20 to +80
Viscosity range		v	mm²/s	10 to 800
Maximum permitted degree of contamination of the hydraulic fluid cleanliness class according to ISO 4406 (c)				Class 19/16/13, for this we recommend a filter with a minimum retention rate of $\beta_{20} \geq 100$ according to ISO 4572

Pressure fluid technical data

Before carrying out any engineering please refer to the extensive information regarding pressure fluid selection and application conditions in our catalogue sheets RE 90220 (mineral oil) and RE 90221 (environmentally compatible fluids). For pressure fluids that require FKM seals please contact the product management.

Operating viscosity

We recommend that the operating viscosity (at operating temperature) for efficiency and service life, is selected within the optimum range of

ν_{opt} = optimum operating viscosity range 16 to 46 mm²/s

with reference to the temperature.

Limiting viscosity

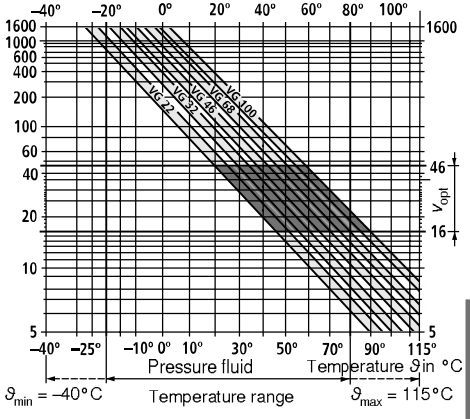
For the limiting conditions the following values apply:

- ν_{min} = 10 mm²/s at a maximum permissible temperature of ϑ_{max} = +80 °C
- ν_{max} = 800 mm²/s

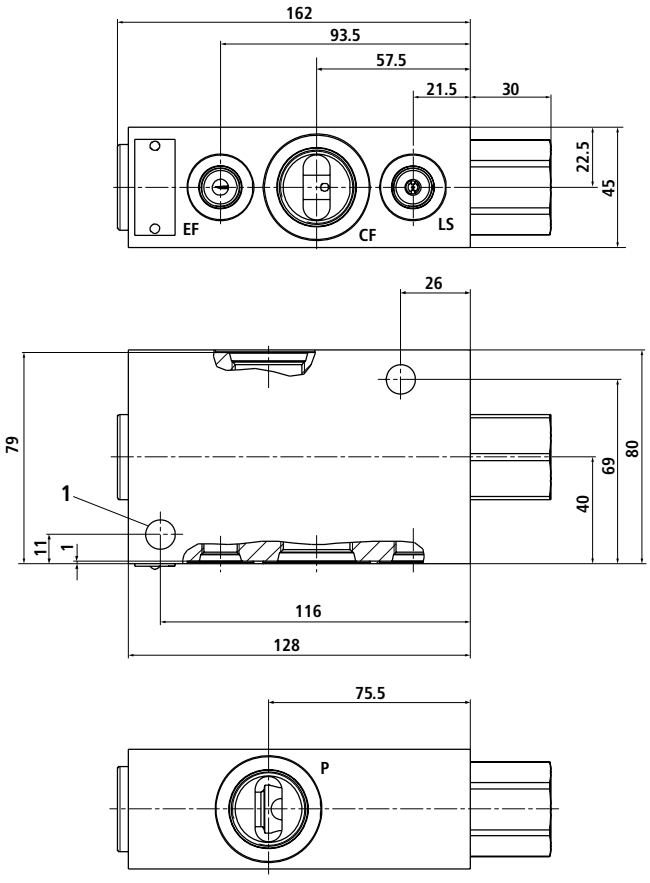
Temperature range: (see selection diagram)

- ϑ_{min} = –20 °C
- ϑ_{max} = +80 °C

Selection diagram



Unit dimensions (in mm)



Ports

P	Pump
CF	Steering
LS	Load signal steering
EF	Control signal at pressure compensator

Connections acc. to ISO 6149-1

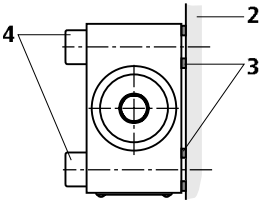
Port	Dimension
P	M27 x 2
CF	M27 x 2
LS	M14 x 1,5
EF	M14 x 1,5

1 Two fixation bores, Ø 11
2 Mounting surface
3 Washer [1)]
4 Fixation screws [1)]

Assembly note

Assemble the LPD free of tension.

Insert a washer between housing and mounting flange before screwing.



[1)] Not included in the scope of supply.

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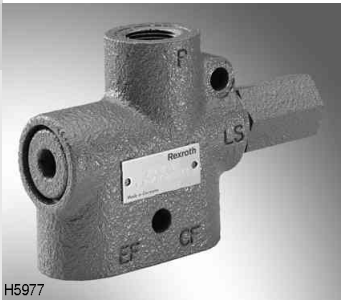
Rexroth
Bosch Group

Priority valve LPS

RE 27548/03.2012 1/10
Replaces: 06.2006

Data sheet

Nominal sizes 40 to 160
Component series 1X
Nominal pressure 250 bar
Maximum flow 40 to 160 l/min



H5977

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Features

- The LPS priority valve is used in conjunction with steering units using load sensing.
- The priority valves guarantee the priority supply of steering circuits, before all other actuators, with pressure fluid as defined in the statutory regulations.
- The steering circuit is supplied with priority independently of pressure. Pressure fluid that is not required for steering is returned to tank or is made available to other actuators. For supplying the steering system and other actuators, e.g. working hydraulics, only one pump is required.
- With the aid of priority valves it is possible, in conjunction with variable displacement pumps, to create energy saving hydraulic systems.
- In conjunction with other valves priority valves can also be used as sequencing valve, flow divider or pressure relief valve.

Ordering details

LP	S			1X/LD	–		/	*

Type of device
Priority valve

Design
Standard = S

Nominal size

l/min	A[1]	P[1]	R[1]	
40	●	●	●	= 40
80	●	●	●	= 80
120			●	= 120
160			●	= 160

Connection type
Flangeable = A
Pump mounting = P
Line mounting = R

Component series
Component series 10 to 19 (10 to 19: unchanged installation and connection dimensions) = 1X

Load Sensing
Dynamic load signal = LD

Control pressure differential

bar	A[1]	P[1]	R[1]	
4	●	◑	◑	= 4
7	●	●	●	= 7
10			●	= 10

Special specifications
Please clarify with our sales organization

Pipe connections
01 = ● Pipe thread to DIN 3852
02 = ◑ Metric ISO thread to DIN 3852
12 = ◑ UNF thread to SAE

[2; 3] **LD damping orifice**
2 = ◑ 1.0 mm
3 = ● 1.5 mm

[2] **LD dynamic orifice**
4 = ● 0.8 mm
6 = ◑ 1.0 mm

[2] **PP damping orifice**
4 = ◑ 0.8 mm
6 = ● 1.0 mm

● = Standard programme
◑ = Extended programme

[1] Connection type
[2] When testing the machine, the system can be optimised by changing the orifices.
[3] **Please take note!**
The LD damping orifice has to be larger than the LD dynamic orifice.

Ordering example:

LPS 80 R1X/LD7-643/01

- Priority valve; line mounting; nominal size 80;
- Dynamic load signal; control pressure differential 7 bar;
- Orifice combinationsn 1.0/0.8/1.5;
- Pipe connections: With pipe thread

LPS 160 R1X/LD10-643/01

- Priority valve; line mounting; nominal size 160;
- Dynamic load signal; control pressure differential 10 bar;
- Orifice combinations 1.0/0.8/1.5;
- Pipe connections: With pipe thread

Function, section

The type LPS priority valves are used in conjunction with steering systems of closed centre - load sensing design. They distribute the pump flow between the steering and work hydraulics, whereby the steering supply has priority (see the sectional view in its initial position).

In conjunction with variable displacement pumps it is possible to create energy-saving hydraulic systems.

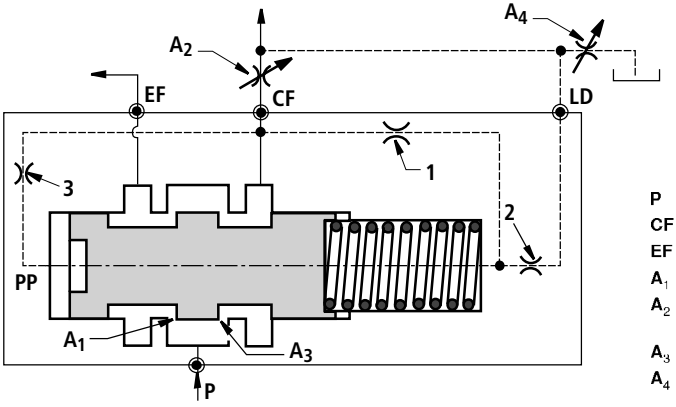
The priority valve works in the same way as a 3-way flow control valve. The controlled flow (**CF**) is made available to the steering and the remaining flow (**EF**) is passed to the work hydraulics.

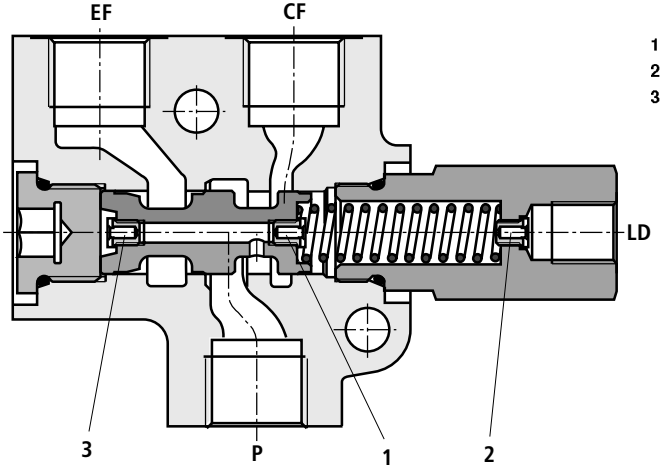
The metering orifice A_2 and A_4 in this system is not in the flow control valve, but in the steering control valve. A_2 is closed in the neutral position of the steering (no steering action) and is opened depending on the required flow. The load signal is sensed behind the metering orifice.

In the neutral position of the steering system the load signal line is connected to tank, i.e. A_4 is open.

As with a 3-way flow control valve the priority valve, by controlling the flow at the control orifice A1, controls the pressure differential at the metering orifice A2 and thereby achieves a balanced between the forces acting on the control spool. The required pressure-independent supply to the steering is thereby guaranteed (see the principle shown in the control position).

The type LPS priority valve works independently of the steering pressure and of the work hydraulics pressure. This is achieved via a second control orifice A3. It moves into its working position when the pressure in the work hydraulics is higher than the steering pressure.





P = Pump
CF = Steering (control flow)
EF = Work hydraulics (excess flow)
A_1 = Control orifice
A_2 = Metering orifie (in steering unit)
A_3 = Control orifice
A_4 = Tank unloading (in the steering power unit)

1 LD dynamic orifice
2 LD damping orifice
3 PP damping orifice

Versions, symbols

Standard version - flangeable

The LPS..A.. priority valve is directly flanged onto the steering unit. Both components result in a compact unit. No piping is required between the priority valve and the steering unit. This design is available with the nominal flows of 40 and 80 l/min. It is suitable for steering units up to 200 cm^3/U. The pilot control pressure relief valve for limiting the steering pressure is contained within the steering unit.

Standard version – line mounting and pump mounting

The LPS..R.. priority valve is a version suitable for line mounting.
These priority valves are available with the nominal flows of 40, 80, 120 and 160 l/min. When using the type LPS..R.. care has to be taken that the pressure relief valve, for the load signal line, is integrated into the steering unit. If a LPS..R.. is used in conjunction with a steering unit without a pressure relief valve, then the load signal lines have to be externally protected.

The LPS..P.. iversion is designed to be directly mounted onto a gear pump. 40 and 80 l/min version are available.

Special version – with throttle check valve as PP damper[1)]

The priority valve with an additional check valve for by-passing the PP dampening orifice in the direction of opening is provided **only** for use in conjunction with variable displacement pumps and was specifically developed for this purpose.
This special variant provides fast closing of control orifice A_1 and suppresses a pressure drop in CF for power-assisted steering in the case of a sudden pressure drop in work hydraulics EF.

[1)] Only available as 160 l/min variant for in-pipe installation

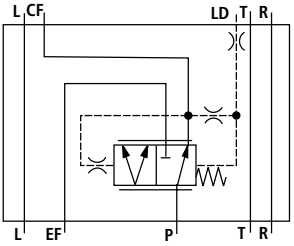
Special version – with throttle check valve and CF max. pressure relief valve in PP

In addition to the special version with check valve in PP, with this version a pressure relief valve is integrated in PP. This pressure relief valve opens, when the pressure in the CF line is by approx. 30 bar higher than the pressure on the PP side.
Control orifice A_1 opens abruptly, and any pressure peaks occurring in the P or CF line are reduced.

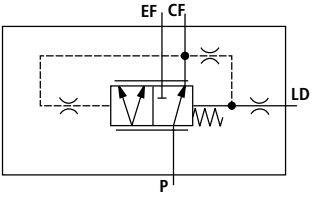
Load signal dynamic

Via the LD dynamic orifice a continuous small flow is passed into the load signal lines from the CF pressure connection. It is therefore guaranteed that the load signal lines are always full. This leads to the priority valve having short reaction times. The dynamic orifice also takes over the unloading the CF connection when the steering does not accept any oil flow and the other actuators are being operated with high pressure.

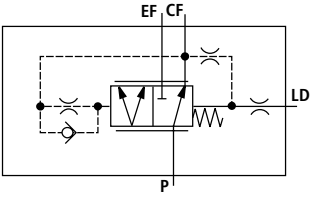
Symbol LPS..A..



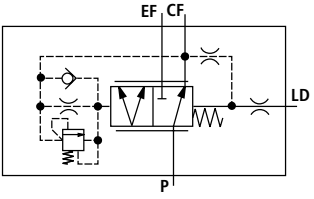
Symbol LPS..R..; LPS..P..



With throttle check valve as PP damper



With throttle check valve and pressure relief valve in PP



P = Pump
CF = Steering
EF = Work hydraulics
T = Tank
LD = Load signal (dynamic)
R; L = Cylinder

Technical data (for applications outside these parameters, please consult us!)

General				
Ambient temperature range		ϑ	°C	–20 to +80
Hydraulic				
Nominal pressure		p	bar	250
Peak pressure	– Ports P, EF		bar	250
	– Ports CF, LD, R, L		bar	175
Pressure fluid				see below
Pressure fluid temperature range		ϑ	°C	–20 to +80
Viscosity range		ν	mm²/s	10 to 800
Maximum permissible degree of contamination of the pressure fluid is to ISO 4406 (c)				Class 19/16/13 [2]

Pressure fluid technical data

Pressure fluids

Before carrying out any engineering please refer to the extensive information regarding pressure fluid selection and application conditions in our catalogue sheets RE 90220 (mineral oil) and RE 90221 (environmentally compatible fluids). These catalogue sheets refer to axial piston units, however, the details can be analogously applied to the steering units. For pressure fluids that require FKM seals please contact ourselves.

Operating viscosity

We recommend that the operating viscosity (at operating temperature) for efficiency and service life, is selected within the optimum range of

ν_{opt} = optimum operating viscosity range 16 to 46 mm²/s

with reference to the temperature.

Limiting viscosity

For the limiting conditions the following values apply:

- ν_{min} = 10 mm²/s at a maximum permissible temperature of ϑ_{max} = +80 °C
- ν_{max} = 800 mm²/s

Temperature range: (see selection diagram)

- ϑ_{min} = –20 °C
- ϑ_{max} = +80 °C

If there is the possibility of there being a temperature difference of more than 20 °C between the steering unit and the pressure fluid, then either a LD or LDA version or an open center version for warming the steering unit should be fitted.

Further on the selection of pressure fluids

A prerequisite to being able to select the correct pressure fluid is knowing the operating temperature and the ambient temperature.

The pressure fluid should be so selected that the operating viscosity at the working temperature lies within the optimum range (see selection diagram).

We recommend that the next higher viscosity class is selected.

Example:

For an ambient temperature of X °C the tank temperature stabilises at 60 °C. To achieve the optimum viscosity, this relates to the viscosity classes of VG 46 or VG 68; VG 68 should be selected.

Pressure fluid filtration

The finer the filtration the higher the cleanliness class of the pressure fluid is achieved and so the higher the service life of the entire hydraulic system.

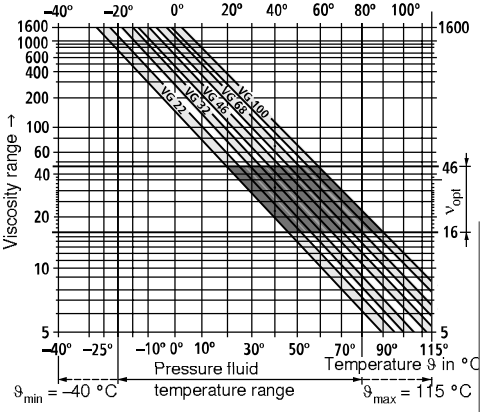
NOTE!

To ensure the functionability of the priority valve a minimum pressure fluid cleanliness class of 19/16/13 according to ISO 4406 is necessary.

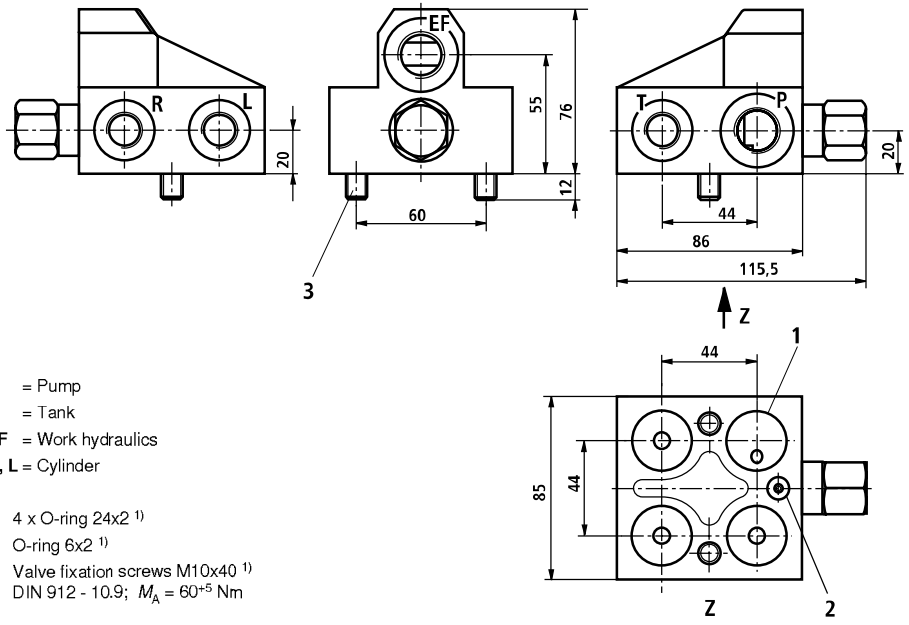
CAUTION!

Operating the unit with contaminated hydraulic fluid may lead to the priority valve failing.

Selection diagram



Unit dimensions: type LPS..A.., NS40 and 80 (nominal dimensions in mm)

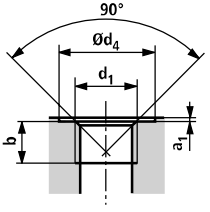


P = Pump
T = Tank
EF = Work hydraulics
R, L = Cylinder

1 4 x O-ring 24x2 [1)]
2 O-ring 6x2 [1)]
3 Valve fixation screws M10x40 [1)]
DIN 912 - 10.9; $M_A = 60^{+5}$ Nm

[1)] Included in the scope of supply

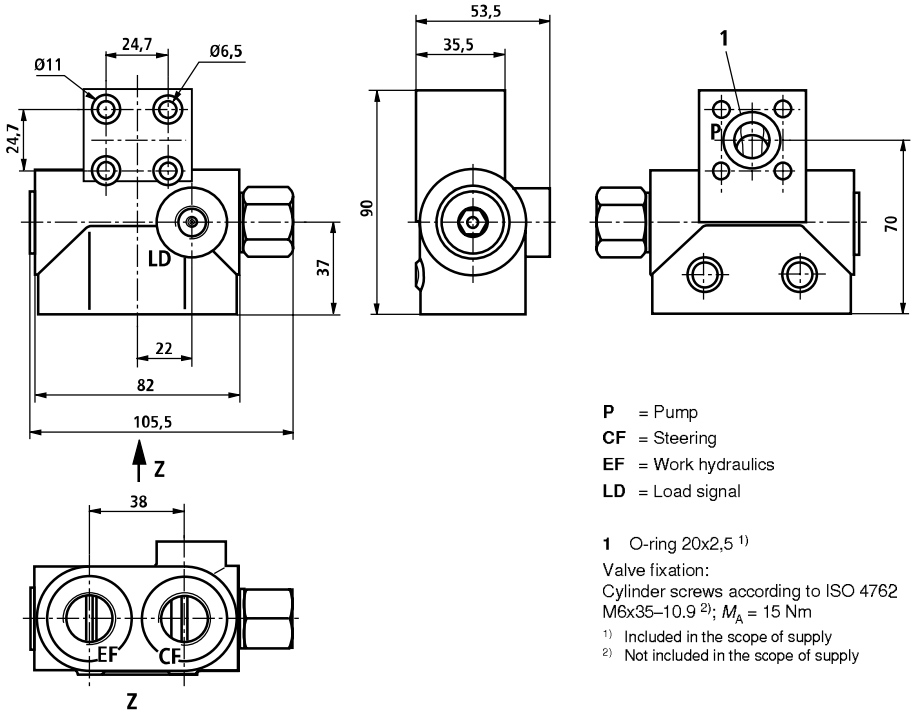
Threads version 01 and 02
(inch, metric)



Thread type

Size	Port	Version	d_1	$Ød_4^{+0.4}$	$b_{min.}$	$a_1 \pm 0.5$
40, 80	P, EF	01	G1/2	34	14	1
		02	M22x1.5	28	16	1
	T, L, R	01	G3/8	28	12	1
		02	M18x1.5	24	12	1

Unit dimensions: type LPS..P...; NS40 and 80 (nominal dimensions in mm)

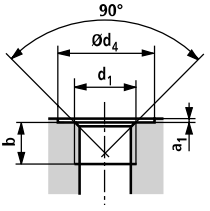


P = Pump
CF = Steering
EF = Work hydraulics
LD = Load signal

1 O-ring 20x2,5 [1)]
Valve fixation:
Cylinder screws according to ISO 4762
M6x35–10.9 [2)]; M_A = 15 Nm

[1)] Included in the scope of supply
[2)] Not included in the scope of supply

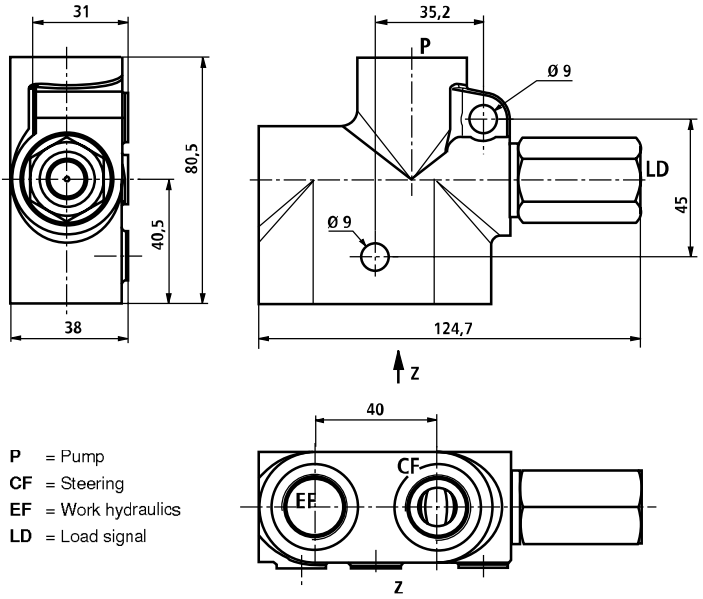
Threads version 01(inch)



Thread type

Size	Port	Version	d_1	$Ød_4^{+0.4}$	$b_{min.}$	$a_1^{\pm 0.5}$
40, 80	EF, CF	01	G1/2	34	14	1
	LD	01	G1/4	–	12	–

Unit dimensions: type LPS..R...; NS40, 80 and 120 (nominal dimensions in mm)

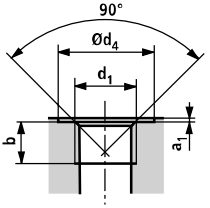


P = Pump
CF = Steering
EF = Work hydraulics
LD = Load signal

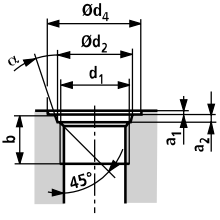
Thread type

Size	Port	Version	d_1	$Ød_2$ $^{+0.13}$	$Ød_4$ $^{+0.4}$	$b_{min.}$	a_1	a_2 $^{\pm 0.4}$	α $^{\pm 1°}$
40, 80	P, EF	01	G1/2	–	27	14	$0.3^{+0.5}_{-0.2}$	–	–
		02	M22x1.5	–	28	14		–	–
		12	7/8-14 UNF	23.9	34	17.5		2.5	15°
	CF	01	G1/2	–	27	14	$0.3^{+0.5}_{-0.2}$	–	–
		02	M22x1.5	–	28	14		–	–
		12	3/4-16 UNF	20.6	30	15		2.5	15°
	LD	01	G1/4	–	–	12	–	–	–
		02	M12x1.5	–	–	12		–	–
		12	7/16-20 UNF	12.5	–	13.5		2.4	12°
120	P, EF	01	G3/4	–	33	16	$0.3^{+0.5}_{-0.2}$	–	–
		02	M27x2	–	33	16		–	–
		12	1 1/16-12 UN	29.2	33	19		3.3	15°
	CF	01	G1/2	–	27	14	$0.3^{+0.5}_{-0.2}$	–	–
		02	M18x1.5	–	24	12		–	–
		12	3/4-16 UNF	20.6	30	15		2.5	15°
	LD	01	G1/4	–	–	12	–	–	–
		02	M12x1.5	–	–	12		–	–
		12	7/16-20 UNF	12.4	–	13.5		2.4	12°

Threads version 01 and 02 (inch, metric)



Threads version 12 (UNF)



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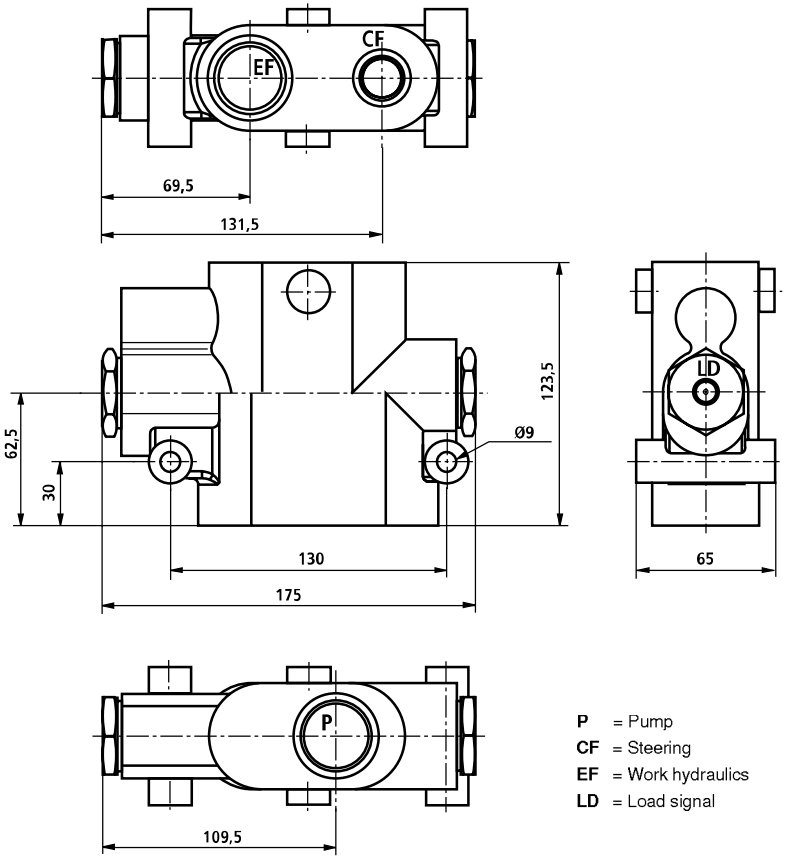
Unit dimensions: type LPS..P...; NS160 (nominal dimensions in mm)

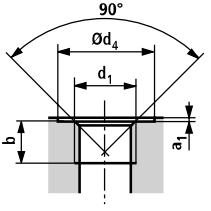


P = Pump
CF = Steering
EF = Work hydraulics
LD = Load signal

Thread type

Size	Port	Version	d_1	$Ød_4{}^{+0.4}$	$b_{min.}$	$a_1{}^{+1}$
160	P, EF	01	G1	40	18	1
		02	M33x2	41	20	1
	CF	01	G1/2	27	14	1
		02	M22x1.5	28	16	1
	LD	01	G1/4	–	12	–
		02	M12x1.5	–	12	–

Threads version 01 and 02
(inch, metric)



Notes

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Rexroth
Bosch Group

Steering column and sensor

RE 11874/07.09 1/10
Replaces: 07.03

Type LAB


HAD 6671/00

Component series 1X
Nominal voltage 12 to 48 Volt
Analog and digital output signal

Table of contents

Features

- The steering column serves as the connection between the steering wheel and the LAG steering unit.
- The sensor LAB makes it possible to obtain contactless measurement of rotary movement. A measurement gear wheel is used as the signal trigger.
- Preferably the sensor LAB is used in conjunction with the steering column and steering unit to control the electric motor of the steering circuit supply pump.
- The digital output signal supplies, after a steering wheel rotary movement of 2°, an impulse.
- The analog output signal is proportional to the turns of the steering wheel.

Ordering details

LA	B		1X/		–		*

Steering column

Design

Standard = B

Nominal size

Longitudinal dim. C::

65 mm	= 65
80 mm	= 80
154 mm	= 154
300 mm	= 300
450 mm	= 400
650 mm	= 650
762 mm	= 762

Component series 10 to 19 (10 to 19: unchanged installation and connection dimensions)) = 1X

Sensor LAB

Without sensor	= No code
Sensor LAB 01	= 01
Sensor LAB 02	= 02

= Standard programme

Further details in clear text e.g. special specifications Please clarify with our sales organisation.

Flange

E =	Flat flange
G =	Formed flange!

Steering wheel connection

A =	Cone 1:20; woodruff key 5 x 6.5
C =	Splined shaft 13/16, cone 1:16
D =	Splined shaft 7/8; cone 1:19.26

Signal connection

No code =	Without signal connection
S01 =	With signal connection 1x
S02 =	With signal connection 2x

Ordering example: LAB 65-1X/-AE

Standard steering column, longitudinal dim. 65 mm, without sensor LAB, without signal connection, steering wheel connection A, flange E.

Ordering example: LAB 300-1X/01S01-CG

Standard steering column, longitudinal dim. 300 mm, with sensor LAB 01, with a signal connection S01, steering wheel connection C, flange G.

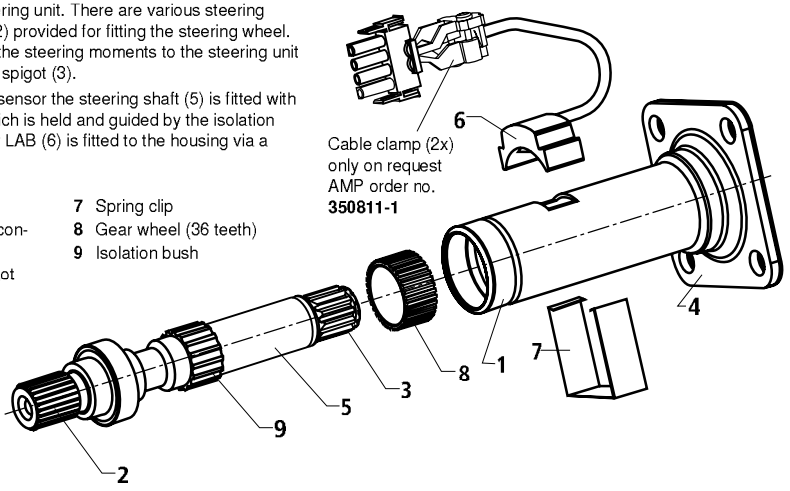
Function, design

The steering column LAB basically comprises of a housing (1), within which a steering shaft (5) is housed, bearing support the shaft within the housing.

A flange (4) is provided on the housing (1) for mounting the column onto the steering unit. There are various steering wheel connections (2) provided for fitting the steering wheel. The transmission of the steering moments to the steering unit is via the connection spigot (3).

For the version with sensor the steering shaft (5) is fitted with a gear wheel (8), which is held and guided by the isolation bush (9). The sensor LAB (6) is fitted to the housing via a spring clip (7).

1 Housing
2 Steering wheel connection
3 Connection spigot
4 Flange
5 Steering shaft
6 Sensor LAB
7 Spring clip
8 Gear wheel (36 teeth)
9 Isolation bush



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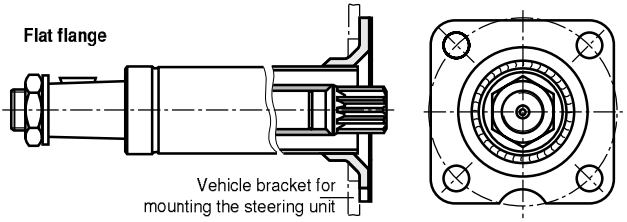
Unit version: steering column LAB

Connection flange

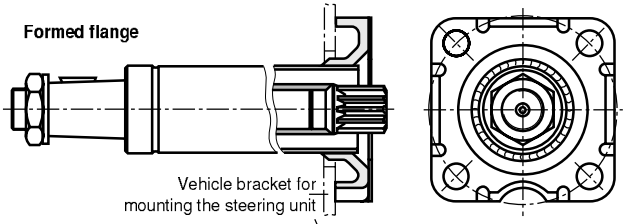
For assembly of the steering column and the steering unit, there are variants available with a formed or flat flange.

The steering column with a formed flange makes it possible to pre-assemble the steering unit and steering column using two screws.

Flat flange



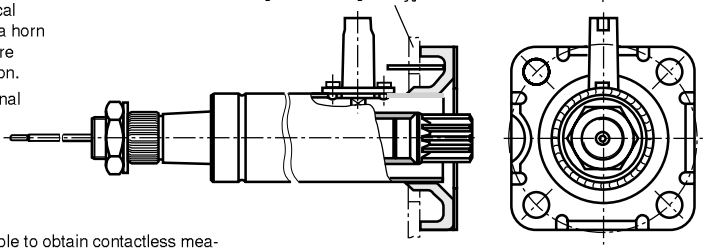
Formed flange



Signal connection

For the installation of an electrical through connection (for use as a horn contact) the steering columns are available with a signal connection.

For special applications two signal connections are possible.



Sensor LAB

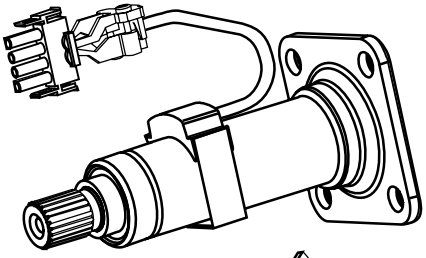
The sensor LAB makes it possible to obtain contactless measurement of rotary movements. A measurement gear wheel acts as the signal trigger.

Preferably the sensor LAB is used in conjunction with the steering column and steering unit to control the electric motor of the steering circuit supply pump.

The digital output signal supplies, after a steering wheel rotary movement of 2°, an impulse.

The analog output signal is proportional to the turns of the steering wheel.

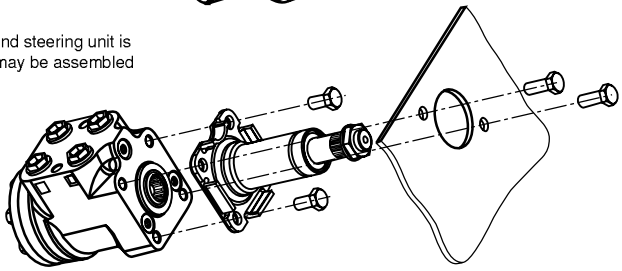
For further information see pages 5 to 8



☞ Assembly note

The connection between steering column and steering unit is calculated so that there no plate (bracket) may be assembled between them.

The maximum tightening torque for fixing screws is 30 Nm.

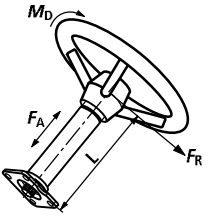


Technical data [1]: steering column LAB

Max. bending moment M_B [2] ($M_B = F_R \times L$)	Nm	200
Max. axial force F_A	N	1000
Max. torque at the steering wheel M_D	Nm	150
Max. tightening torque M_A of the nut for the steering wheel connection	Nm	40
Max. tightening torque M_A for the fixing screws	Nm	30

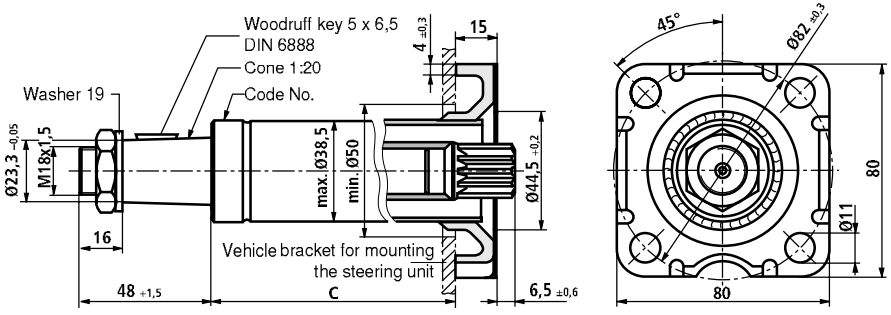
[1] See page 9 for sensor LAB technical data.

[2] When the length L exceeds 150 mm, then the steering column has to be supported

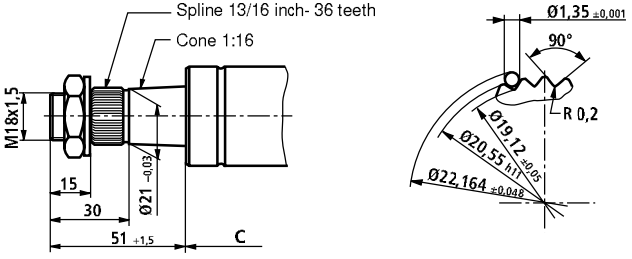


Unit dimensions: steering column LAB (Dimensions in mm)

Steering wheel connection A, with cone and woodruff key, formed flange



Steering wheel connection C with cone 1:16 and splines



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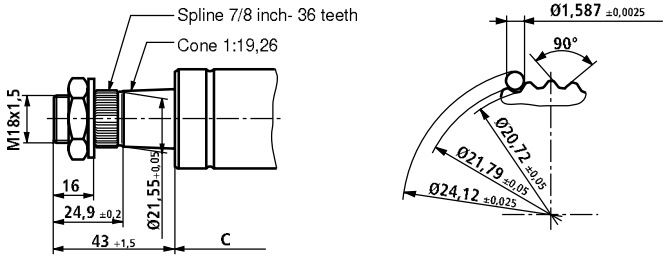
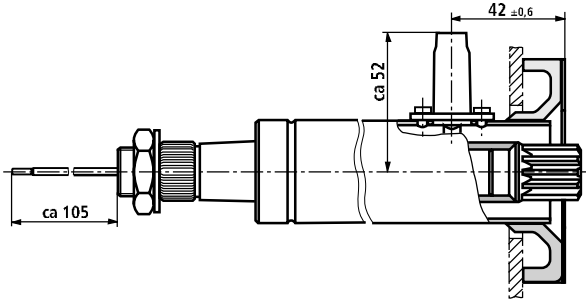
Unit dimensions: steering column LAB (Dimensions in mm)

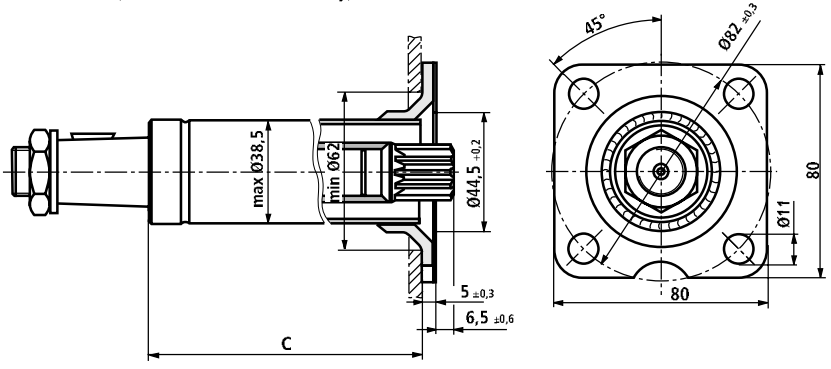
Steering wheel connection D with cone 1:19,26 and splines



Steering column with signal connection



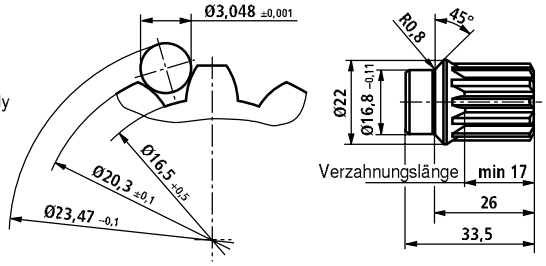
Steering wheel connection A, with cone and woodruff key, flat flange



Unit dimensions: steering column connection spigot (Dimensions in mm)

No. of teeth	$z = 12$
Module	$m = 1{,}5875$ mm
Pitch circle diameter	$d_0 = 19{,}05$ mm
Material	Case hardened steel

The connection spigot can also be obtained separately for manufacturing your own special steering columns.



☞ **Note!**

- So that the correct connection to the steering unit can be guaranteed it has to be ensured, during the design stage, that the dimensions for the part of the connection pin protuding out of the flange is exactly 6.5 mm.
- The steering column should only have one bearing as close as possible to the steering wheel connection.
- The connection spigot must line up, and run round, with the welded component.

Sensor LAB

Sensor LAB 01

- Nominal voltage: 12 to 48 volts
- Output signal: Analog and digital
- Cable length: Approx. 300 mm
- Plug 4-pin AMP - plug housing without mechanical unloading (pulling of the cable)

Function

The rotary movement sensor LAB makes it possible to recognise rotating machine components without contact. The magnetostrictive sensor is fitted, in a radial direction, onto the rotating component where the ferromagnetic gear wheel (steel) is located. A permanent magnet, which is fitted in the sensor, generates a static magnetic field whose field lines pass through a magnetostrictive bridge resistance comprising of four resistors and exits from the front of the sensor. With an undisturbed field the four field strength-dependent resistances have the same resistance values, i.e. the bridge is in balance and the bridge voltage is 0 V.

If the field is disturbed by a ferromagnetic body entering from the side (a gear wheel tooth), the field strength distribution in the resistance bridge becomes unsymmetrical, the resistances have differing values and the bridge voltage is $\neq 0$ V. With a symmetrical rotary movement of the gear wheel a virtual sinusoidal bridge voltage results.

This signal is amplified with a differential amplifier, low pass filtered and digitized. In a micro-processor the phase angle is calculated from the sine. The change in the phase angle is therefore proportional to the change in the rotary angle of the gear wheel.

This change is limiting value monitored with regard to increase (= speed) and absolute value (= rotary angle), (the limits are parameterised by the manufacturer). If both parameters exceeded the given limiting values then the digital output is set and when one of the limiting values falls below the given limiting value the digital output is reset, after a delay time which has been defined within the parameterisation carried out by the manufacturer.

To this principle it is possible to detect changes in rotary angles that lie considerably below half a tooth division, as (theoretically) phase information is available at any point in time.

The calculation of the actual speed for the analog speed output results from the time spacing between the zero passages of the sensor signal. As a minimum of three zero passages (= three edges) are required the analog output is accordingly activated after an appropriate time delay. The form of the speed/output voltage characteristic curve within the control range of the analog output signal (0 ... 4.3 V) is freely selectable by the manufacturer. The switched condition of the digital output is signaled by an LED (light emitting diode).

The digital output is galvanically separated from the supply voltage of the sensor. By changing the plug allocation the output can be configured (switchable) against V+, V– or against any other potential.

The analog and digital outputs of the sensor are overload and short-circuit proof. Overloads or short-circuits are signaled by a blinking LED. The operating voltage connections are protected against polarity reversal.

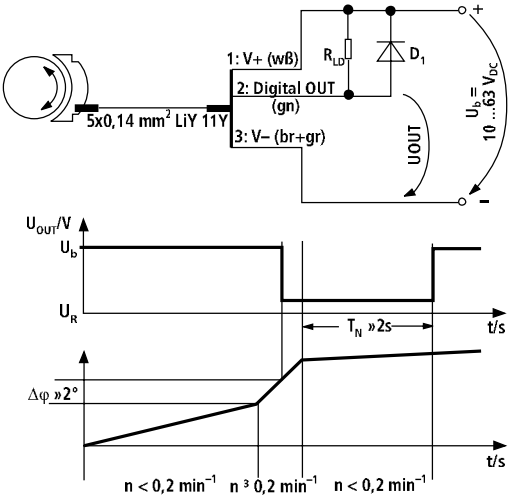
The sensor is maintenance and wear-free, has a high degree of protection (IP 63) and in contrast to optical pricesses is practically resistant to dirt.

Larger deposits of ferromagnetic particles or chips on the front side of the sensor should however be prevented, (a permanent magnet is located on the inside).

Unit versions: sensor LAB – connection diagram

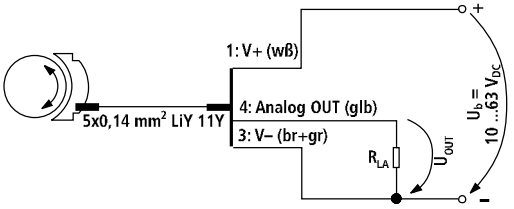
1. Digital output signal:

- Output against V – switching
- Output switching via ($U_{OUT} = U_R \leq 1{,}5$ V), when $n > 0{,}2$ min^{-1} and $\Delta\varphi > 2°$ (see charateristic curves)
- Holding time T_N dof the output when falling below n_{min} approx. 2 s
- R_{LD} must be so selected that the maximum output current does not exceed –50 mA.
- The free-wheel diode D_1 can be omitted when the load resistance R_{LD} does not have an inductive component.
- When the maximum permissible output current is exceeded then the output switches off. As $U_{OUT} = U_b$; after the overload condition has been rectified the output switches back on.



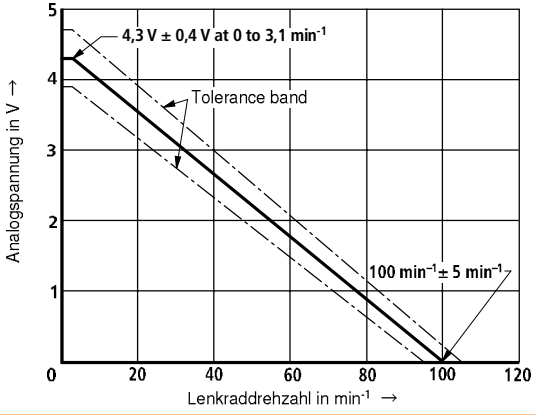
2. Analog output signal:

- Output voltage $U_{OUT} = 0 \ldots 4{,}3$ V against V–
- Maximum output current 1 mA → $R_{Lmin} \geq 4.3$ kΩ
- Output against V– is short- circuit proof, a continuous short circuit should however be avoided
- With an overload at the output, the output is set to 0 V; the output is reactivated when the overload condition has been rectified.
- The output voltage is as per the characteristic curve (identical for the right and left)
- The analog output reacts within φ = 10° ... 15° when starting the rotary movement.



Characteristic curves: analog output signal

Output characteristics (36 teeth)
Analog OUT with tolerance range



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Technical data: sensor LAB

General

Ambient temperature range		°C	–25 to +70
Storage temperature range		°C	–40 to +105
Air humidity			max. 100 % r. F.
Resistance to aggressive mediums			Mineral oil

Electrical

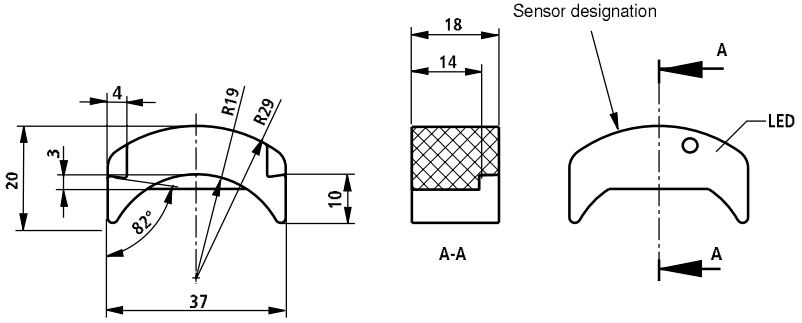
Electrical connections	Pin 1	White	Operating voltage V+
	Pin 2	Green	Digital OUT
	Pin 3	Brown+Grey	Operating voltage V–
	Pin 4	Yellow	Analog OUT
Operating voltage V+ (V– = 0 VDC)			10 VDC ... 63 VDC
Over votlage resistance at connection V+ (V– = 0VDC)			190 V for 3 ms at 200 Hz
Current consumption at connection V+			≤ 14 mA
Switching current digital OUT			≤ 50 mA
Max. switching voltage, digital OUT (ohmic load)			≤ 100 mA
Residual voltage U_R at digital OUT with an active output I_{last} = 50 mA		U_R	≤ 1.5 V
Switching characteristic digital OUT NPN output (against V– switching)::	Gear wheel is moving (n > ca. 0,2 min^{-1})		→ V_{OUT} = V– + U_R
			LED continuously on
	Gear wheel is not moving (n < ca. 0,2 min^{-1})		→ Digital OUT high ohmic
			LED off
Output characteristic analog OUT			See characteristic curves on page 8
Max. output current analog OUT (source / sinking)			≤ 1 mA (→ R_{LA} ≥ 4.3 kΩ
Supply cable			LiY 11 Y 5 x 0,14 mm^2 PUR/PVC black
Supply cable length			Approx. 300 mm
Plug standard			4-pin AMP Mate-N-LOK
Holding time T_N of the output			2 seconds after falling below n_{min}

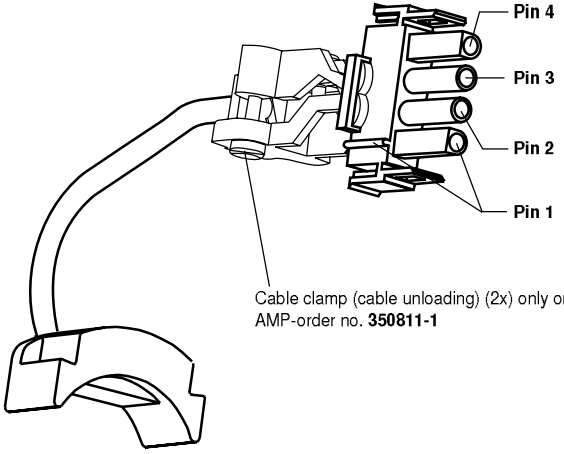
Fault reactions

Fault	Reaction
Incorrect polling of the operating voltage (V+ ↔ V–)	No movement recognision, the sensor is functional when the operating voltage has been correctly connected
Over current at digital OUT (approx. I_{OUT} > ca. 80 mA) Short circuit a digital OUT against V+, Gear wheel in movement	LED slowly blinks (approx. 1.5 Hz) Digital OUT deactivated, analog OUT is functional, Digital OUT after falling below the maximum current/ rectification of the short circuit is functional
Short circuit analog OUT against V–	LED blinks quickly (approx. 3.5 Hz) Analog OUT deactivated, digital OUT is functional, Analog OUT is functional after rectification of the short circuit
Over voltage at V+ to specifications	During the over voltage impulses there are function faults, afterwards functional

Unit dimensions: sensor LAB (Dimensions in mm)

Sensor is shown without cable and plug





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