Over-center valves type LHT
with oscillation damping

Flow rate Q_{max} = 250 lpm
Operation pressure p_{max} = 450 bar

See also:
- Over-center valve type LHK acc. to D 7100
- Over-center valve type LHDV acc. to D 7770

Version for screwing-in

Version for direct pipe connection

Version for manifold mounting

Banjo bolt version

1. General information

These over-center valves are throttle valves which are commonly used for a well controlled movement of loads connected to double acting hydraulic consumers (lifting and swivel cylinders). They prevent a collapse or eventual rupture of the fluid column. The velocity is determined by the flow to the consumer.
With dragging loads the flow out of the consumer is throttled in such a way that the pump, feeding the contrary side, always has to overcome a slight back pressure.
This back pressure is caused by a spring which usually is set about 15% higher than the respective maximum load induced pressure for the device enabling compensation of dynamic forces.
These valves can be customized to suit most applications by employing orifices of various diameter at the in- and outflow of the control line that influence the release ratio as well as the dampening characteristic. Special dampening elements like with type LHDV (D 7770) are only used at type LHTZ. Their use is most advantageous at applications where the dampening characteristic of type LHK (D 7100) is not sufficient, i.e. applications, which are less prone to low frequent oscillations like nodding etc.
The valve is zero leakage in unoperated state. All of these valves, beside valves with geometric release ratio 1 : ∞, perform also as a safety valve. At valves with release ratio 1 : ∞ (line rupture safety valves), the control pressure is independent of the load pressure. Therefore a shock valve installed as option in the valve body is necessary to safe guard eventual pressure surges or creeping pressure rise on the consumer side.
When the load is dropped via pressure at the opposing side this pressure will also enter the control line and open-up the outflow side i.e. only the design related back pressure valve will be effective.

- **Design versions:**
  - Pipe connection (tapped ports or SAE-flange)
  - for manifold mounting
  - as banjo bolt
  - for screwing-in

- **Versions:**
  - double acting cylinders with control line (coding 11)
  - double acting cylinders, ports of the opposite side in the block, minimized piping effort (coding 14)
  - with additional shock valve enabling quick removal of pressure peaks (coding 15)
  - with additional port enabling connection of a second, double acting consumer being operated in parallel (making a second over-center valve superfluous; coding 18)
  - Circuitry for winches with integrated loose rope prevention (coding 17)
  - Circuitry for double acting cylinders and alternating load directions (coding 21, 23, 25)

2. Available versions, main data

Order examples:

LHT 50 G -15-8- A 6-300/280	Individual valve for pipe connection
LHT 50 SAE -11-6- C 6-80	Individual valve with SAE connection flange
LHT 3 E B 7-400	Cartridge valve
LHT 21 H -14 B 4-350	Version for banjo bolt mounting
LHT 33 OMP -21 A 7-250 -B 7-250	Double valve for sub-plate mounting

Outflow orifice D2 see table 2, page 3

Shock pressure (bar) (only at symbol -15, -23, -25)

Load pressure (bar) (or release pressure with ψ_{geo} = 1 : ∞)

Pressure ranges shock valves:

Basic type	Pressure range (bar)
LHT 23 SAE-25W	90 ... 160 161 ... 220 221 ... 340
LHT 33 P-15 LHTZ 33 P-15 LHTZ 30 P-23	20 ... 160 161 ... 400
LHT 34 G-15	150 ... 250 251 ... 340
LHT 50 ...-15	20 ... 160 161 ... 450

Table 1:

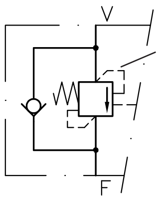
Basic type, size, connection manner and symbols	Flow coding A	B	C	D	E	F	Geometric release ratio ψ_{geo}	
Size 2	28	14	10	6	3	--	**4** 1 : 4 **8** 1 : 8	
LHT 21 G -11 **LHT 21 P -11** **LHT 21 P -14** **LHT 21 UNF P -14** **LHT 21 H -14** **LHT 22 G -11** **LHT 22 P -11** **LHT 23 SAE -25W**	Flow rating (lpm) with $\Delta p_{V \rightarrow F}$ of approx. 40 bar Also avail. coding **AB**, flow rating = 20 lpm (see Δp-Q-curve in sect. 3)						Pressure range (bar) [1] 20 ... 60 61 ... 250 251 ... 400	
Size 3	130	85	55	35	20	10	**7** 1 : 7	**0** 1 : ∞ [2]
LHT 33 G -11 **LHT 33 P -11** **LHT 33 P -15** **LHT 33 OMT -17E** **LHT 33 SAE -18** [3] **LHT 33 OMP -21** **LHT 34 G -15** **LHTZ 30 P -23** **LHTZ 33 P -15**	Flow rating (lpm) with $\Delta p_{V \rightarrow F}$ of approx. 40 bar						Pressure range (bar) [1] 20 ... 49 50 ... 199 200 ... 319(400) [3] from 320	Release pressure D2 = 0: 9 ... 14; 15 ... 25; 26 ... 40; 41 ... 65; 66 ... 90 D2 = 6: 24 ... 43; 46 ... 123; 250 ... 310
LHT 3 E [1]	130	85	55	35	20	10	**4** 1 : 4 **7** 1 : 7	
	130	85	55	--	--	--	**10** 1 : 10	
	Flow rating (lpm) with $\Delta p_{V \rightarrow F}$ of approx. 40 bar						Pressure range (bar) [1] 20 ... 200 201 ... 400	
Size 5	250	200	150	100	50	25	**6** 1 : 6	**0** 1 : ∞ [2]
LHT 50 G -11 **LHT 50 SAE -11** [3] **LHT 50 SAE -14** [3] **LHT 50 G -15** **LHT 50 SAE -15** [3]	Flow rating (lpm) with $\Delta p_{V \rightarrow F}$ of approx. 40 bar						Pressure range (bar) 20 ... 89 90 ... 259 260 ... 450(400) [3]	Release pressure D2 = 0: 15 ... 30; 31 ... 70; 71 ... 100 D2 = 6: 46 ... 90; 95 ... 215; 216 ... 305

Symbol

Connection manner:

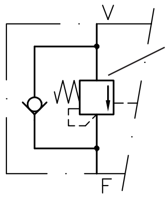
- E = Cartridge valve (The inflow and the optional outflow orifice must be integrated somewhere else in the manifold!)
- H = With banjo bolt
- G = For pipe connection conf. ISO 228/1 (BSPP)
- P = For manifold mounting (only port V is housed in the manifold)
- SAE = For SAE connection flange
- OMT = For direct mounting onto motors type OMT (Co. DANFOSS)
- OMP = For direct mounting onto motors type OMP or OMR (Co. DANFOSS)

Geometric release ratio $\psi_{geo} \neq 1 : \infty$



Effective load pressure

Geometric release ratio $\psi_{geo} = 1 : \infty$ [2]



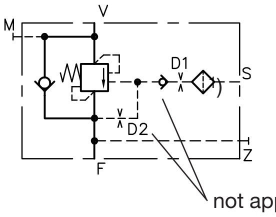
Without influence of the load pressure

Footnotes [1] [2] [3] see page 3!

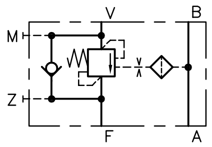
Symbols

Basic valve (illustrated for geom. release ratio $\psi_{geo} \neq 1:\infty$)

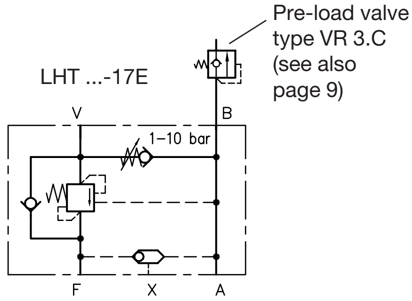
LHT ...-11



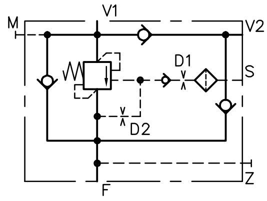
LHT ...-14



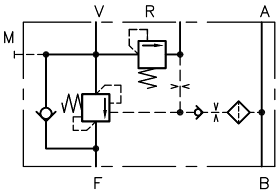
LHT ...-17E



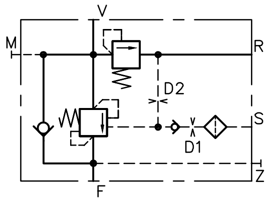
LHT ...-18



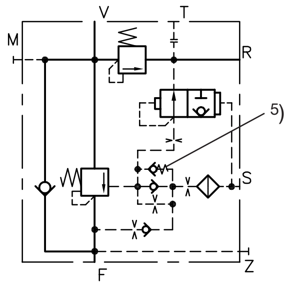
LHT 34 G ...-15



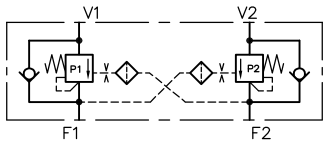
LHT 50 ...-15



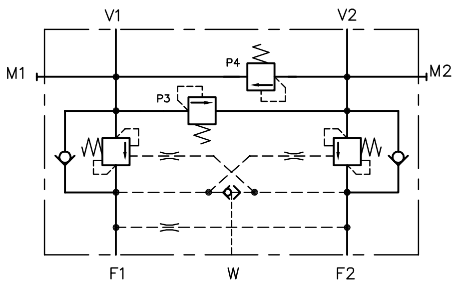
LHTZ ...-15



LHT 33 OMP-21



LHT 23 SAE -25W



LHTZ 30 P-23

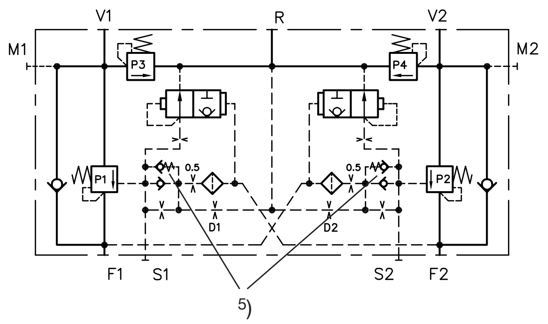
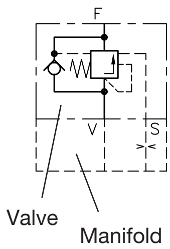


Table 2: Effective release ratio ψ_{real}, outflow orifice D2
Type LHT 2..., LHT 33 OMT(OMP) and LHT 3 E only with geom. release ratio ψ_{geo}
(no outflow orifice D2); With all other versions the effective release ratio ψ_{real} i.e. the necessary release pressure is determined by the orifice combination D1/D2

Cartridge valve
LHT 3E



Examples:

LHT 33 P11 - **6** - A7 - 200 ψ_{geo} = 1: 7, ψ_{real} = 1 : 2.28	A release pressure p_{contr} of approx. 90 bar is necessary (without effective load pressure)
LHT 33 P11 - **0** - A7 - 200 ψ_{geo} = ψ_{real} = 1 : 7	A release pressure p_{contr} of approx. 30 bar is necessary

Coding		**4**	**5**	**6** (series)	**7**	**8**	**0** 4)
Orifice-∅ (mm)		0.4	0.5	0.6	0.7	0.8	--
Actual (dynamic) release ratio with type	LHT 3..-..4-...	1 : 2.84	1 : 2	1 : 1.30	1 : 0.83	1 : 0.53	1 : 4
	LHT 3..-..7-...	1 : 4.96	1 : 3.5	1 : 2.28	1 : 1.45	1 : 0.93	1 : 7
	LHT 5..-..6-...	1 : 4.26	1 : 3	1 : 1.95	1 : 1.24	1 : 0.79	1 : 6
Note: Inflow orifice D1 ∅0.5 mm (standard, no coding).							

1) Type LHT 2..., LHT 33 OMT(OMP) and LHT 3E only with geom. release ratio ψ_{geo} (no outflow orifice D2)
2) Notes regarding geom. release ratio $\psi_{geo} = 1:\infty$
   - This valve version does not show a safety valve function, as the load pressure is not applied (see symbol)
   - The set release pressure p_{contr} directly corresponds to the necessary pressure at port S to open the valve.
   - The functionality is like with a line rupture safety valve.
   - **Attention:** The use of an outflow orifice D2 (acc. to table 2) will dampen oscillations but will raise the required pressure at port S (see the various pressure ranges at table 1)
3) p_{max} is restricted for version with SAE hole pattern
4) Prepared, the outflow port of the control line is plugged, corresponds to the geom. release ratio ψ_{geo}
5) Set at 30 bar by HAWE (adjustable range 10 ... 50 bar)

3. Additional parameters

Nomenclature	Over-center valve with hydraulic release and bypass check valve
Design	Over-center valve: cone seated valve Bypass check valve: plate seated valve
Installed position	Any
Ports	F, V, V1, V2, A, B and R — Main ports M, S and Z — Control and pick-up ports dep. on type

Mass (weight) approx. kg

LHT 21 H	-14	= 0.6	LHT 33 G(P)	-11	= 1.3	LHT 50 G	-11	= 2.4
LHT 21(22) G(P)	-11	= 0.8	LHT(Z) 33 P	-15	= 1.7	LHT 50 SAE	-11	= 3.0
LHT 21 (UNF)P	-14	= 1.0	LHT 33 SAE	-18	= 2.4	LHT 50 G	-15	= 3.2
LHT 23 SAE	-25W	= 3.2	LHT 33 OMT	-17E	= 2.4	LHT 50 SAE	-14(15)	= 3.9
			LHT 33 OMP	-21	= 2.8			
LHT 3 E		= 0.6	LHT 34 G	-15	= 2.2			
			LHTZ 30 P	-23	= 5.0			

Flow direction	Operation direction (load holding function) V → F, V1 → F or V2 → F Free flow F → V, F → V1, F → V2
Release ratio	Blocked valve approx. 1 : 4, 1 : 7, 1 : 8, 1 : 6 dep. on basic type Opened (released) valve approx. 1 : 1 to 1 : 5 dep. on orifice-∅-ratio and basic type see sect. 2

Pressure adjustment

A pressure gauge should be used whenever the pressure setting is adjusted or altered! The given figures for pressure alternation per rotation and per mm adjustment travel of the perforated disc (within the connector F) or of the set screw (at the spring housing) are only a rough guide line for approximately achieving the desired setting (start of operation). The setting should be at least 15% above the max. expected load pressure.

Over-center valve function (ψ_{geo} = 1 : 4; 1 : 8; 1 : 7; 1 : 6)

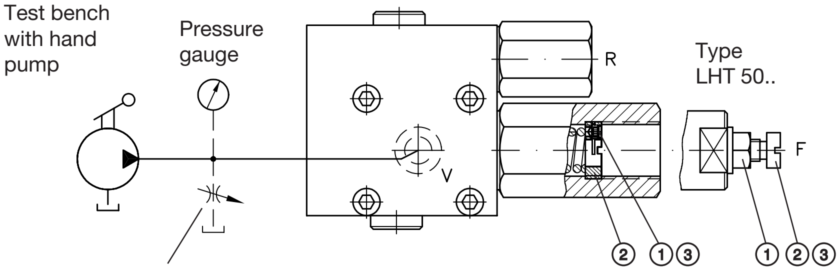
Line rupture safety valve function (ψ_{geo} = 1 : ∞)

Pressure alterations (over-center valve)

Type	ψ_{geo}	Pressure variation per mm according to pressure range Δp_{Spring} (bar/mm)			Pressure variation per turn Δp_{set} (bar/U) = k · Δp_{Spring}
LHT 2		0 ... 60 bar	61 ... 250 bar	251 ... 400 bar	k = 1.34 k = 1.25 (only LHT 21 (UNF) P 14)
	1 : 4	24	41	124	
	1 : 8	49	85	255	
LHT 3		20 ... 42 bar	50 ... 199 bar	200 ... 318 bar	k = 1.81 k = 1.25 (only LHTZ 30 P 23)
	1 : 7	18	30	40	
		9 ... 14 bar	26 ... 40 bar	41 ... 65 bar	
	1 : ∞	1	3	13	
LHT 3 E		---	0 ... 200 bar	201 ... 400 bar	
	1 : 4	---	16	30	
	1 : 7	---	30	40	
LHT 5		20 ... 89 bar	90 ... 259 bar	260 ... 450 bar	k = 1.25
	1 : 6	14	27	29	
		15 ... 30 bar	31 ... 70 bar	71 ... 100 bar	
	1 : ∞	3	5	6	

Pressure alterations (shock valve)

Type	LHT 23..-25..			LHT 33 P-15..		LHT 34 G-15..		LHT 5..-15..	
Spring (pressure p_{max} bar)	340	220	160	400	160	340	250	450	160
Pressure alternation (bar/rev.)	--	--	--	100	19	--	--	80	17.5
Pressure alternation (bar/mm)	40	27	17	--	--	66	40	--	--

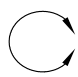


This bypass-throttle valve is a must with test rigs using a motor pump! The pump should be circulating via opened throttle valve, then close the throttle valve slowly until LHT starts barely responding (avoid larger flow since the valve might squeal).

Attention: The pump has to be connected to port S with geom. release ratio ψ_{geo} = 1 : ∞ !

① Slacken the Both grub screw or SEAL-LOCK nut which serve for locking ② and must be slackened prior to any pressure adjustment

② The perforated disc can be rotated with an allan key a/f 6 (mm), the set screw with a screw driver



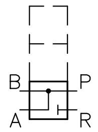
= pressure increases

= pressure decreases

③ Retighten the grub screw / SEAL-LOCK nut ① after performed adjustment.

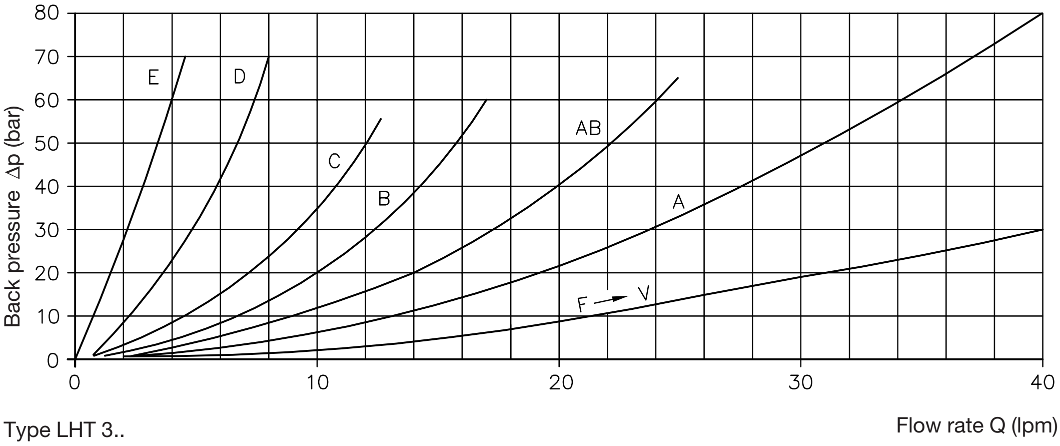
Continuation: Additional parameters

Hydraulic fluid	Fluids acc. to DIN 51524 table 1 to 3; ISO VG 10 to 68 acc. to DIN 51519 Viscosity range: min. approx. 4; max. approx. 1500 mm²/s Optimal operation range: approx. 10...500 mm²/s Also suitable are biologically degradable pressure fluids of the type HEPG (Polyalkylenglycol) and HEES (synth. Ester) at operation temperatures up to approx. +70°C.
Temperature	Ambient: approx. -40...+80°C Fluid: -25...+80°C, pay attention to the viscosity range! Start temperature down to -40°C are allowable (Pay attention to the viscosity range during start!), as long as the operation temperature during subsequent running is at least 20K higher. Biological degradable pressure fluids: Pay attention to manufacturer's information. With regard to the compatibility with sealing materials do not exceed +70°C.
Functional restriction	The use of these is restricted when combined with directional valves enabling differential circuitry during any switching position e.g. coding C of D 5700. Valves intended for one load direction only (symbols 11 to 18) must not be connected to the rod side of hydraulic cylinders.

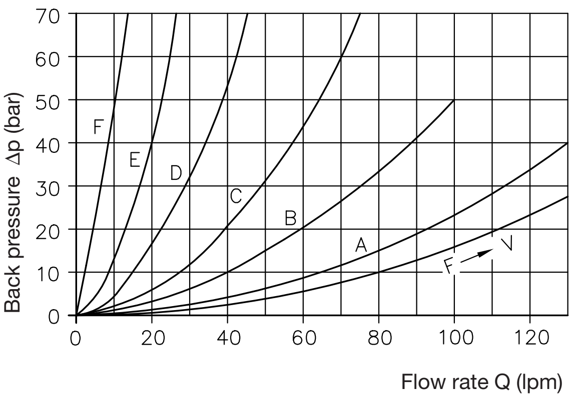


Δp-Q-curves	Operation direction V → F (depending on the flow size, acc. to table 1 in sect. 2) Free flow F → V (characteristic back pressure)

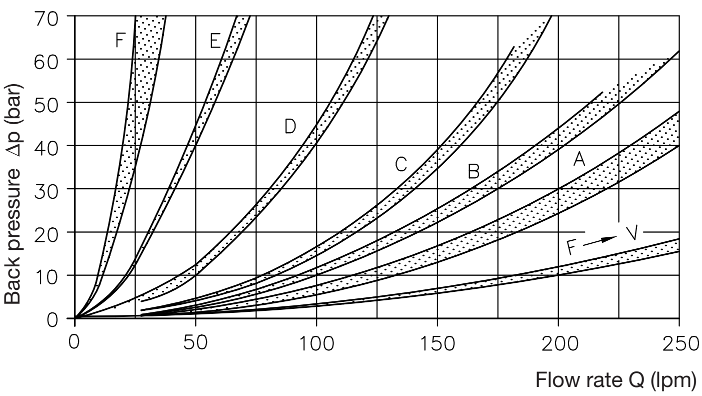
Type LHT 2..



Type LHT 3..



Type LHT 50..



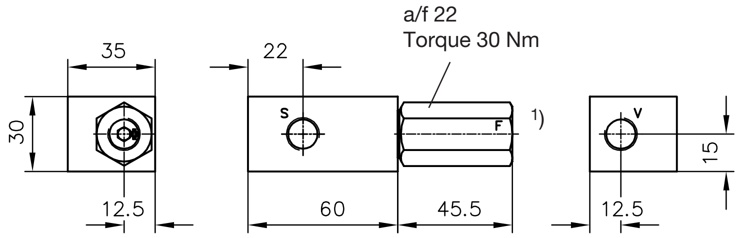
Fluid viscosity during tests approx. 50 mm²/s

4. Unit dimensions

All dimensions in mm, subject to change without notice!

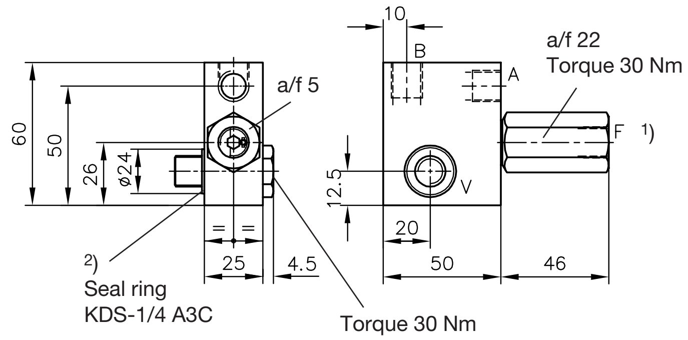
4.1 Basic valves

Type LHT 21 G-11
LHT 22 G-11



Ports conforming ISO 228/1 (BSPP):
LHT 21 V, F = G 1/4; S = G 1/4
LHT 22 V, F = G 3/8; S = G 1/4

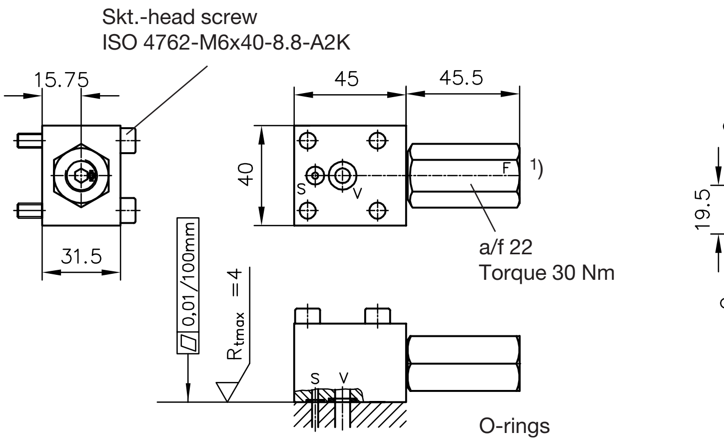
Type LHT 21 H-14



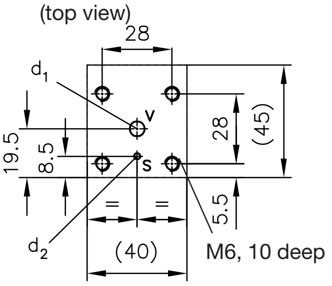
Ports conforming ISO 228/1 (BSPP):
A, B, F, V = G 1/4

2) Both, the seal ring and the spot face show the same diameter.

Type LHT 21 P-11
LHT 22 P-11

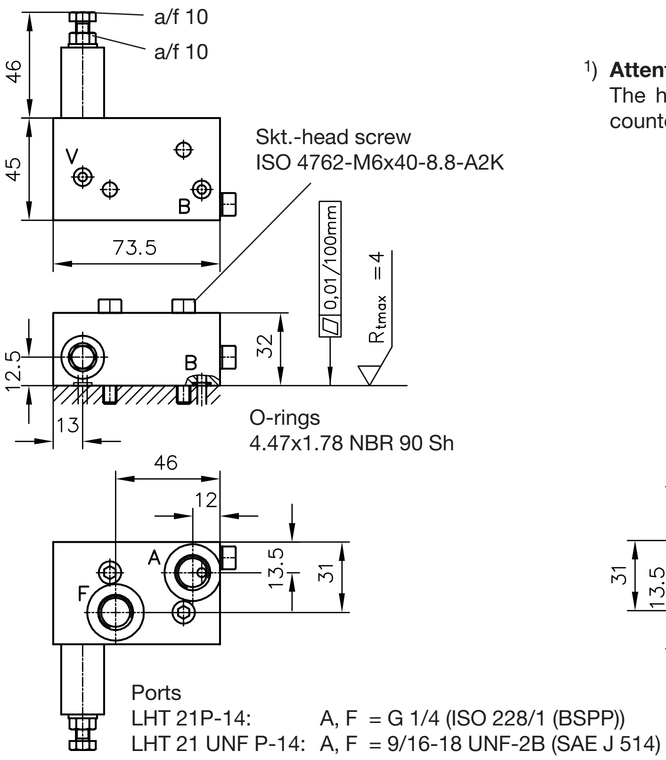


Hole pattern of the manifold
(top view)



d_1 = max. ∅5
d_2 = max. ∅3

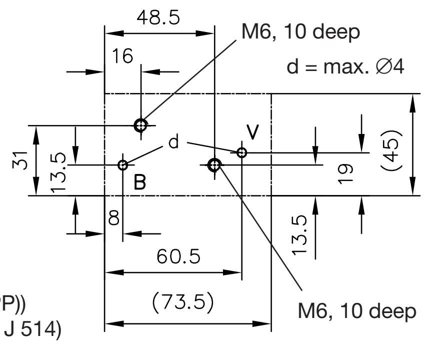
Type LHT 21 P-14
LHT 21 UNF P-14



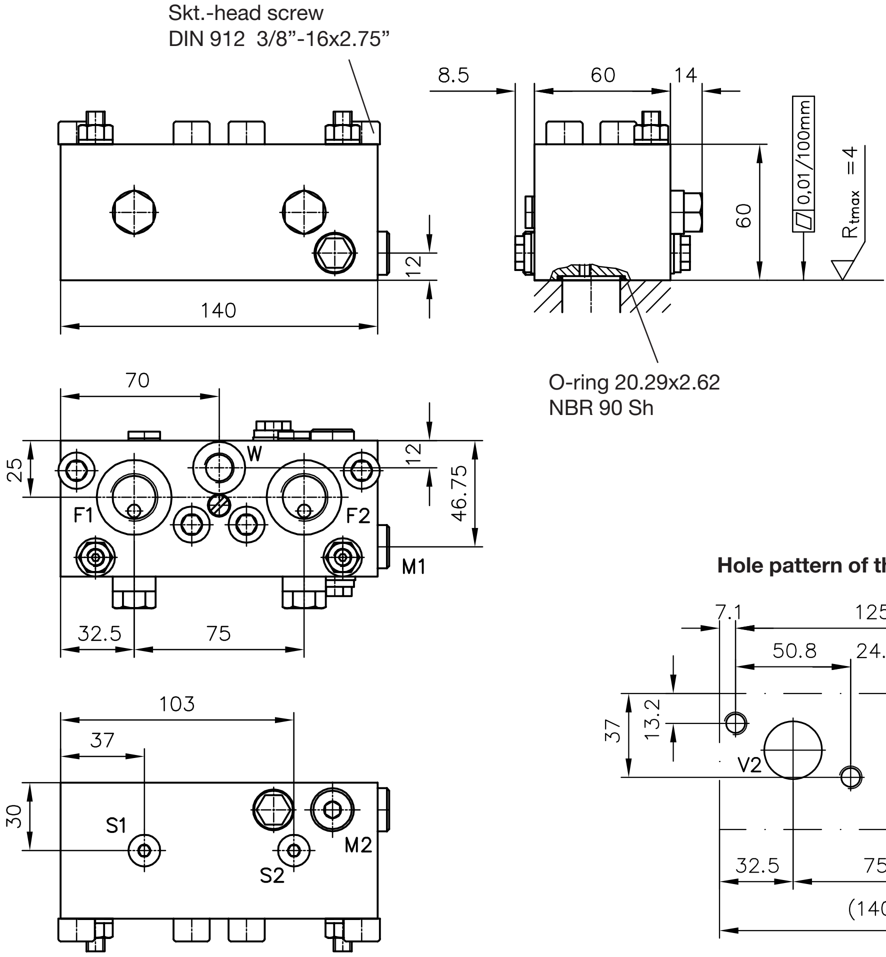
Ports
LHT 21P-14: A, F = G 1/4 (ISO 228/1 (BSPP))
LHT 21 UNF P-14: A, F = 9/16-18 UNF-2B (SAE J 514)

1) **Attention:**
The hexagonal spring housing must be countered while installing the pipe fitting !

Hole pattern of the manifold
(top view)

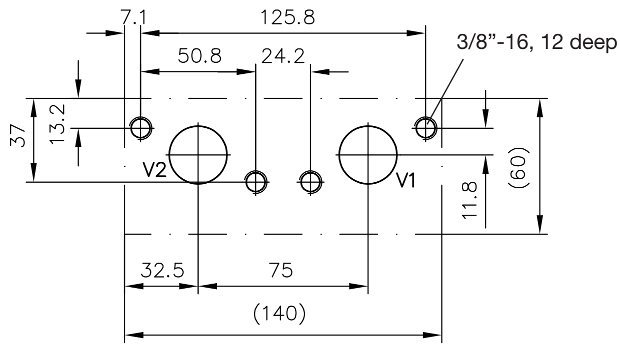


Type LHT 23 SAE-25W



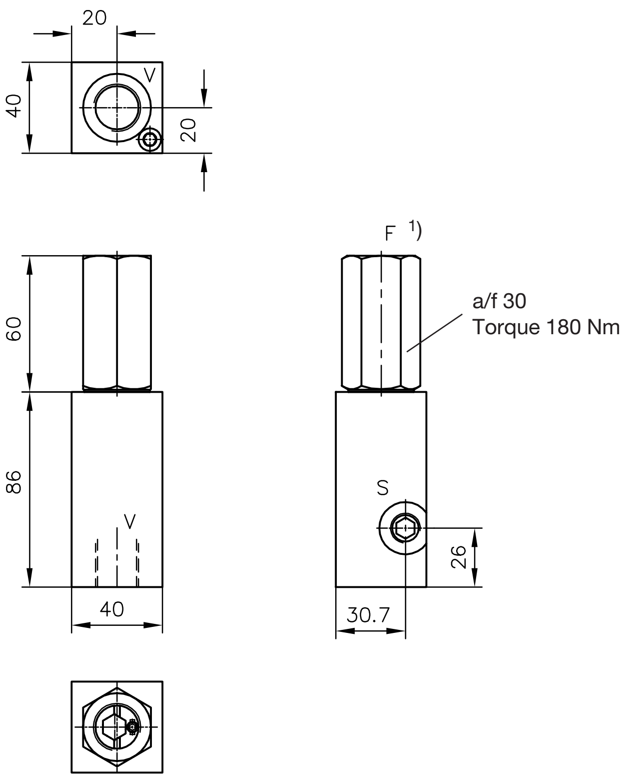
Ports conforming
ISO 228/1 (BSPP):
F1, F2 = G 1/2
W = G 1/4
M1, M2 = G 1/4
S1, S2 = G 1/8

Hole pattern of the manifold (top view)



$d_{V1, V2}$ = max. ∅17 mm

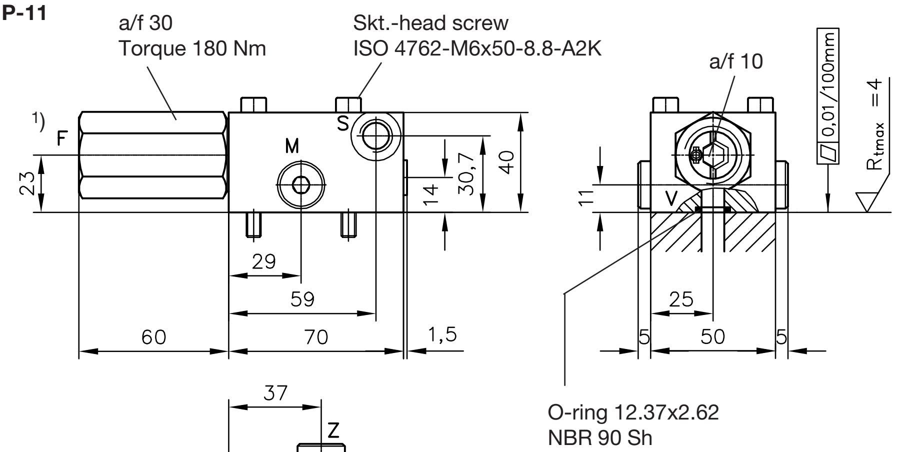
Type LHT 33 G-11

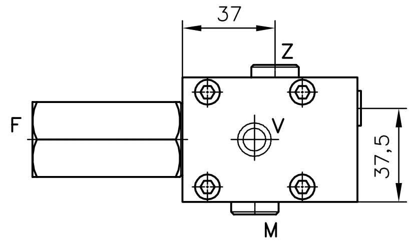


1) **Attention:**
The hexagonal spring housing must be countered while installing the pipe fitting!

Ports conforming ISO 228/1 (BSPP):
F, V = G 1/2
S = G 1/4

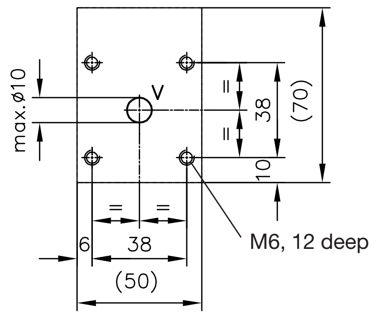
Type LHT 33 P-11



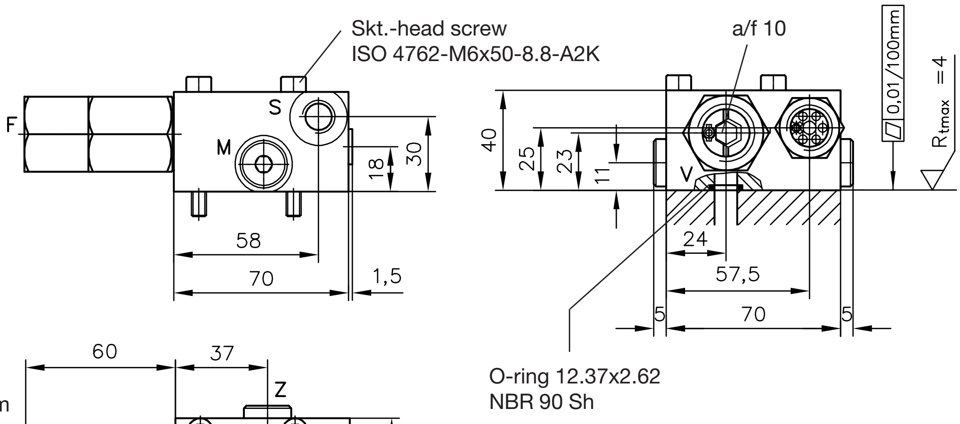


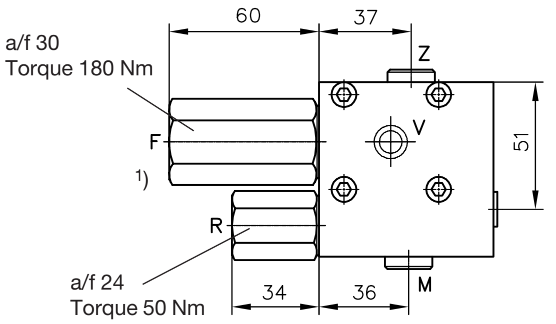
Ports conforming
ISO 228/1 (BSPP):
F = G 1/2
M, S, Z = G 1/4

Hole pattern of the manifold (top view)



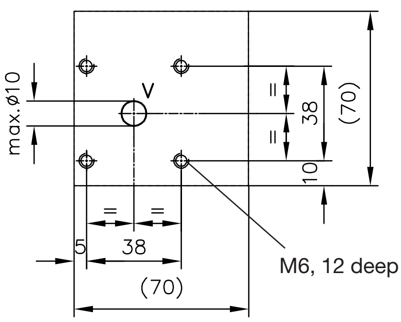
Type LHT 33 P-15





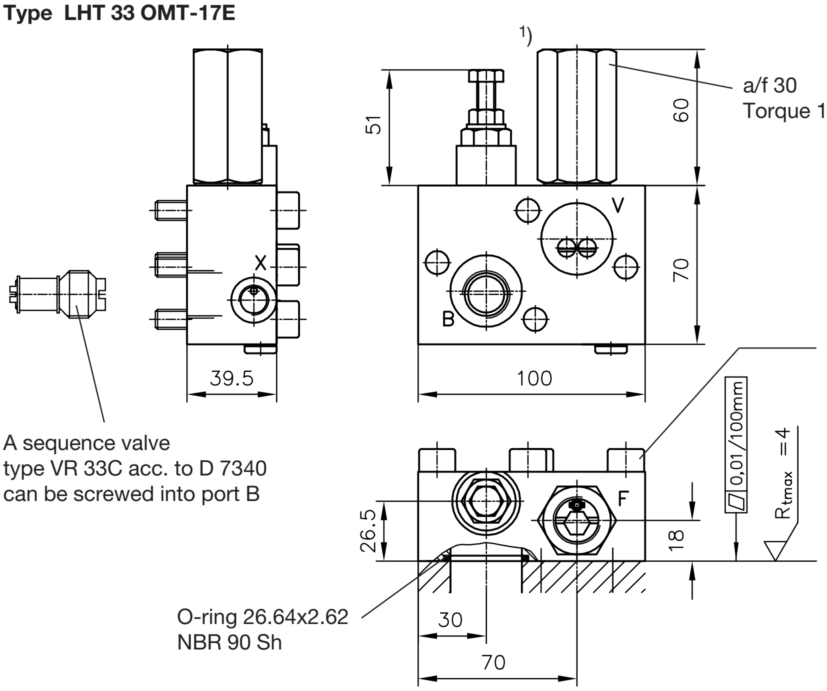
Ports conforming ISO 228/1 (BSPP):
F = G 1/2
M, S, Z = G 1/4
R = G 3/8

Hole pattern of the manifold (top view)

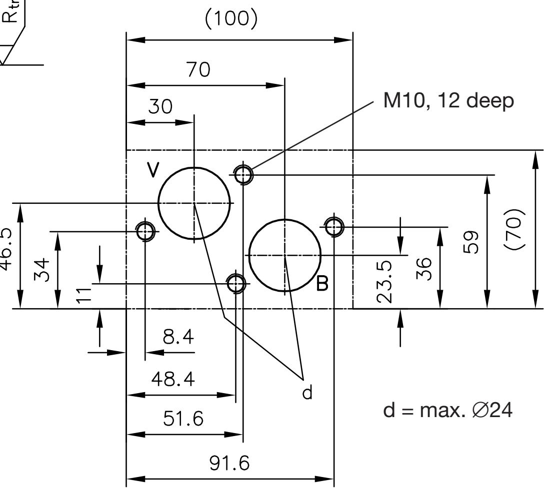


1) **Attention:**
The hexagonal spring housing must be countered while installing the pipe fitting!

Type LHT 33 OMT-17E

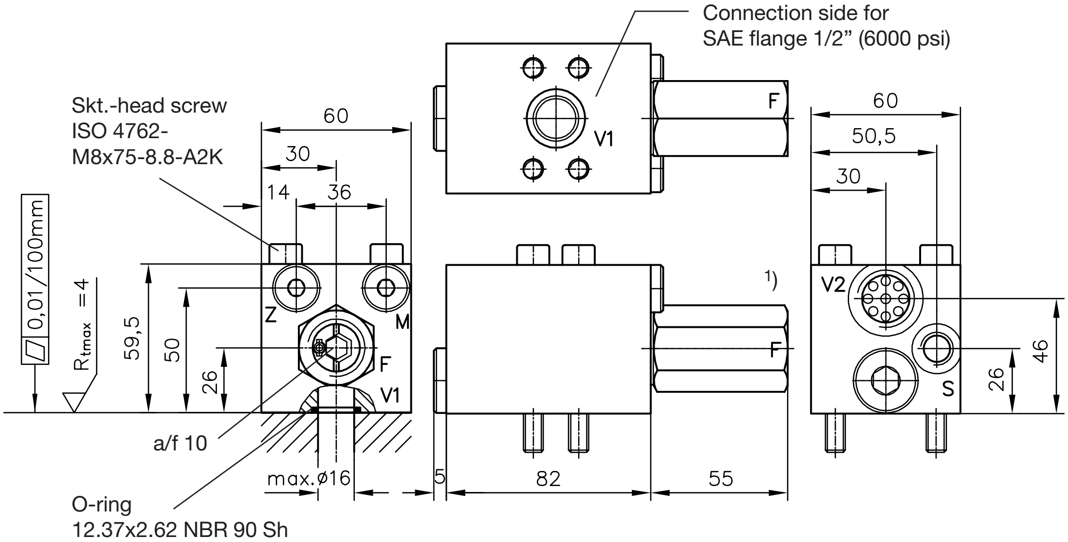


Flange for connection to motor

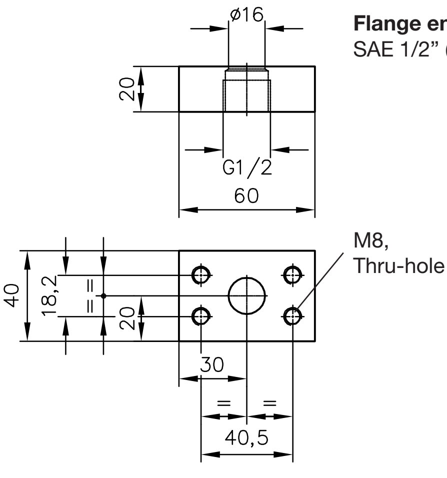


Ports conforming ISO 228/1 (BSPP):
F = G 1/2
M = G 1/4

Type LHT 33 SAE-18



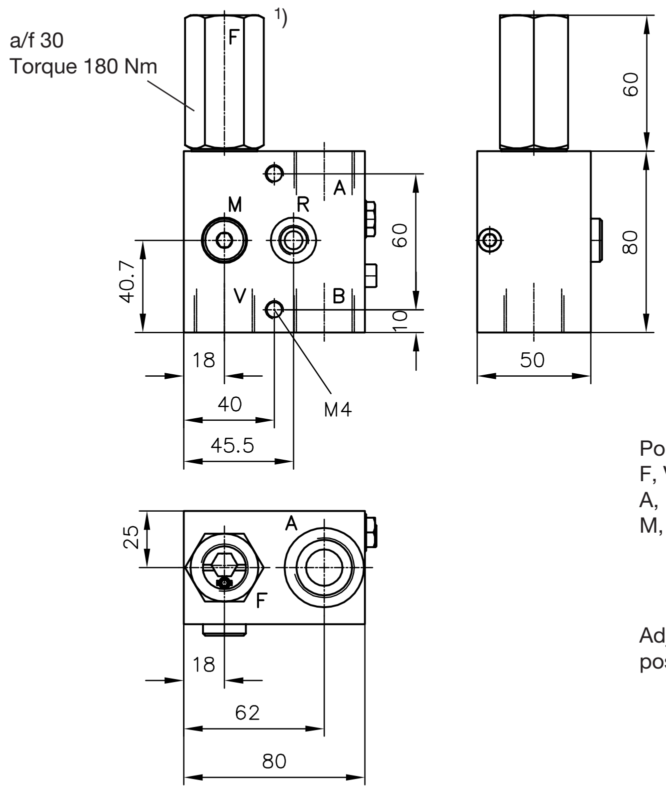
Flange enabling pipe connection at V1
SAE 1/2” (6000 psi)



Ports conforming
ISO 228/1 (BSPP):
M, S, Z = G 1/4
F, V2 = G 1/2

1) **Attention:**
The hexagonal spring housing must be countered while installing the pipe fitting!

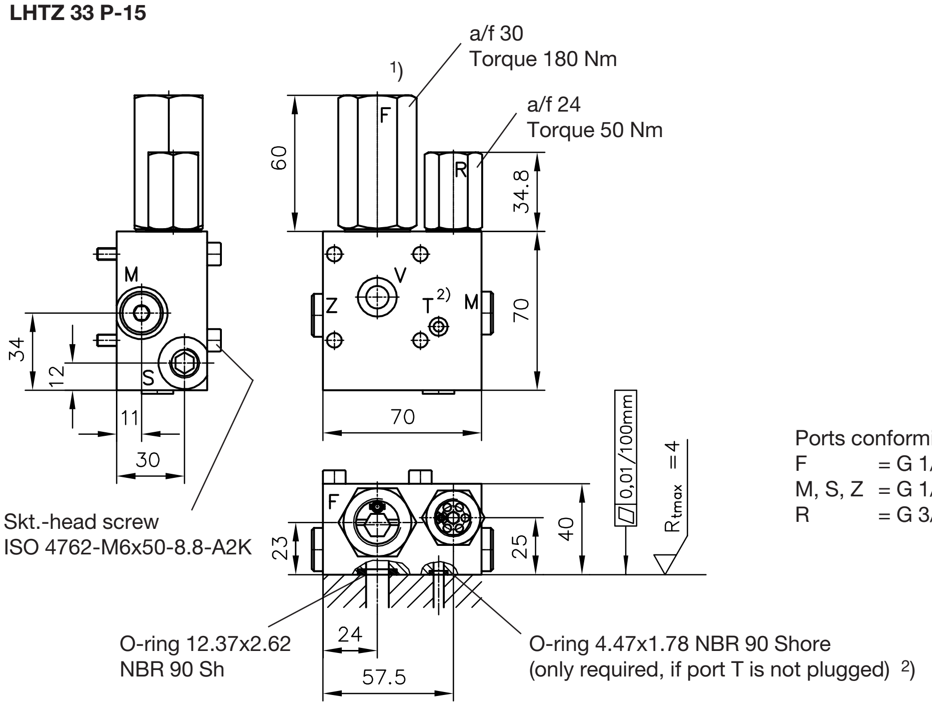
Type LHT 34 G-15



Ports conforming ISO 228/1 (BSPP):
F, V = G 1/2
A, B = G 3/4
M, R = G 1/4

Adjustment of the shock valve only possible via washers (see sect. 3)

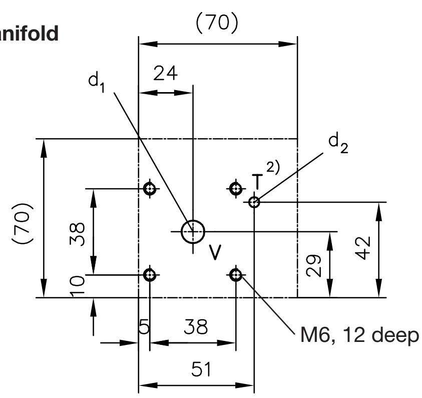
Type LHTZ 33 P-15



Ports conforming ISO 228/1 (BSPP):
F = G 1/2
M, S, Z = G 1/4
R = G 3/8

Hole pattern of the manifold
(top view)

d_1 = max. ∅10
d_2 = max. ∅4

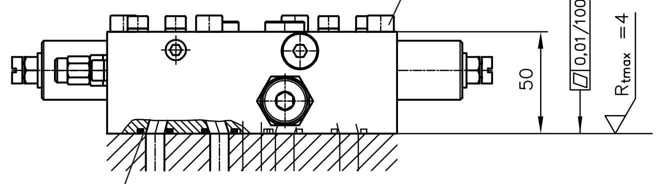


1) **Attention:**
The hexagonal spring housing must be countered while installing the pipe fitting !

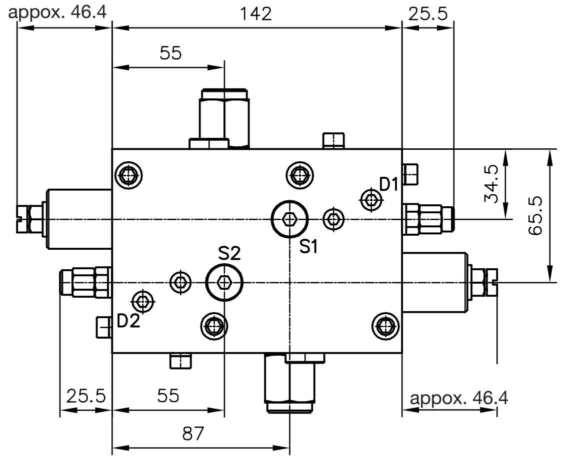
2) Port T is plugged with a grub screw ISO 4027-M4x5-45H and a ball 3 mm DIN 5401 with all standard versions.
A sealing via O-ring is not required.

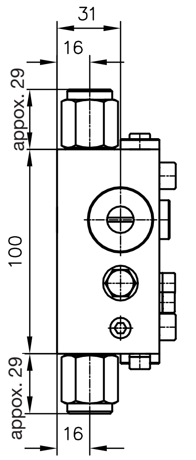
Type LHTZ 30 P-23

Skt.-head screw
ISO 4762-M8x60-A2-70



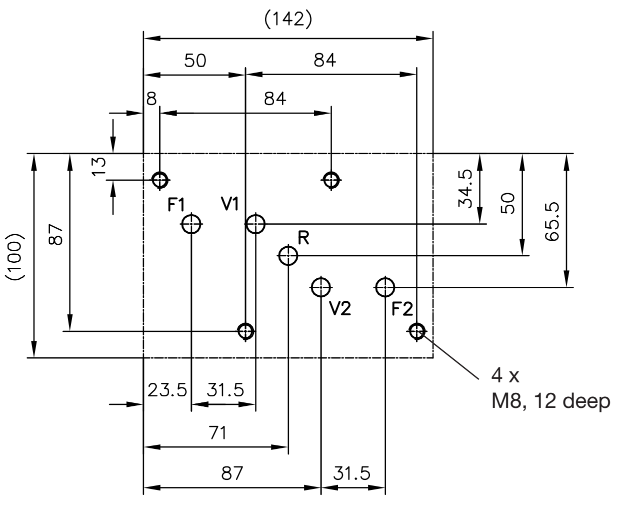
O-ring 12.37x2.62
NBR 90 Sh





Ports conforming
ISO 228/1 (BSPP):
S1, S2 = G 1/4

Hole pattern of the manifold (top view)

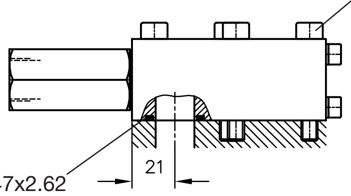


4 x
M8, 12 deep

$d_{F1,\ F2,\ V1,\ V2,\ R}$ = max. ∅10

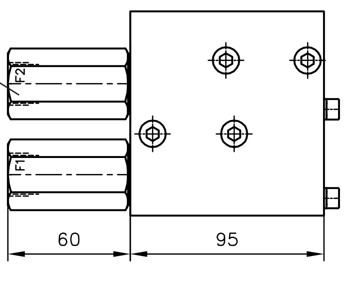
Type LHT 33 OMP-21...

Skt.-head screw
ISO 4762-M8x50-A2-70

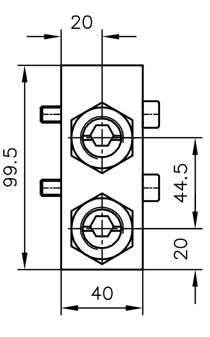


O-ring 23.47x2.62
NBR 80 Sh

a/f 30
Torque
180 Nm

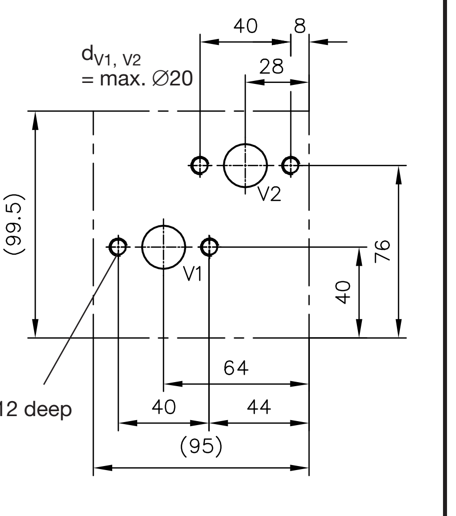


Ports conforming
ISO 228/1 (BSPP):
F1, F2 = G 1/2



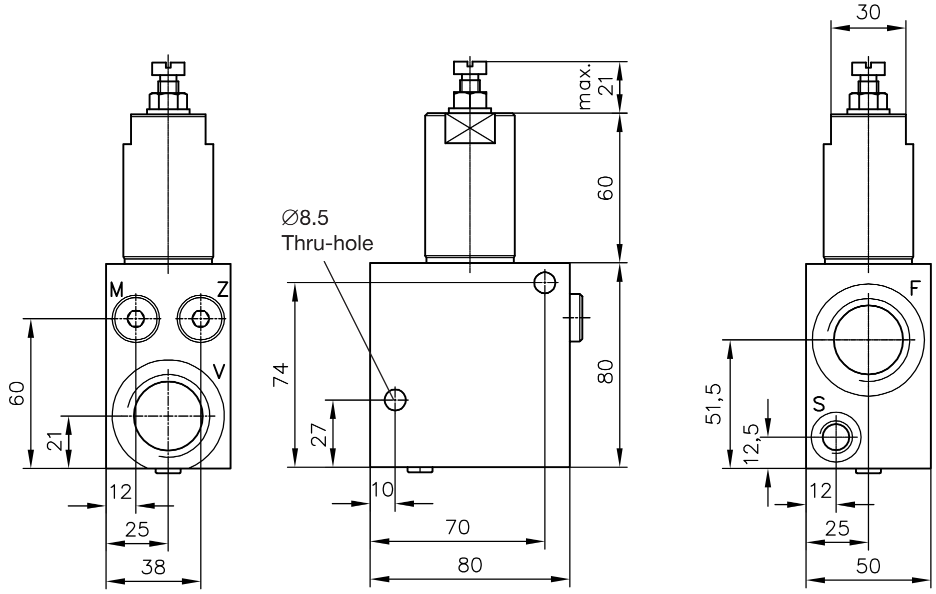
Hole pattern of the manifold (top view)

$d_{V1,\ V2}$
= max. ∅20



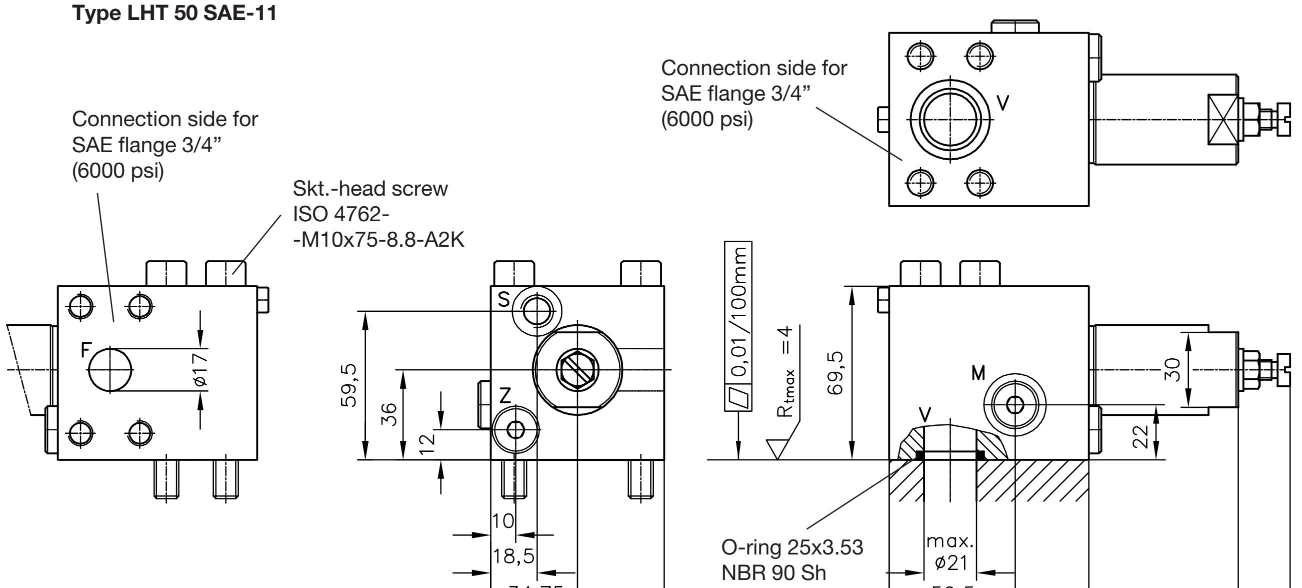
4x
M8, 12 deep

Type LHT 50 G-11



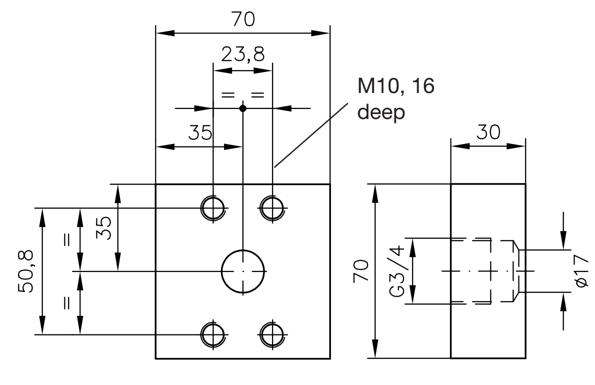
Ports conforming
ISO 228/1 (BSPP):
F, V = G 1
M, S, Z = G 1/4

Type LHT 50 SAE-11

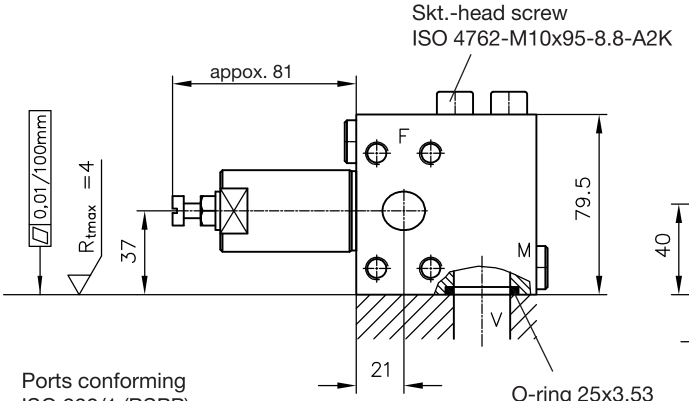


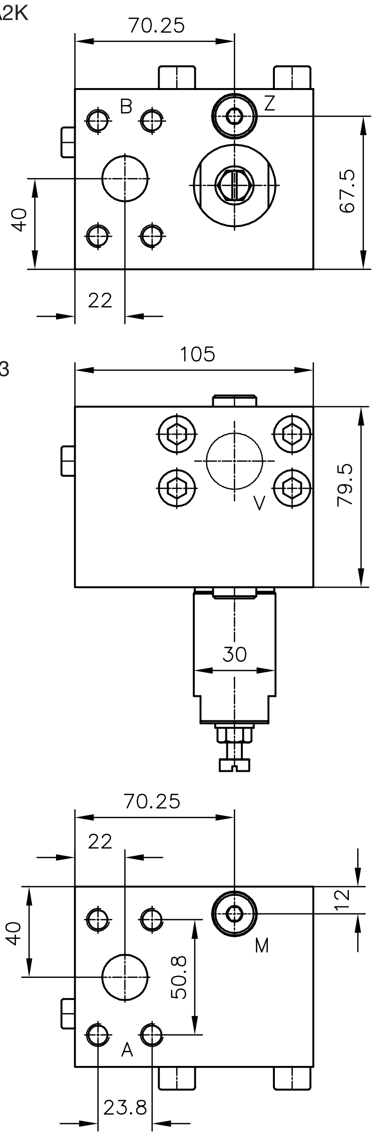
Ports conforming
ISO 228/1 (BSPP):
M, S, Z = G 1/4

Flange enabling pipe connection at V
SAE 3/4" (6000 psi)



Type LHT 50 SAE-14

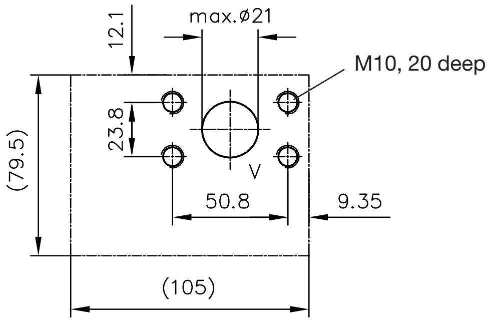




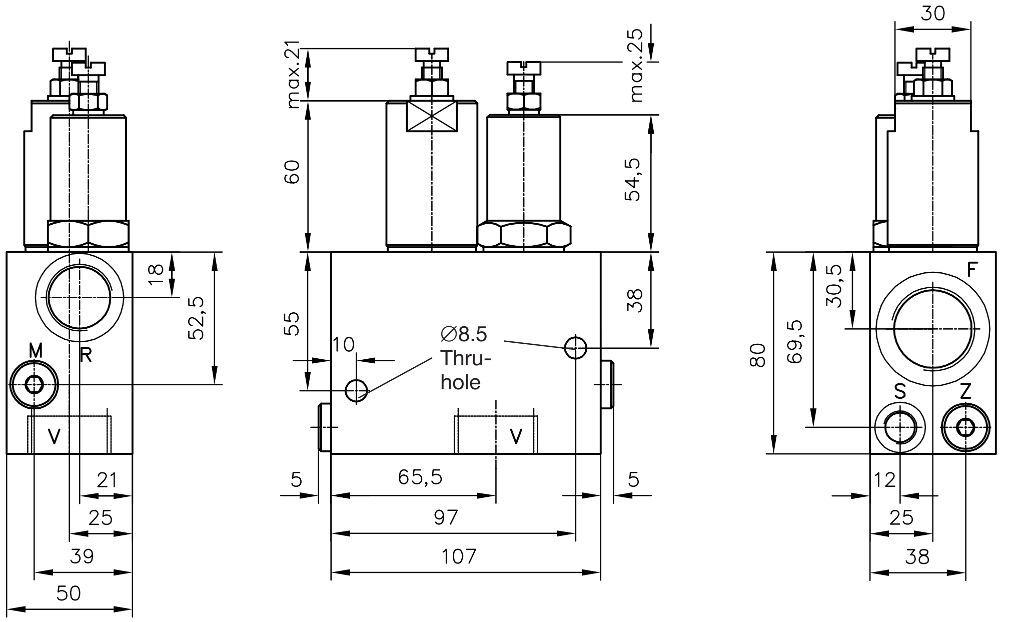
Ports conforming
ISO 228/1 (BSPP):
M, Z = G 1/4

Flange A, B, and F SAE 3/4” (6000 psi)

Flange enabling pipe connection at V

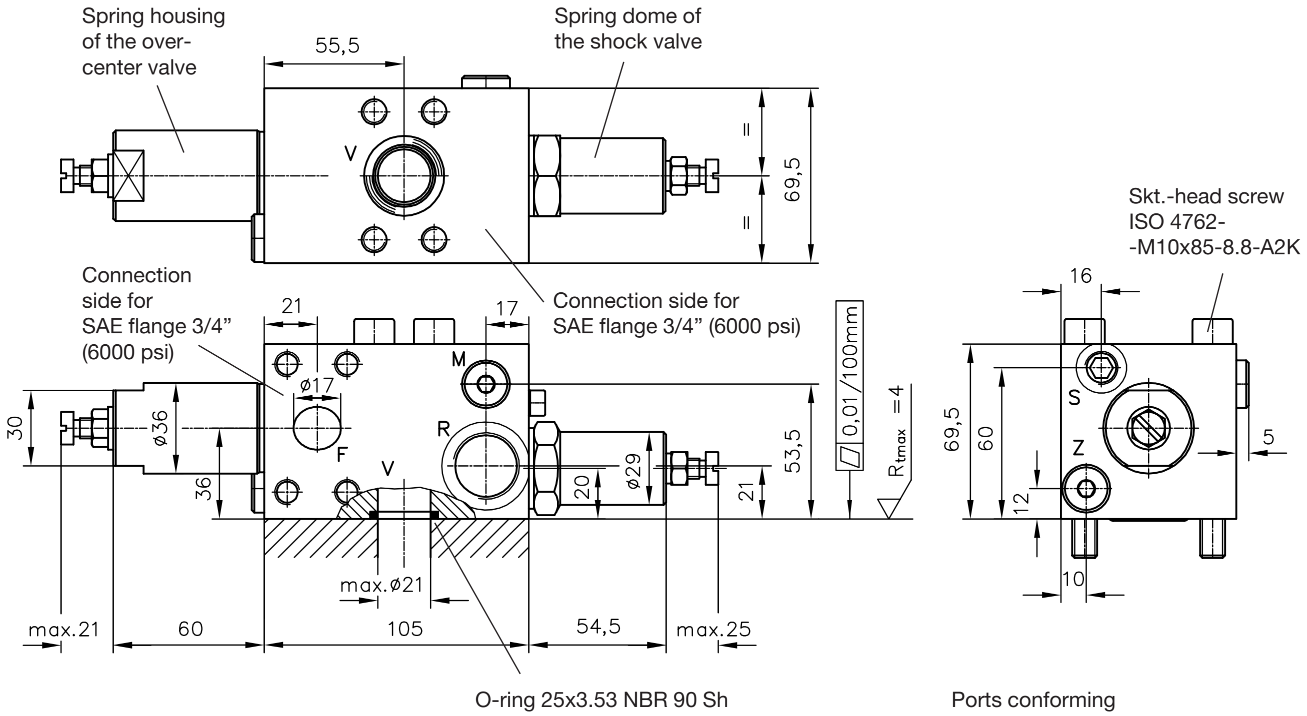


Type LHT 50 G-15



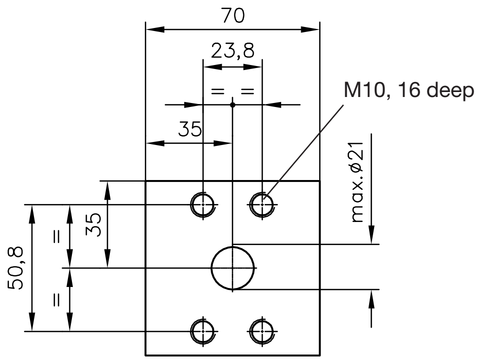
Ports conforming ISO 228/1 (BSPP):
F, V = G 1
R = G 3/4
M, S, Z = G 1/4

Type LHT 50 SAE-15

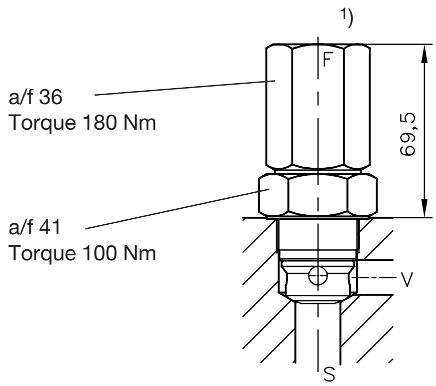


Ports conforming
ISO 228/1 (BSPP):
M, S, Z = G 1/4

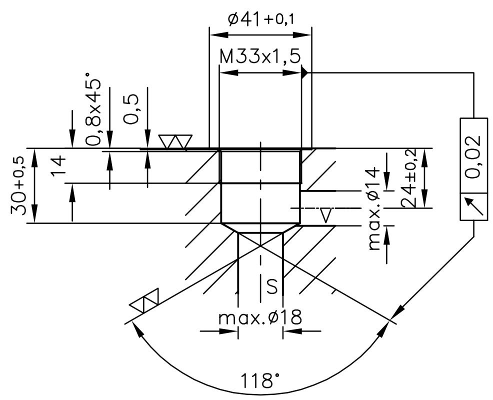
Flange enabling pipe connection at V SAE 3/4" (6000 psi)



4.2 Cartridge valve Typ LHT 3E



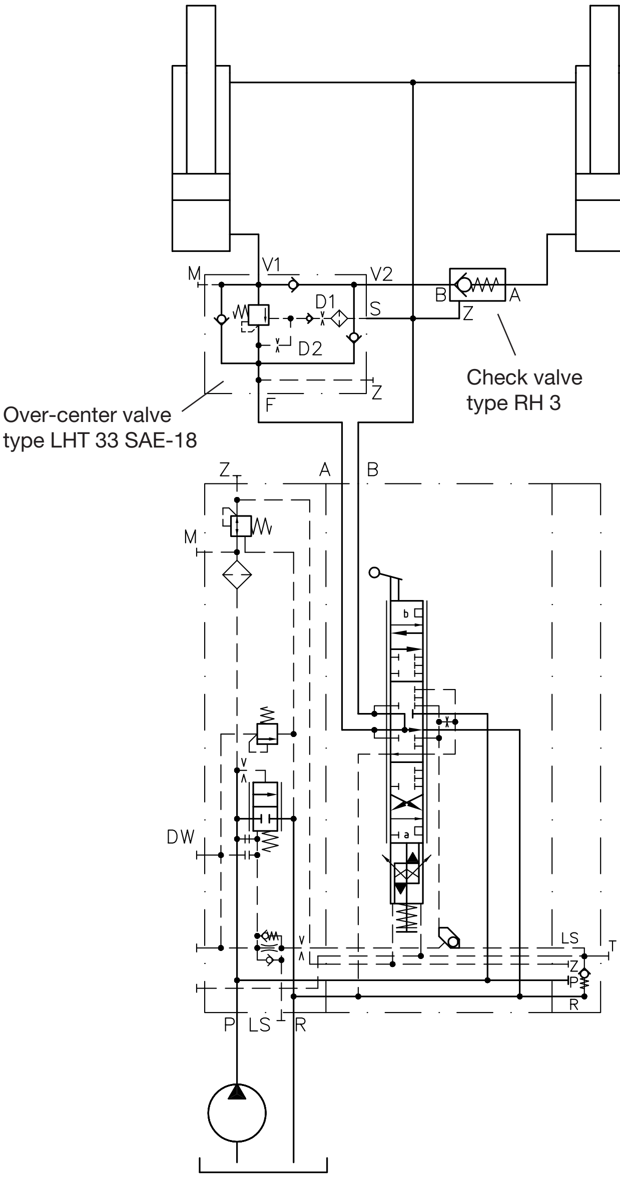
Mounting hole



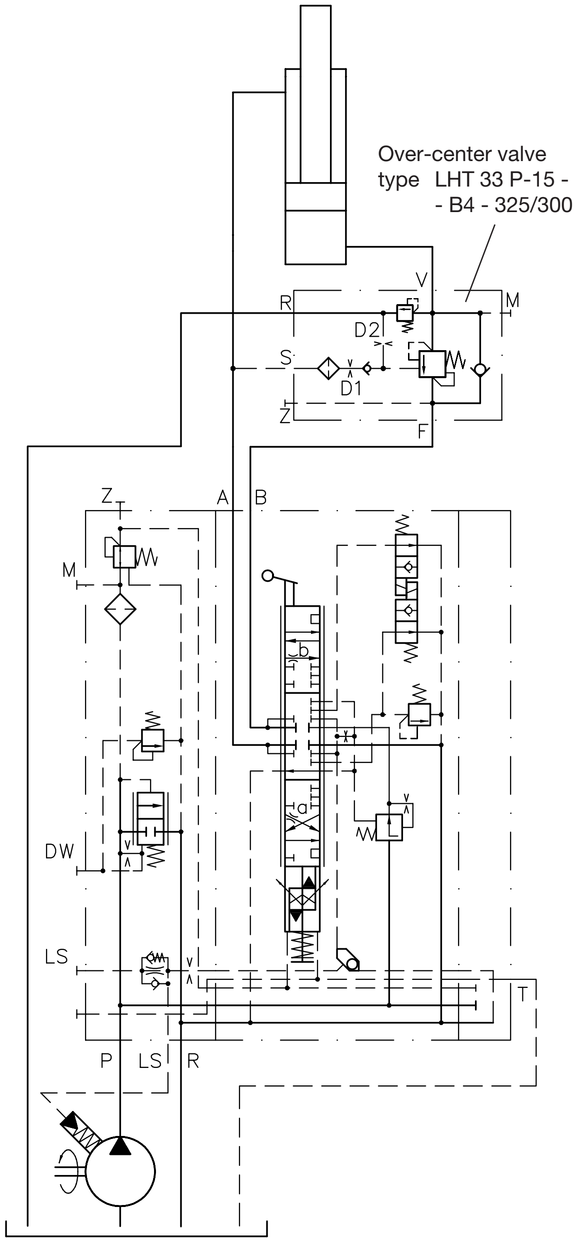
Port F = G 1/2 conforming ISO 228/1 (BSPP)

1) **Attention:**
The hexagonal spring housing must be countered while installing the pipe fitting !

5. Example circuit



Proportional directional spool valve
type PSL 51/400 - 3 - H80/40/EA
- E4 - G 24



Proportional directional spool valve
type PSV 55S1/250 - 3 - J25/60 A100 F3 / EA
- E1 - G 24