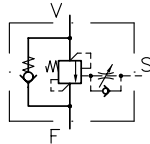


Over-center valves type LHK with hydraulic release, zero leakage

Operation pressure p_{\max} = 400 bar
Flow Q_{\max} = 100 lpm



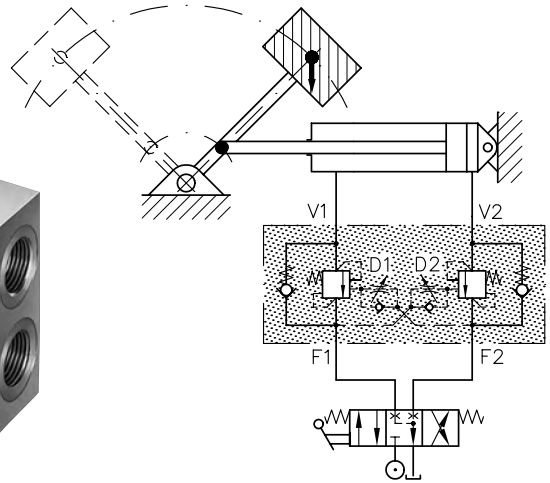
Symbol



Example:
Type LHK 33 G - 11 - 230
for single-sided load direction,
see section 2.1



Example:
Type LHK 33 G - 21 - 320/320
for alternating load directions (like example circuitry),
see section 2.2



1. General

The units included in the pressure valve group in accordance with DIN ISO 1219-1 prevent double-acting consumers (hydraulic cylinders, hydraulic motors) with an attached, pulling or pushing load from moving uncontrollably at high speeds (acceleration), when moving in the load direction that corresponds to the oil inflow (pump) (stalling, oil column torn free).

Example: Any type of lifting and swiveling equipment with change of direction (swiveling over dead point). Cable winch and swing gear motors.

As a side-effect of this, when the directional control valves or directional spool valves are in the neutral position, there is protection against undesired or unauthorized movements of a hydraulic cylinder's piston in the load direction if the directional spool valve controllers are contaminated with leaked oil in the stop position. See section 5.4 for details.

Example: Lifting and push-out cylinders, rotating piston rods and steering racks/pinion swivel cylinder.

Use also possible as relievable servo valves (pressure back valves) for special applications.

Example: For feed cylinders in machine tools, for stamping cylinders in fixtures, in hydraulic synchronizers if the synchronism or parallel working of two hydraulic cylinders is maintained with two equal part delivery currents of the pump etc., also see section 5.3.

See D 7381 for details of other synchronized control operations using flow dividers type TQ.

The over center valves type LHK are intended for all kind of turning, swiveling or rotating devices etc. which are sufficiently stiff and therefore show only a low tendency for oscillations.

For application that heavily tend to low frequent oscillations, especially when used together with prop. control type PSL / PSV acc. to D 7700 ++, type LHDV acc. to D 7770 or type LHT acc. to D 7918 should be used.

The outlet side (return side) of the hydraulic consumer, referred to the load and movement direction, is preloaded with the load holding valve. Depending on requirements, the pressure setting can be selected approx. 15... 25% higher than the highest possible load pressure. When hydraulic cylinders are in the resting state, the good sealing properties ensure that leaking oil from the consumer side cannot travel to a directional spool valve. The good sealing properties also make sure that the load cannot overcome the pre-load pressure or back press, of the valve.

If the hydraulic consumer is set in the „lower load“ direction via the directional control valve, the load cannot set the consumer in motion itself due to the back pressure on the load holding valve (see previous paragraph). Rather, the pump must „push“ on the consumer inflow side. The pressure required for this acts on the unlocking piston in the load holding valve via a control line. The force of the piston is directed against the spring pre-load. This reduces the pressure setting to load pressure. The valve is brought into a throttle operating position (unlocked) and movement of the consumer begins. The pressure on the pump side for moving the load depends on the difference between the set pressure value in the over-center valves and the current load pressure. It also depends on the area ratio in the hydraulic consumer and on the unlocking ratio in the over-center valves. It is only a fraction of the set pressure.

When the consumer is triggered, the valve quickly opens the outlet side so that no pressure intensification can occur and then goes over damped into the load-dependent throttle position. Starting jumps on consumers and associated pitching of the components moved by them are thereby largely suppressed just as they start or quickly die out. This starting behavior is achieved by way of threaded throttles with bypass check valves in the internal control channels. The effectiveness of the threaded throttles can be changes within a certain range and adapted to local requirements.

For additional notes regarding function and application see sect. 5.1

2. Available versions, main data

2.1 Valves for single-sided load direction V → F

For notes regarding the use of the different versions, see sect. 5

For comparison of old and new type coding, see sect. 5.5

Order example: **LHK 22 G - 11H - 180**
LHK 33 G - 15C - 250/220
LHK 44 F - 14W - 200

Table 1:

Pressure setting shock valve p_2 (bar) ²⁾

Pressure setting over-center valve p_1 (bar) ¹⁾

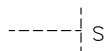
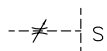
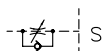
Basic type, size	Dampening characteristic	Symbol and connection mode	Relief ratio	Flow approx. (lpm)	Pressure range p_1 (bar) ¹⁾	Port thread ISO 228/1 (BSPP) F/V, R, A, B ³⁾	Dimensional drawings		
LHK 21	G F	-14	Pipe connection	1 : 4.6	15	50...200	G 1/4	7	
		-14 T						6	
		-14 - 3/8						7	
		-14 T - 3/8						6	
LHK 22	G F U	-11	Pipe connection	1 : 4.6	20	50...200 201...400	G 3/8	1	
		-11 H	V - banjo bold connection					2	
		-11 H16	V - manifold mounting					M 16x1.5 / G 3/8	2
		-11 K -11 P						4	
LHK 227	G F	-11 K	V - manifold mounting	1 : 7		G 3/8	5		
LHK 30	G F	-11 PV -11 C PV	Manifold mounting, external pressure adjustment	1 : 4.4	60	60...130 131...320 321...360	--	3	
LHK 32	G F U	-11	Pipe connection	1 : 4.4	40	60...130 131...320	G 3/8	1	
LHK 33	G F U	-11 -11 C	Pipe connection	1 : 4.4	60	60...130 131...320 321...360	G 1/2	1	
		-11 H	V - banjo bold connection					2	
		-11 K -11 P	V - manifold mounting					4	
		-14 -14 W	Pipe connection					7	
		-15 ²⁾ -15 C ²⁾	Pipe connection					9	
		-17 OMR -17 OMT -17 OMV	V - manifold mounting					10/11	
LHK 333	G F U	-11 K	V - manifold mounting	1 : 3			4		
LHK 337		-11	Pipe connection	1 : 7			1		
		-11 K -11 P	V - manifold mounting					4	
LHK 40	G F	-11 PV -11 C PV	Manifold mounting, external pressure adjustment	1 : 4.4	100		--	3	
LHK 43	G F	-14	Pipe connection	1 : 4.4	80		G 3/4 / G 1/2	7	
LHK 44	G F U	-11 -11 C	Pipe connection	1 : 4.4	100	60...130 131...350	G 3/4	1	
		-11 P	V - manifold mounting					4	
		-14 -14 W	Pipe connection					7	
		-14 W M1C	V - manifold mounting					8	
		-15 ²⁾ -15 C ²⁾	Pipe connection					9	

Dampening characteristic

G = Dampened via throttle/check valve combination (adjustable throttle screw)

F = Simple dampening via adjustable throttle screw

U = no dampening

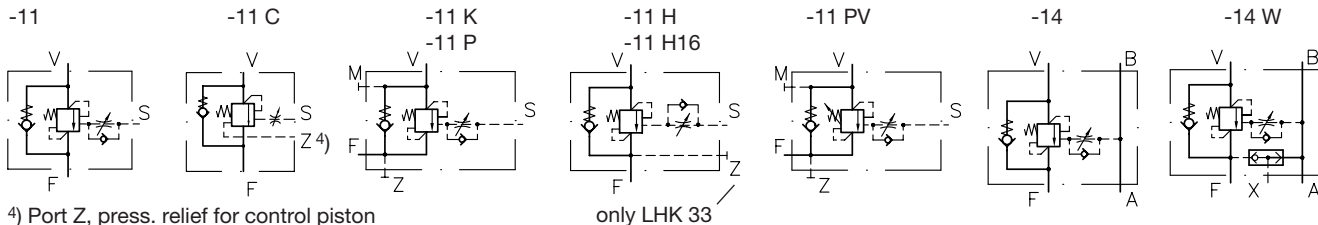


¹⁾ Various pressure ranges (pressure springs) according to the specified pressure.

²⁾ Pressure setting for shock valve $p_{2\max} \leq 340$ bar (Pressure range: 150...250 bar and 251...340 bar)

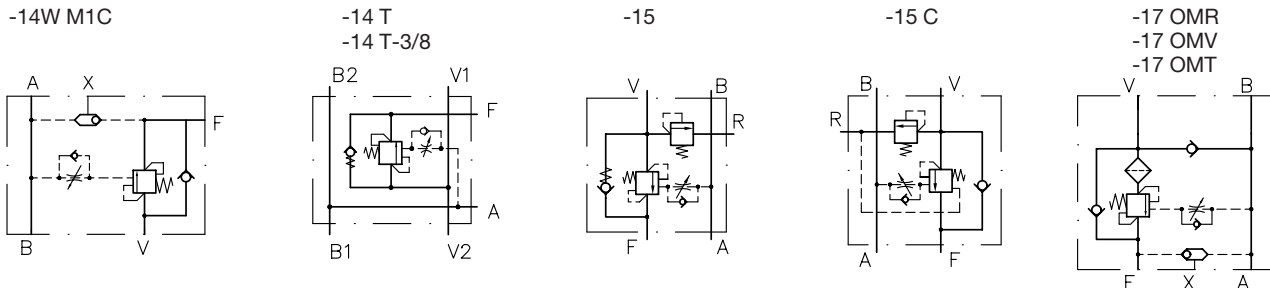
³⁾ Port thread M, S, X, Z see dimensional drawings section 4 ++

Symbols for section 2.1



4) Port Z, press. relief for control piston

only LHK 33



2.2 Valves for alternating load directions (crossing the dead center, see illustration on page 1)

Order example:

LHK 22 G - 21 - 220/220
LHK 33 G - 25WD - 280/280 - 260/260
LHK 44 F - 21 - 180/180

Pressure setting shock valve p₄ (bar) ²⁾

Pressure setting shock valve p₃ (bar) ²⁾

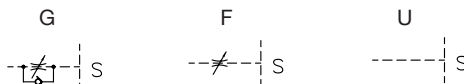
Pressure setting over-center valve p₂ (bar) ¹⁾

Pressure setting over-center valve p₁ (bar) ¹⁾

Table 2:

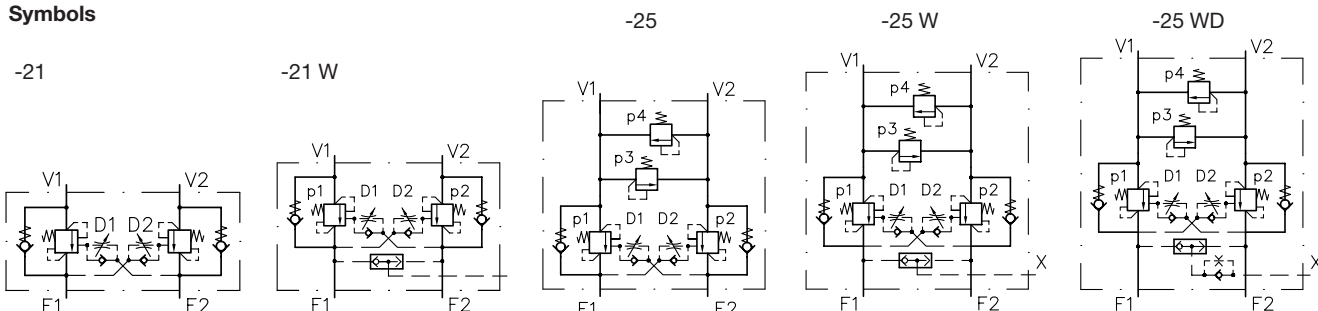
Basic type, size	Dampening characteristic	Symbol and connection mode	Relief ratio	Flow approx. (lpm)	Pressure range (bar) ¹⁾	Port thread ISO 228/1 (BSPP) F, V, R, A, B ³⁾	Dimensional drawings	
LHK 22	G F U	-21	Pipe connection	1 : 4.6	20	50...200 201...400	G 3/8	12
LHK 33	G F U	-21	Pipe connection	1 : 4.4	60	60...130 131...320 321...360	G 1/2	12
		-25						13
		-25 WD						13
LHK 337	G F U	-21	Pipe connection	1 : 7	100	60...130 131...350	G 3/4	12
		-25						13
LHK 44	G F U	-21 -21 W	Pipe connection	1 : 4.4	100	60...130 131...350	G 3/4	12
LHK 447	G F U	-21	Pipe connection	1 : 7	100	60...130 131...350	G 3/4	12

Dampening characteristic
G = Dampened via throttle/check valve combination (adjustable throttle screw)
F = Simple dampening via adjustable throttle screw
U = no dampening



- 1) Various pressure ranges (pressure springs) according to the specified pressure.
- 2) Pressure setting for shock valve p₃, p_{4 max} ≤ 400 bar (Pressure range: 0...160 bar, 161...315 bar, 316...400 bar)
- 3) Port X = G 1/4

Symbols



2.3 Over-center valve cartridges

The over-center valve cartridges are available individually for customer furnished base bodies featuring ducts V and S. Therefore function test and pressure setting have to be carried out after assembly on site. For notes regarding the adjustment, see „Pressure adjustment“ in sect. 3 and sect. 4.3. A specification of the intended load pressure is necessary for a pre-selection of the pressure spring.

The restrictor check valve type FG2 (acc. to D 7275) is used best for damping the control piston (port A = control piston side, port B = control inflow).

Order example:

LHK 21 - 180

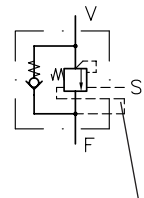
LHK 30 V - 260

LHK 447 - 120

Table 3:

A specification of the intended load pressure p_1 (bar) is necessary for a pre-selection of the pressure spring.

Basic type, size	Relief ratio	Flow approx. (lpm)	Pressure range (bar) ¹⁾ p_1	Port thread (BSPP)	Utilized symbol	Dimensional drawings
LHK 20 V	1 : 4.6	15	50...200	2) --	---	17
LHK 21				G 1/4	14.	14
LHK 22		20	50...200 201...400	G 3/8	11., 21	14
LHK 227	1 : 7				11.	14
LHK 30 V	1 : 4.4	60	60...130 131...320 321...360	2) --	11 PV, 11 CPV	18
LHK 32		40	60...130 131...320	G 3/8	11	15
LHK 33		60	60...130 131...320 321...360	G 1/2	11., 14., 15., 17., 21., 25.	15
LHK 33 S	11 SK				20	
LHK 33 SL	21 SL				15	
LHK 337	1 : 7				11., 21, 25	15
LHK 40 V	1 : 4.4	100	60...130 131...350	2) --	11 PV, 11 CPV	19
LHK 44				G 3/4	11., 14., 15., 21.,	16
LHK 447					21	16



Connection hole Y see dimensional drawings sect. 4.3

1) Various pressure ranges (pressure springs) according to the specified pressure.

2) All ports are in the manifold. The pressure is adjustable after loosening the lock nut.

3. Further data

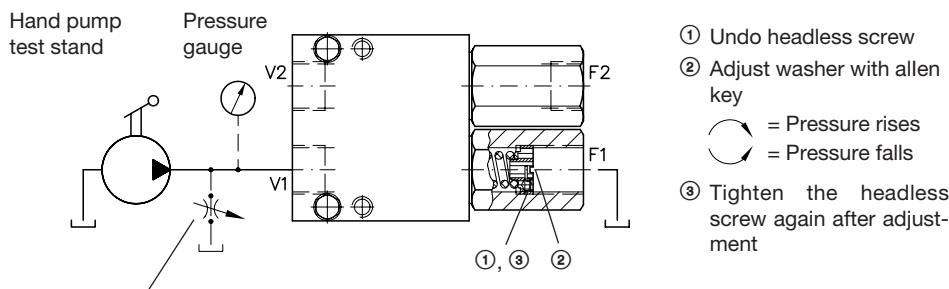
Designation	Over-center valve, with hydraulic relief, with bypass check valve
Design	Pressure valve part (load holding valve): Ball or cone seated valve Bypass check valve: Plate seated valve
Mounting	Depending on type, see dimensional drawings in sect. 4
Installation position	Any
Connections	F, F1, F2; V, V1, V2; A, B and R = Main connections, depending on type S, X and M = Control and measuring connections, depending on type All connections can be loaded with full operating pressure.
Flow direction	Operating direction (load holding function) V → F, V1 → F1, V2 → F2 flow F → V, F1 → V1, F2 → V2
Unlocking ratio	See Table 1, 2 and 3; section 2.1 to 2.3 The relief pressure is 0.23 x (set pressure - load pressure) for 1 : 4.4 0.22 x (set pressure - load pressure) for 1 : 4.6 0.14 x (set pressure - load pressure) for 1 : 7

The area ratio for hydraulic cylinders is included in the calculation.

Pressure setting

Self-performed pressure setting or modification only with simultaneous pressure gauge monitoring!
The given pressure change valves per revolution or per mm adjustment distance on the washer in connection F (F1 and F2) are reference valves for approx. determining the desired operating point.

Type	LHK 20		LHK 21		LHK 22		LHK 30			LHK 32		LHK 33 LHK 337			LHK 40		LHK 43 LHK 44		LHK 447	
Pressure range to ... (bar)	200	400	200	200	400	400	130	320	360	130	320	130	320	360	130	350	160	350	200	400
Pressure change per revolution (bar/rev.)	18	75	55	24	100	100	22	24	30	46	62	63	85	87	31	47	45	70	72	112
approx. per mm distance (bar/mm)	18	75	45	18	75	75	17	19	24	36	46	36	46	48	25	38	25	38	40	60



Bypass throttle valve required for motor pump test stand. Set pump to circulation via open throttle valve and then slowly close the throttle valve until the over-center valve responds directly (avoid excessive flow rates, otherwise valve squeaks).

Pressure fluid

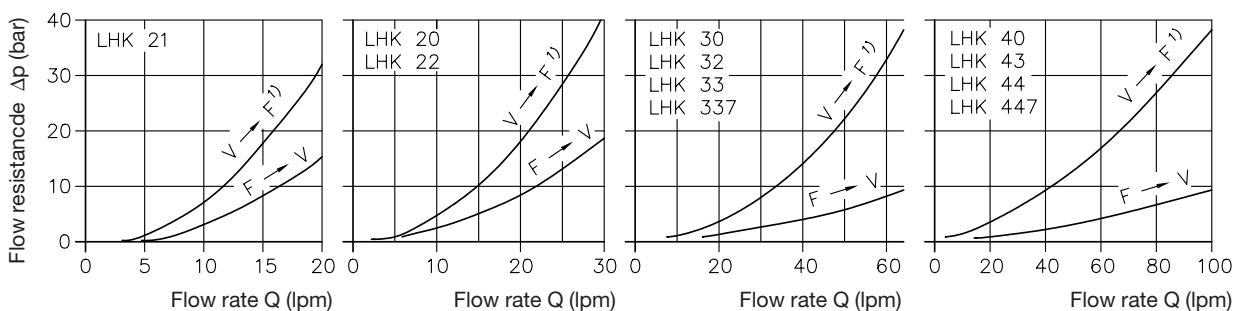
Hydraulic oil conforming DIN 51524 part 1 to 3: ISO VG 10 to 68 conforming DIN 51519.
Viscosity limits: min. approx. 4, max. approx. 1500 mm²/s;
opt. operation approx. 10... 500 mm²/s.
Also suitable for biological degradable pressure fluids types HEPG (Polyalkylenglycol) and HEES (Synth. Ester) at service temperatures up to approx. +70 °C.

Temperature

Ambient: approx. -40 ... +80 °C
Fluid: -25 ... +80°C, Note the viscosity range!
Permissible temperature during start: -40°C (Note start-viscosity!), as long as the service temperature is at least 20K higher for the following operation.
Biological degradable pressure fluids: Note manufacturer's specifications. By consideration of the compatibility with seal material not over +70 °C.

Δp -Q-characteristics, recommended valves

In the case of customer-furnished housings (connection side F), the flow resistance may differ depending on the configuration of the oil channels.

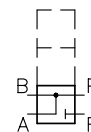


Oil viscosity during the measurements approx. 50 mm²/s

1) fully de-blocked

Functional restriction:

Load-holding valves cannot be used in conjunction with directional spool valves which show the flow diagram of the differential circuit in any operating position, e.g. with code letter C, Y in accordance with D 5650/1 or D 5700. The over-center valves with symbol -15 should not be connected to the rod side of the cylinder. Only exception are symbols -11C and -15C with external control piston relief (port Z).

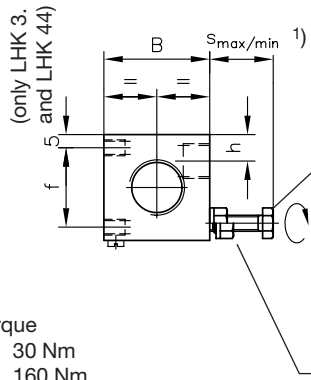
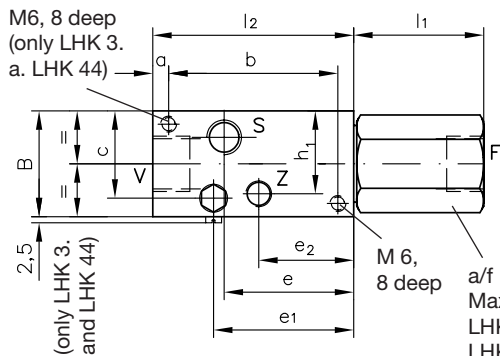


4. Dimensions

All dimensions are in mm, subject to change without notice!

4.1 Valves for single-sided load direction V → F

Dimensional drawings 1: Type LHK ... - 11 - ...
LHK ... - 11 C - ...



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

Max. torque
LHK 22: 30 Nm
LHK 3.: 160 Nm
LHK 44: 180 Nm

Attention:

If necessary, include the following instructions with diagram in the operating manual or operating instructions of the system:

Throttle screw a/f 3 (LHK 22) resp. a/f 10 (LHK 3., LHK 44) for valve damping.
Throttle effect increases (clockwise rotation)

Caution:

Do not turn the throttle screw beyond the maximum measurement shown in the dimensional drawings. It cannot be structurally safeguarded inside the units.

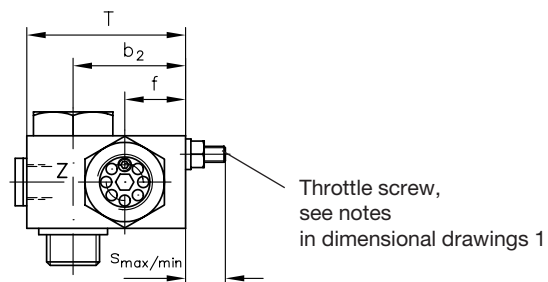
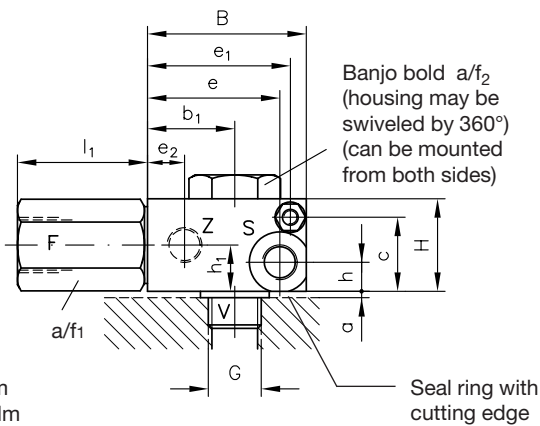
Before adjusting the throttle screw, loosen the locknut a/f 10 (seal locknut) sufficiently so that the vulcanized - on sealing ring is not damaged by the thread!

1) Omitted with dampening version „U“

Type	Ports			B	l ₁	l ₂	a	b	c	e	e ₁	e ₂	f	h	h ₁	a/f	s		Mass (weight) approx. kg
	V, F	S	Z														min	max	
LHK 22(7) - 11 - ...	G 3/8	G 1/8	--	32	40	57	--	--	25	35	35	--	--	8	--	22	8	17	0.5
LHK 32 - 11 - ...	G 3/8	G 1/4	--	40	49	74	5	64	33	49	53	--	30	10	--	30	14	24	1.0
LHK 33(7) - 11 - ...	G 1/2	G 1/4	--	40	49	76	5	64	33	49	53	--	30	10	--	30	14	24	1.0
LHK 33(7) - 11 C	G 1/2	G 1/4	G 1/8	40	49	76	5	64	33	49	53	37	30	10	31	30	14	24	1.0
LHK 44(7) - 11 - ...	G 3/4	G 1/4	--	45	90	80	6	70	39.5	51.5	55	--	35	21	--	36	14	24	1.6
LHK 44(7) - 11 C - ...	G 3/4	G 1/4	G 1/8	45	90	80	6	70	39.5	51.5	55	38	35	21	36	36	14	24	1.6

Ports G... = (BSPP)

Dimensional drawings 2: Type LHK ... - ... H
LHK ... - ... H16



Max. torque
LHK 22: 30 Nm
LHK 33: 160 Nm

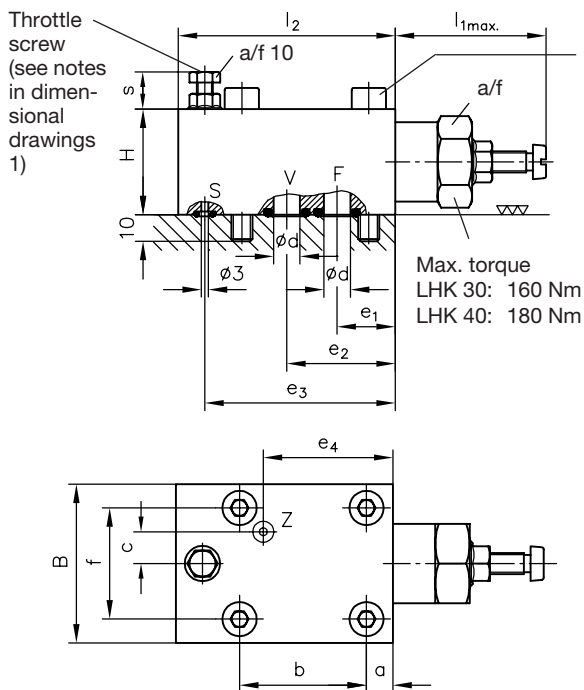
Attention:
The hexagonal spring housing must be countered while installing the pipe fitting!

Type	Ports			G	B	H	T	l ₁	a	b ₁	b ₂	c	e	e ₁	e ₂	f	h	
	F	S	Z															
LHK 22...-H	G 3/8	G 1/4	--	G 3/8 A	40	25	60	40	4.5	26	46	13	10	35	--	30	12.5	--
LHK 22...-H16	G 3/8	G 1/4	--	M16x1.5	40	25	60	40	4.5	26	46	13	10	35	--	30	12.5	--
LHK 33...-H	G 1/2	G 1/4	G 1/4	G 1/2 A	60	35	60	52	2.4	33	42.5	28	50	54	14	23	11	17.5

Type	a/f ₁	a/f ₂	min	s max	Mass (weight) approx. kg	Seal ring with cutting edge
LHK 22...-H16	22	27	8	17	0.6	ERMETO DKA 3/8
LHK 33...-H	30	30	6	15	1.0	ERMETO DKA 1/2

Ports G... = (BSPP)

Dimensional drawings 3: **Type LHK ... - 11 PV**
LHK ... - 11 CPV



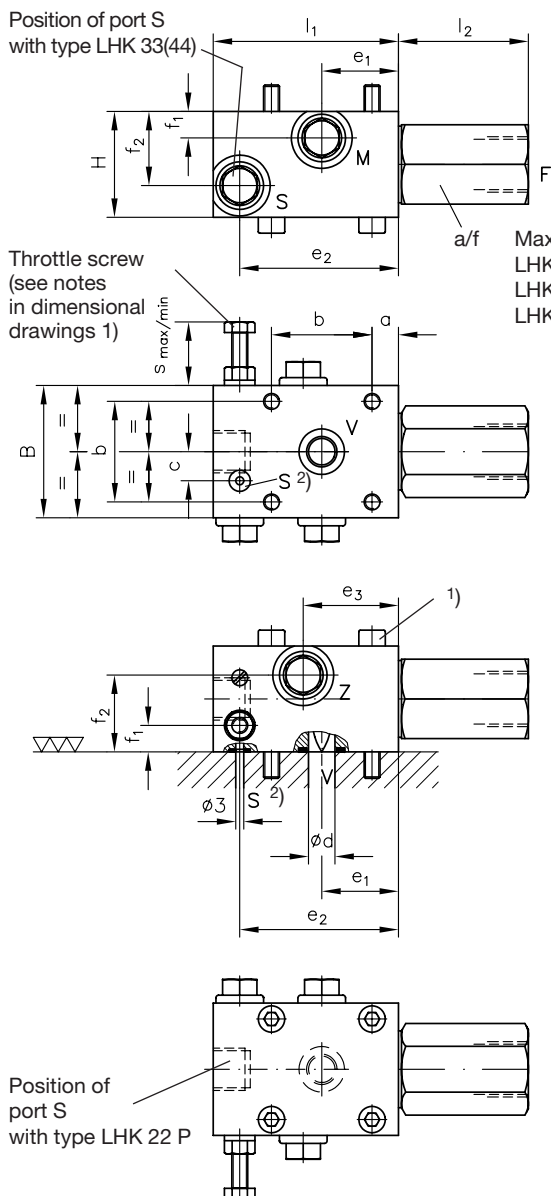
Socket-head screws
LHK 33: M 8x50 DIN 912-8.8
LHK 44: M 8x60 DIN 912-8.8

Type l ₂	O-rings NBR 90 Shore at ports		B	H	l ₁	
	F and V	S and Z				
LHK 30 -11 (C)PV	12.37 x 2.62	4.47 x 1.78	60	40	57	82
LHK 40 -11 (C)PV	17.12 x 2.62	4.47 x 1.78	62	50	85	80

Type	a	b	c	Ød	e ₁	e ₂	e ₃
LHK 30 -11 PV	10	48	--	10	22	41	72
LHK 30 -11 CPV	10	48	12	10	22	41	72
LHK 40 -11 PV	17	50	--	14	28.5	52.5	74
LHK 40 -11 CPV	17	50	15	14	28.5	52.5	74

Type	e ₄	f	a/f	s		Mass (weight.) approx. kg
				min	max	
LHK 30 -11 PV	--	42	30	14	24	1.5
LHK 30 -11 CPV	49	42	30	14	24	1.5
LHK 40 -11 PV	--	48	36	12	24	1.8
LHK 40 -11 CPV	60	48	36	12	24	1.8

Dimensional drawings 4: **Type LHK ... - 11 P**
Type LHK ... - 11 K



- 1) Socket-head screws
LHK 22: M 6x35 DIN 912-8.8
thread depth 8 mm
LHK 33: M 6x50 DIN 912-8.8
thread depth 11 mm
LHK 44: M 8x60 DIN 912-8.8
thread depth 14 mm

- 2) Port S on flange side
only with type
LHK 33 (333, 337) .. - 11 K

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

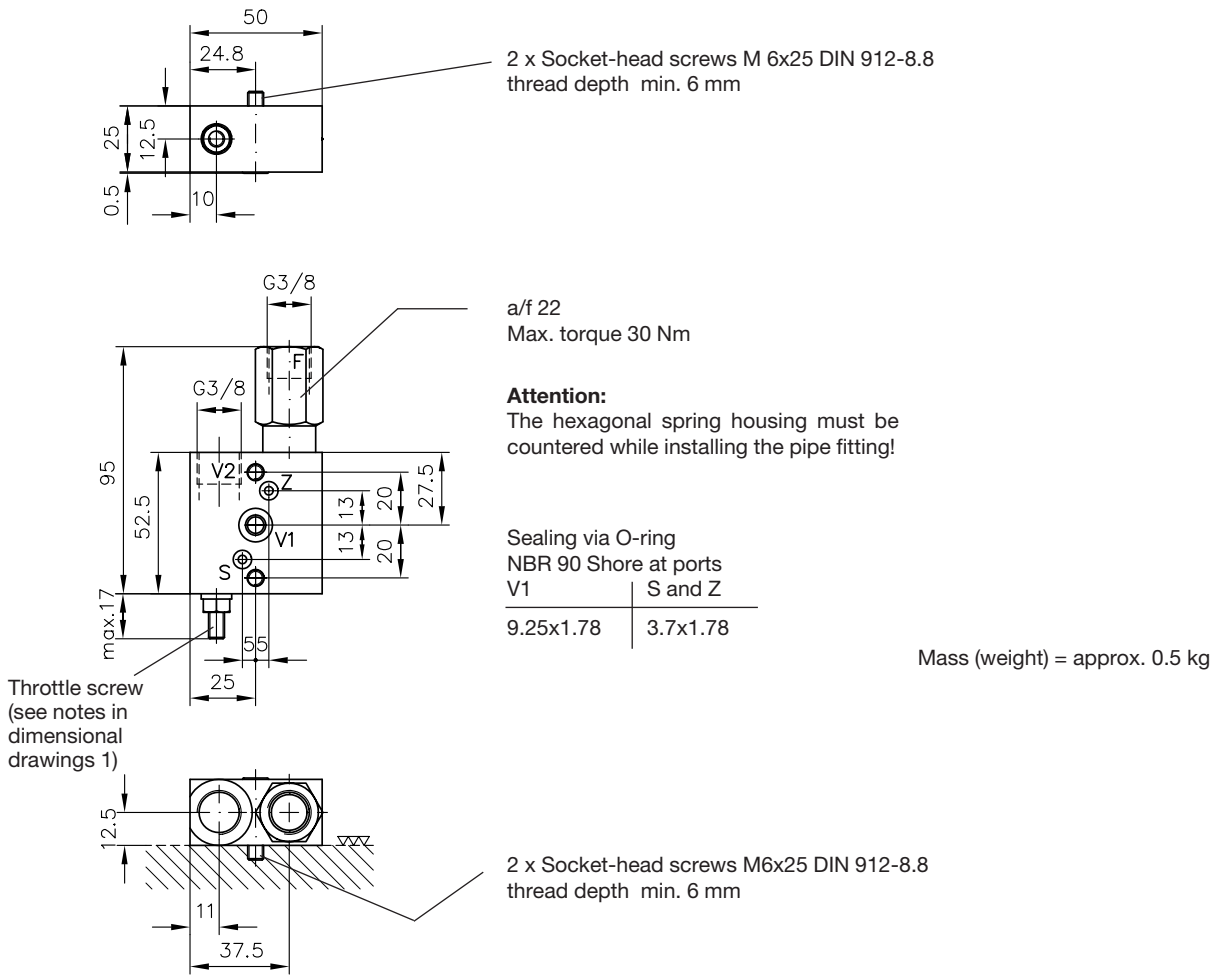
Ports G... = (BSPP)

Type	Ports			O-rings NBR 90 Shore at ports	
	F	S	M, Z	F and V	S and Z
LHK 22	G 3/8	G 3/8	--	10.77 x 2.62	--
LHK 33 (333, 337)	G 1/2	G 1/4	G 1/4	12.37 x 2.62	4.47 x 1.78
LHK 44	G 3/4	--	--	15.55 x 2.62	4.47 x 1.78

Type	B	H	l ₁	l ₂	a	b	c	Ød	e ₁	e ₂	e ₃
LHK 22	40	28	70	40	9.5	28	--	8	23.5	--	--
LHK 33 (333, 337)	50	40	70	49	10	38	11	10	29	60	36
LHK 44	60	48	90	60	18	28	0	14	33	54.5	--

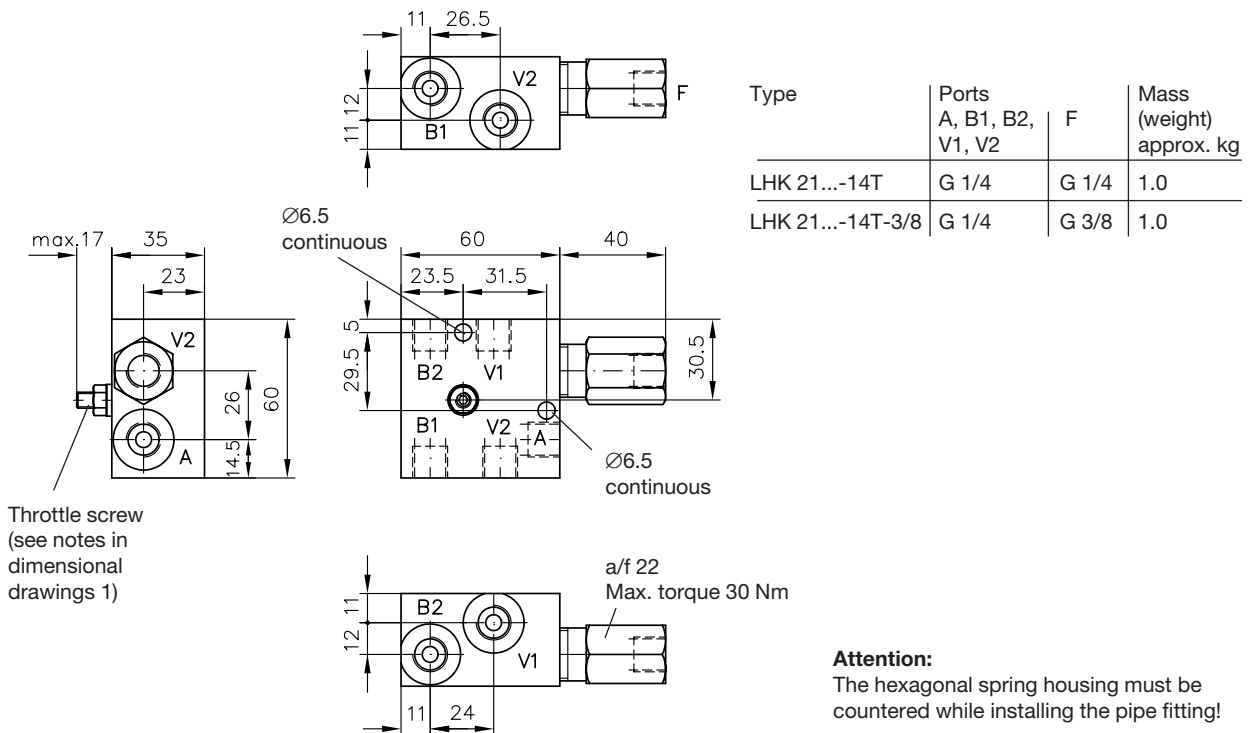
Type	f ₁	f ₂	a/f	s		Mass (weight) approx. kg
				min	max	
LHK 22	14	--	22	8	15	0.6
LHK 33 (333, 337)	10	28	30	14	24	1.0
LHK 44	12	--	36	12	24	2.0

Dimensional drawings 5: **Type LHK 22 ... - 11 K**



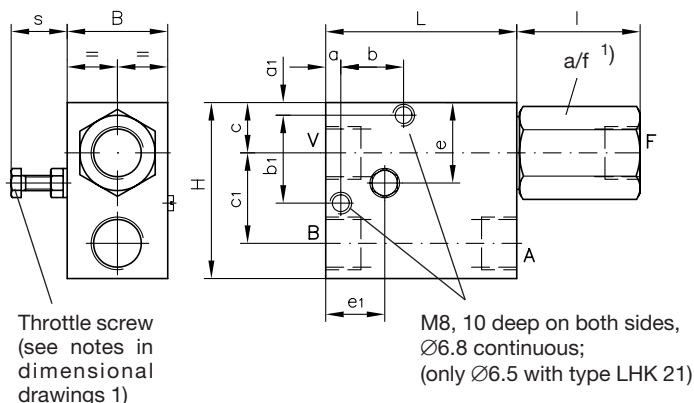
Dimensional drawings 6: **Type LHK 21 ... - 14 T**
LHK 21 ... - 14 T - 3/8

Ports G... = (BSPP)

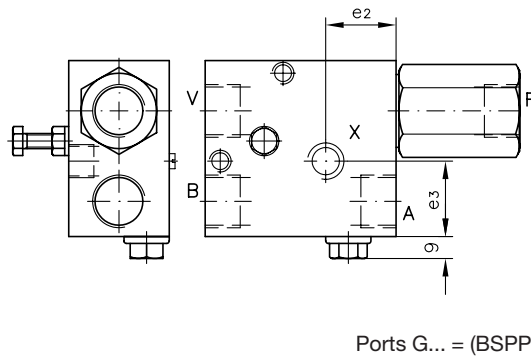


Dimensional drawings 7: **Type LHK 21 ... - 14 - ...**
LHK 21 ... - 14 - 3/8
LHK 33 ... - 14 - ...
LHK 43 ... - 14 - ...
LHK 44 ... - 14 - ...

Type LHK 33 G-14W -...
LHK 44 G-14W -...



For missing dimensions, see illustration



Type	Ports A, B	F/V	X	B	H	L	I	a	a1	b	b1	c	c1	e	e1	e2	e3	a/f
LHK 21.. - 14 LHK 21.. - 14 - 3/8	G 1/4	G 1/4 / G 3/8	--	35	50	57	40	10	28.5	30	0	11.5	28	24.5	22	--	--	22
LHK 33.. - 14 (W)	G 1/2	G 1/2	G 1/4	40	70	76	49	6	5	25	35	20	36	32	23.5	28	30	30
LHK 43.. - 14	G 1/2	G 3/4	--	50	80	80	90	7	6	26	40	23	40	46	25.5	--	--	36
LHK 44.. - 14 (W)	G 3/4	G 3/4	G 1/4	50	85	80	90	7	8	26	40	23	44	48	25.5	32	37	36

Type	s		Mass (weight) approx. kg
	min	max	
LHK 21.. - 14 LHK 21.. - 14 - 3/8	12	17	0.7
LHK 33.. - 14 (W)	15	24	1.6
LHK 43.. - 14	14	25	2.6
LHK 44.. - 14 (W)	14	25	2.6

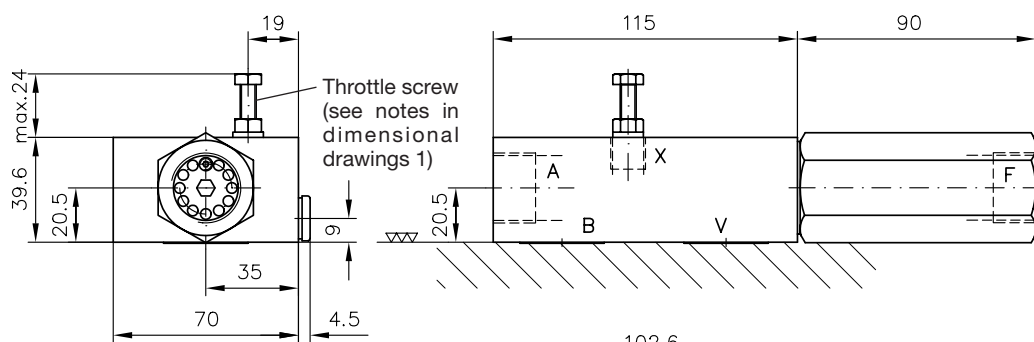
1) Max. torque

- LHK 21: 30 Nm
- LHK 33: 160 Nm
- LHK 43, 44: 180 Nm

Attention:

The hexagonal spring housing must be countered while installing the pipe fitting!

Dimensional drawings 8: **Type LHK 44 ... - 14W M1C**

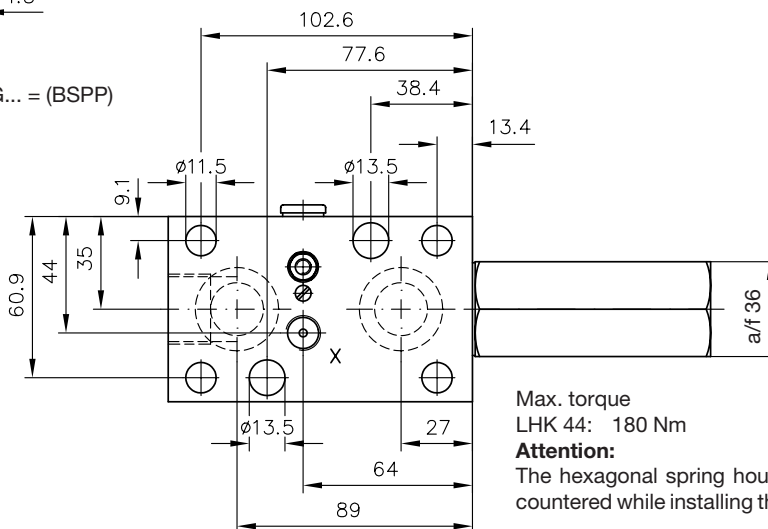


Port thread
 F and A = G 3/4
 X = G 1/4

Ports G... = (BSPP)

Sealing via O-ring at ports B and V:
 26.64 x 2.62

Mass (weight) = approx. 2.5 kg



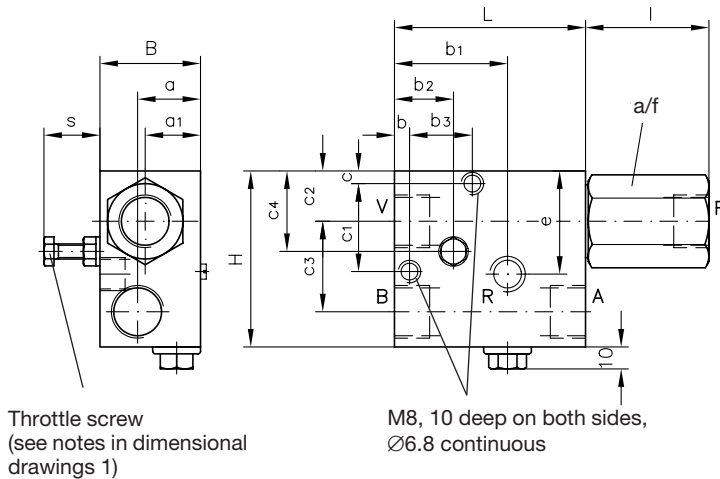
Max. torque

LHK 44: 180 Nm

Attention:

The hexagonal spring housing must be countered while installing the pipe fitting!

Dimensional drawings 9: **Type LHK 33 ... - 15(C)**
LHK 44 ... - 15(C)



Throttle screw
(see notes in dimensional drawings 1)

M8, 10 deep on both sides,
Ø6.8 continuous

Max. torque
LHK 33: 160 Nm
LHK 44: 180 Nm

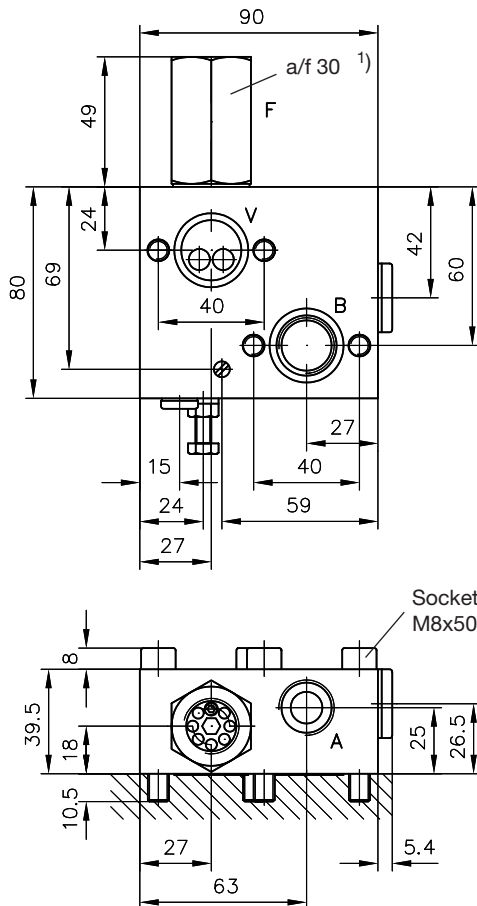
Attention:
The hexagonal spring housing must be countered while installing the pipe fitting!

Ports G... = (BSPP)

Type	Ports		R	B	H	L	l	a	a1	b	b1	b2	b3	c	c1	c2	c3	c4	e
	A, B, F and V																		
LHK 33 G - 15(C)	G 1/2		G 1/4	40	70	76	49	25	22	6	46	23.5	25	5	35	20	36	32	47
LHK 44 G - 15(C)	G 3/4		G 1/4	50	85	80	90	25	25	7	42.5	25.5	26	8	40	23	44	48	52.5

Type	a/f	s		Mass (weight) approx. kg
		min	max	
LHK 33 G - 15(C)	30	13	22	1.6
LHK 44 G - 15(C)	36	19	28	2.6

Dimensional drawings 10: **Type LHK 33 ... - 17 OMR**



Socket-head screws
M8x50 DIN 912-8.8

1) Max. torque
LHK 33: 160 Nm

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

Sealing via O-ring
at ports V and B:
23.47 x 2.62

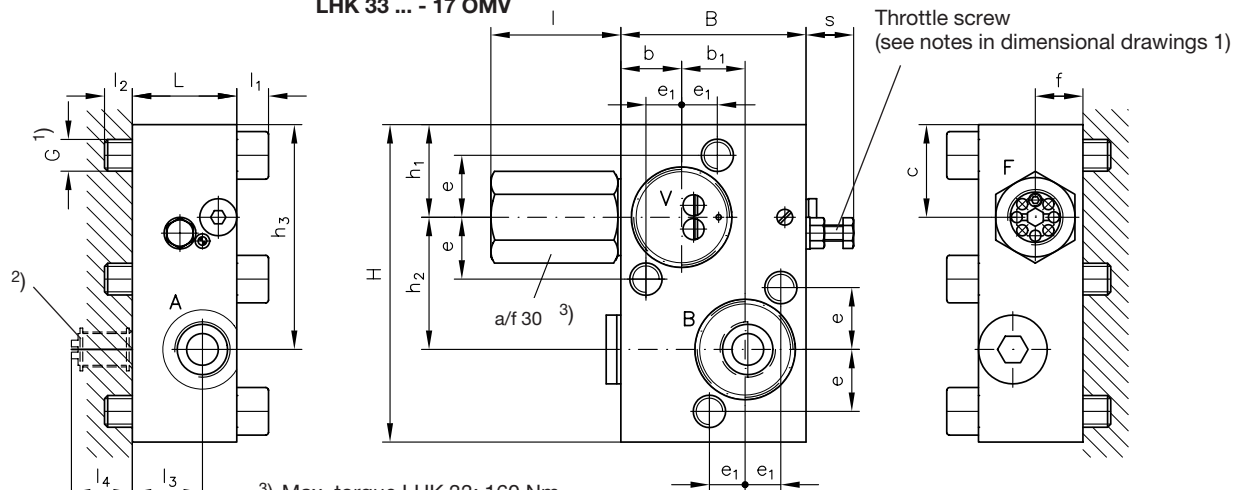
Ports:
A and F = G 1/2
X = G 1/4

Ports G... = (BSPP)

Mass (weight) = approx. 2.2 kg

Throttle screw
(see notes in dimensional drawings 1)

Dimensional drawings 11: **Type LHK 33 ... - 17 OMT**
LHK 33 ... - 17 OMV

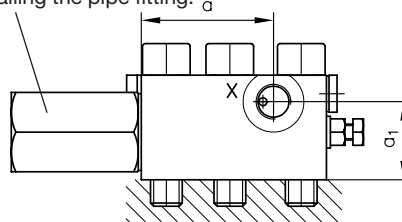


3) Max. torque LHK 33: 160 Nm

Attention:

The hexagonal spring housing must be countered while installing the pipe fitting!

- 1) Socket-head screws "G"
LHK 33...-17 OMT: M 10x50 DIN 912-8.8
LHK 33...-17 OMV: M 12x50 DIN 912-8.8
- 2) Screwed-in sequence valve type VR 3...,
see notes in sect. 5.2.d



Ports G... = (BSPP)

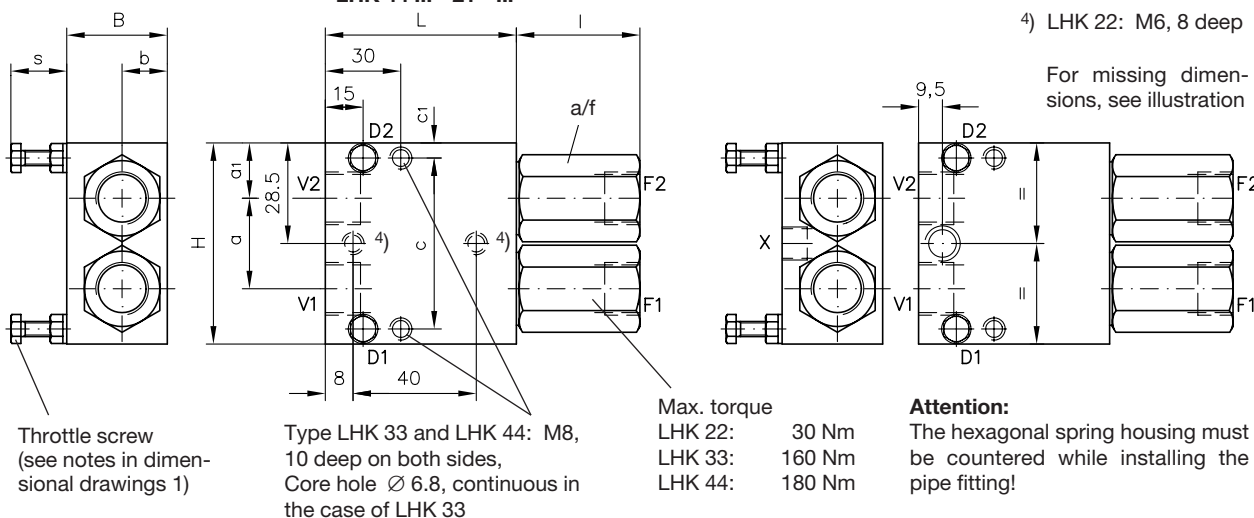
Type	Ports													a	a1	b	b1	c
	A, B, F	X	B	H	L	l	l1	l2	l3	l4								
LHK 33 ...-17 OMT	G 1/2	G 1/4	70	100	39.5	49	10	10.5	26.5	23	50	29.5	23.5	23	30			
LHK 33 ...-17 OMV	G 1/2	G 1/4	70	120	39.5	49	12	10.5	26.5	23	50	29.5	23	24	35			

Type	e	e1	f	h1	h2	h3	s		O-rings HNBR 90 Sh a ports B, V	Mass (weight) approx. kg
							min	max		
LHK 33 ...-17 OMT	21.6	12.5	18	30	40	70	8	18	26.64 x 2.62	2.1
LHK 33 ...-17 OMV	23.4	13.5	18	35	50	85	8	18	34.65 x 1.78	2.5

4.2 Valve for alternating load directions

Dimensional drawings 12: **Type LHK 22 ... - 21 - ...**
LHK 33 ... - 21 - ...
LHK 44 ... - 21 - ...

Type LHK 33 ... - 21W - ...
LHK 44 ... - 21W - ...



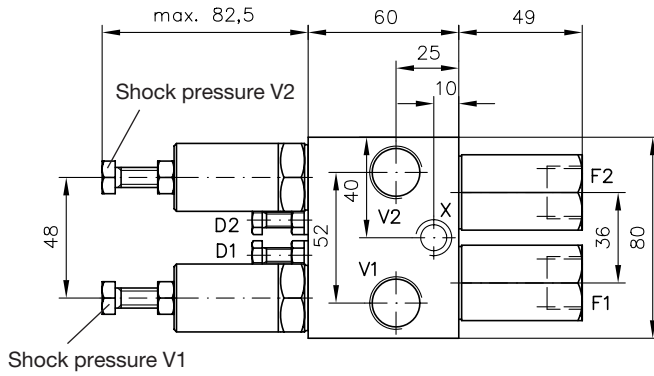
4) LHK 22: M6, 8 deep

For missing dimensions, see illustration

Ports G... = (BSPP)

Type	Ports				B	H	L	l	a	a1	b	c	c1	a/f	s		Mass (weight)
	F1, F2, V1, V2	X	min	max													
LHK 22... - 21	G 3/8	--	30	60	58	40	28	16	14	48	6	22	12	19	0.85 kg		
LHK 33... - 21(W)	G 1/2	G 1/4	40	80	76	49	36	22	18	68	6	30	15	25	2.4 kg		
LHK 44... - 21(W)	G 3/4	G 1/4	50	90	80	90	44	23	25	75	7.5	36	14	25	3.5 kg		

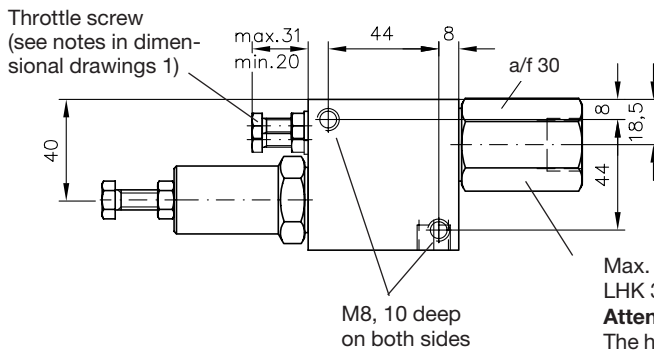
Dimensional drawings 13: **Type LHK 33 ... - 25 - ...**
LHK 33 ... - 25 W
LHK 33 ... - 25 WD



Ports:
 F1, F2, V1, V2 = G 1/2
 X = G 1/4

Ports G... = (BSPP)

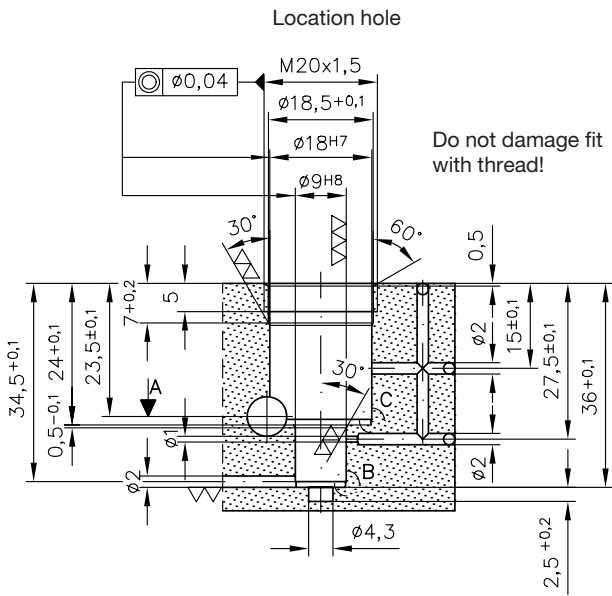
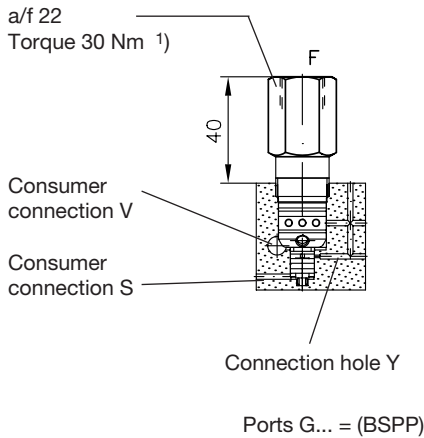
Mass (weight) = approx. 2.7 kg



Max. torque
 LHK 33: 160 Nm
Attention:
 The hexagonal spring housing must be counter-
 erated while installing the pipe fitting!

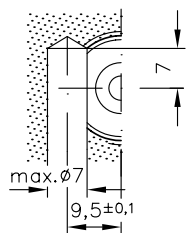
4.3 Assembly kits - Dimensions and required mounting hole

Dimensional drawings 14: **Type LHK 21 ...**
LHK 22 ...

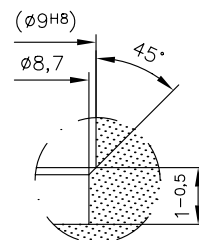


Type	Port F	Mass (weight) approx. kg
LHK 21...	G 1/4	0.1
LHK 22...	G 3/8	0.1

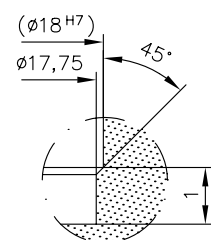
Partial section A



Detail of B



Detail of C



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

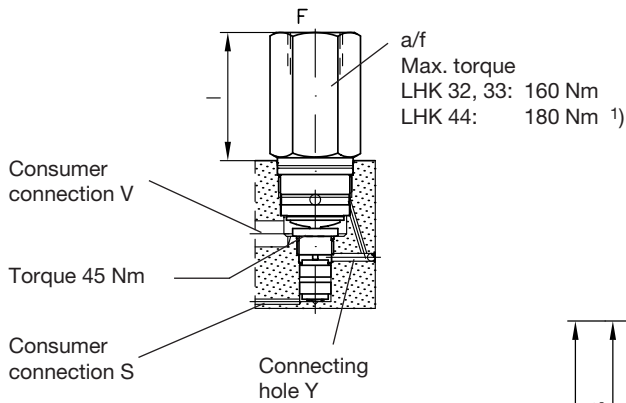
Dimensional drawings 15: **Type LHK 32 ...**

LHK 33 ...

Dimensional drawings 16: **LHK 44 ...**

LHK 44 ...

Location hole for type LHK 32(33) - dimensional drawings 15

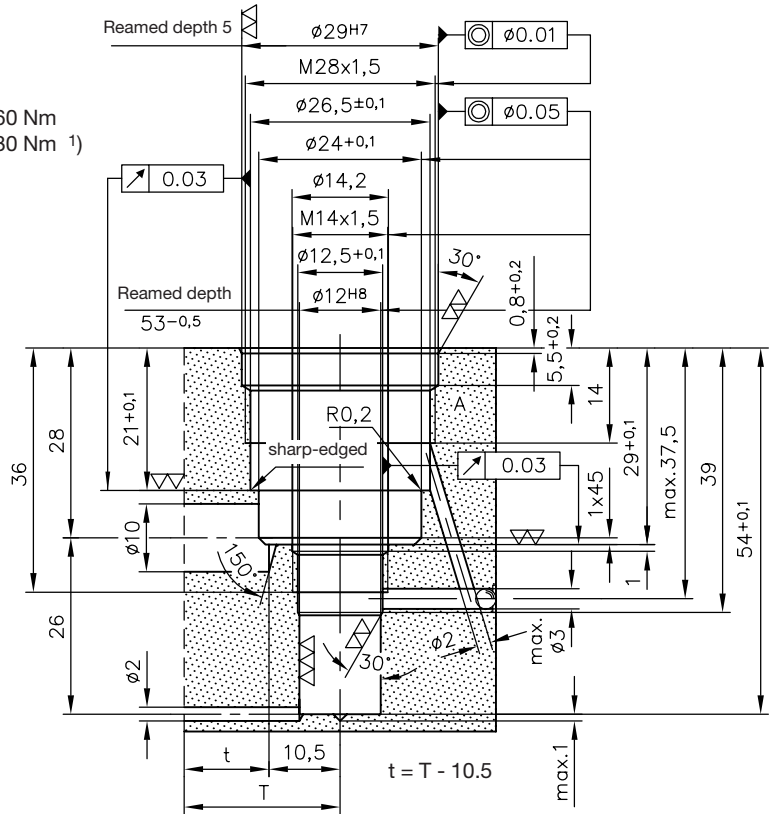


1) **Attention:**

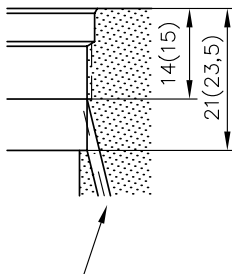
The hexagonal spring housing must be countered while installing the pipe fitting!

Type	Port F	l	a/f	Mass (weight) approx. kg
LHK 32	G 3/8	49	30	0.3
LHK 33	G 1/2	49	30	0.3
LHK 44	G 3/4	90	36	1.0

Ports G... = (BSPP)

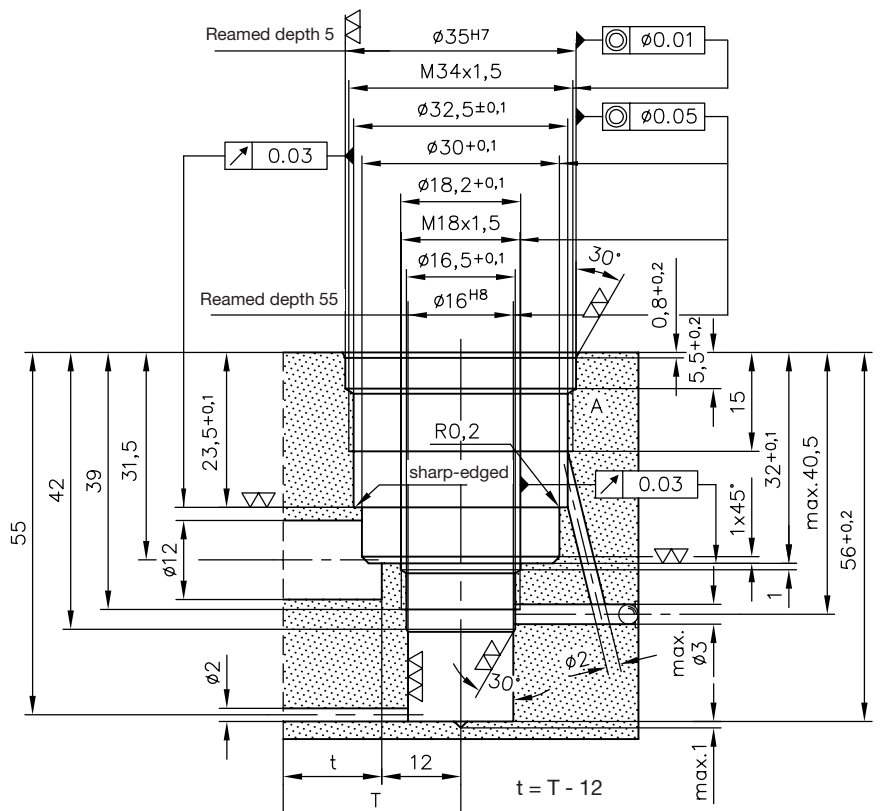


Detail of A

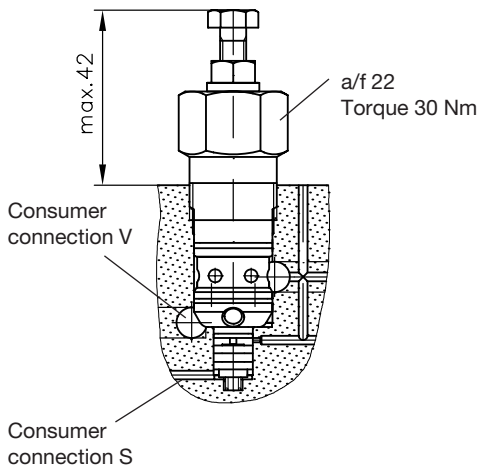


Connecting channel Y must break through between the given depths. () - dimensions for type LHK 44.

Location hole for type LHK 44 - dimensional drawings 16

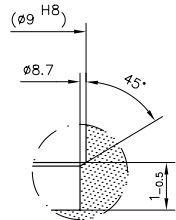


Dimensional drawings 17: **Type LHK 20 V ...**

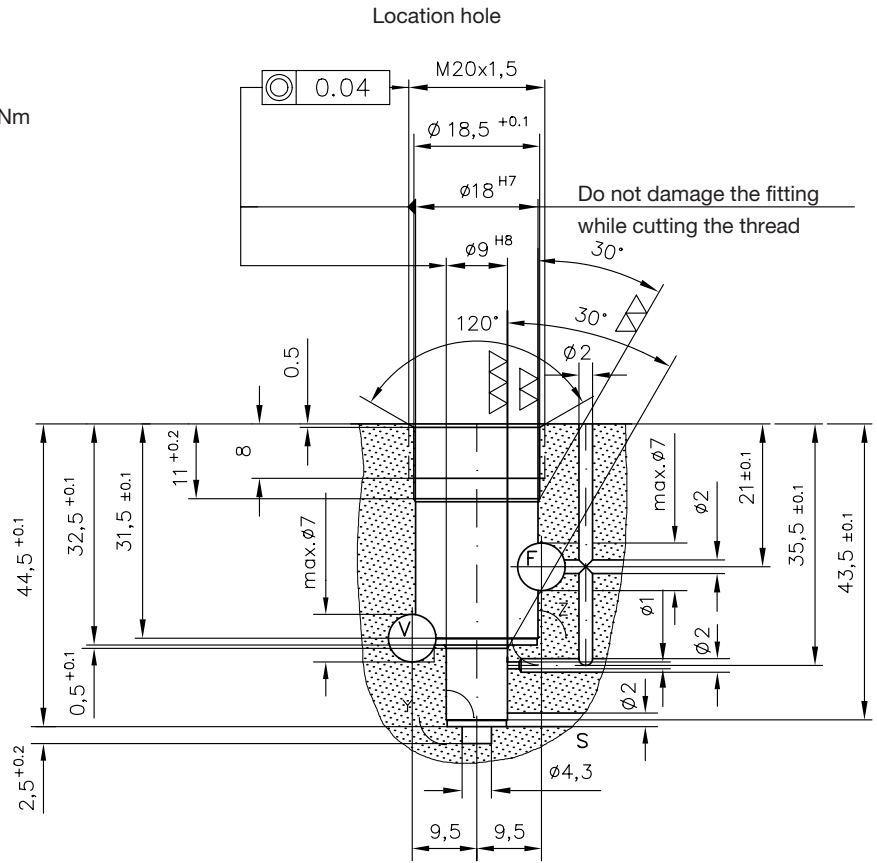
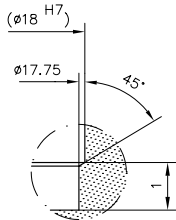


Mass (weight) = approx. 0.3 kg

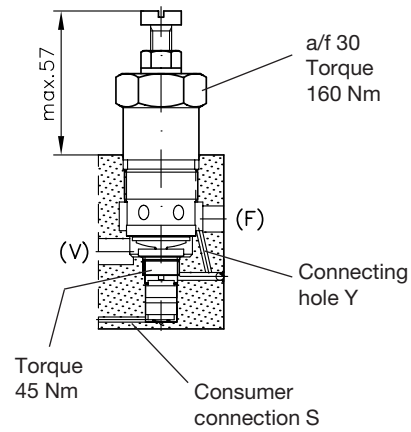
Detail of Y



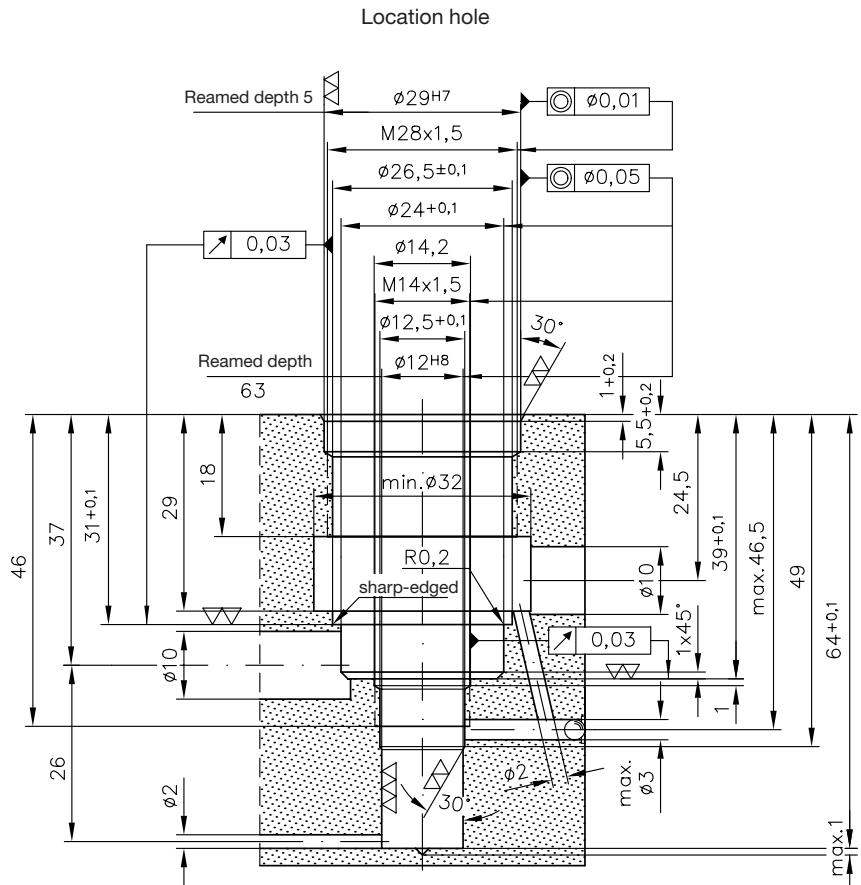
Detail of Z



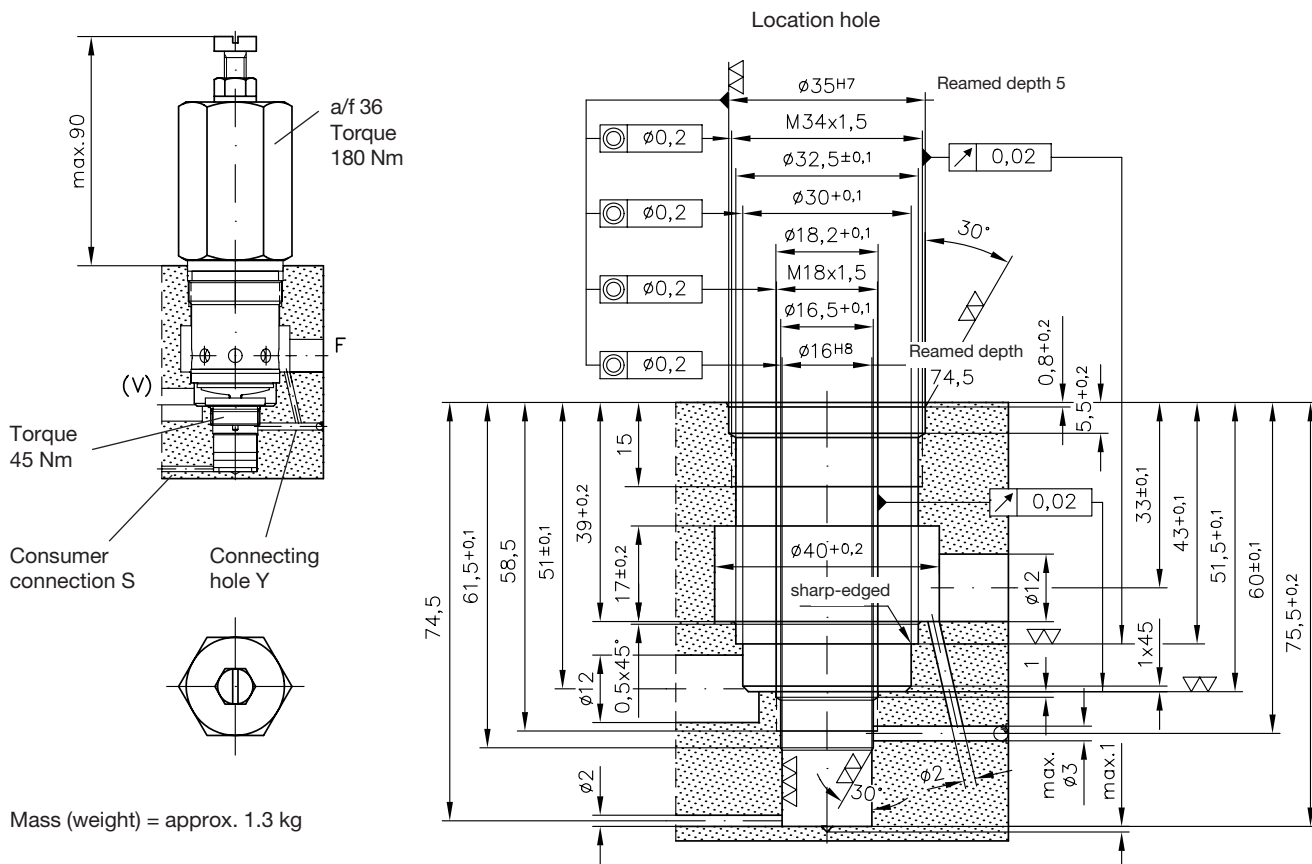
Dimensional drawings 18: **Type LHK 30 V ...**



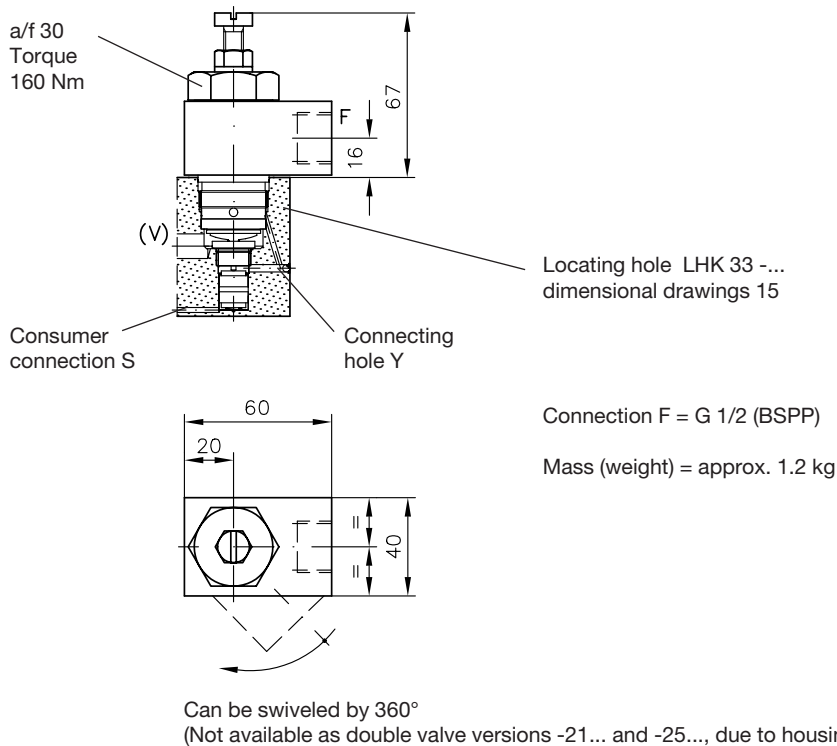
Mass (weight) = approx. 1.0 kg



Dimensional drawings 19: Type LHK 40 V ...

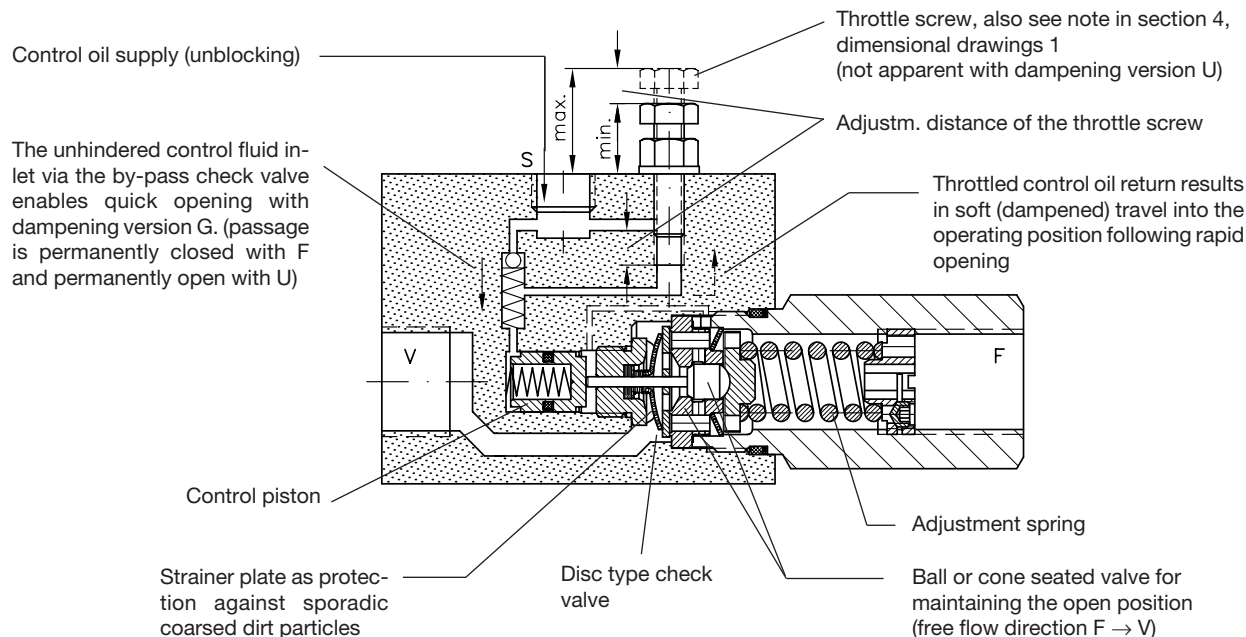


Dimensional drawings 20: Type LHK 33 S ...



5. Appendix

5.1 Schematic mounting on example LHK 33 G -11 -...



5.2 Brief description of the symbols

a) Symbols -11, -11C

The relief of the valve is carried out via the external control line S from the pump sided consumer line.

The rear side of the control piston is connected with port F with version -11, i.e. the return pressure (back pressure from the directional valve to the tank) influences the relief characteristic of the valve. This is also the reason for the functional restrictions with differential circuits (see sect. 3).

The rear side of the control piston of symbol -11C is routed externally (depressurized) via port Z to the tank, which eliminates any influence of the return pressure. This ensures sure closing function of version -11C. It is therefore suited for differential circuits as well as for use together with directional spool valves with blocked flow in yidle position).

b) Symbols -14, -14W, -14W M1C

The pick-up of the control line is here internal as the consumer line (A - B) is routed here through the valve (different to symbol -11), which minimizes the effort for piping.

Symbol -14W features an additional shuttle valve for the brake control line (port X) e.g. for hydraulically disengaged brake (winches etc.).

Version -14W M1C can be mounted directly onto DENISON motors (e.g. type M1C) or VOAC motors (e.g.. type F 12).

c) Symbols -15, -15C

The consumer side is safe guarded by an additional shock valve. This enables a functional separation of max. load pressure function (set at the shock valve) and the relief ratio (dep. on relief ratio and the pressure setting at the valve)

d) Symbols -17 OMR, -17 OMT, -17 OMV

These versions are intended for direct mounting onto DANFOSS motors type OMR, OMT, and OMV or other brands with the same hole pattern.

An additional sequence valve (type VR 33 acc. to D 7340, pre-load approx. 3 bar) may be installed optionally at port B. This prevents running of the winch motor without load (no loose hanging of the rope).

e) Symbols -21, -21W

Valve for alternating load directions (i.e. going over a dead center).

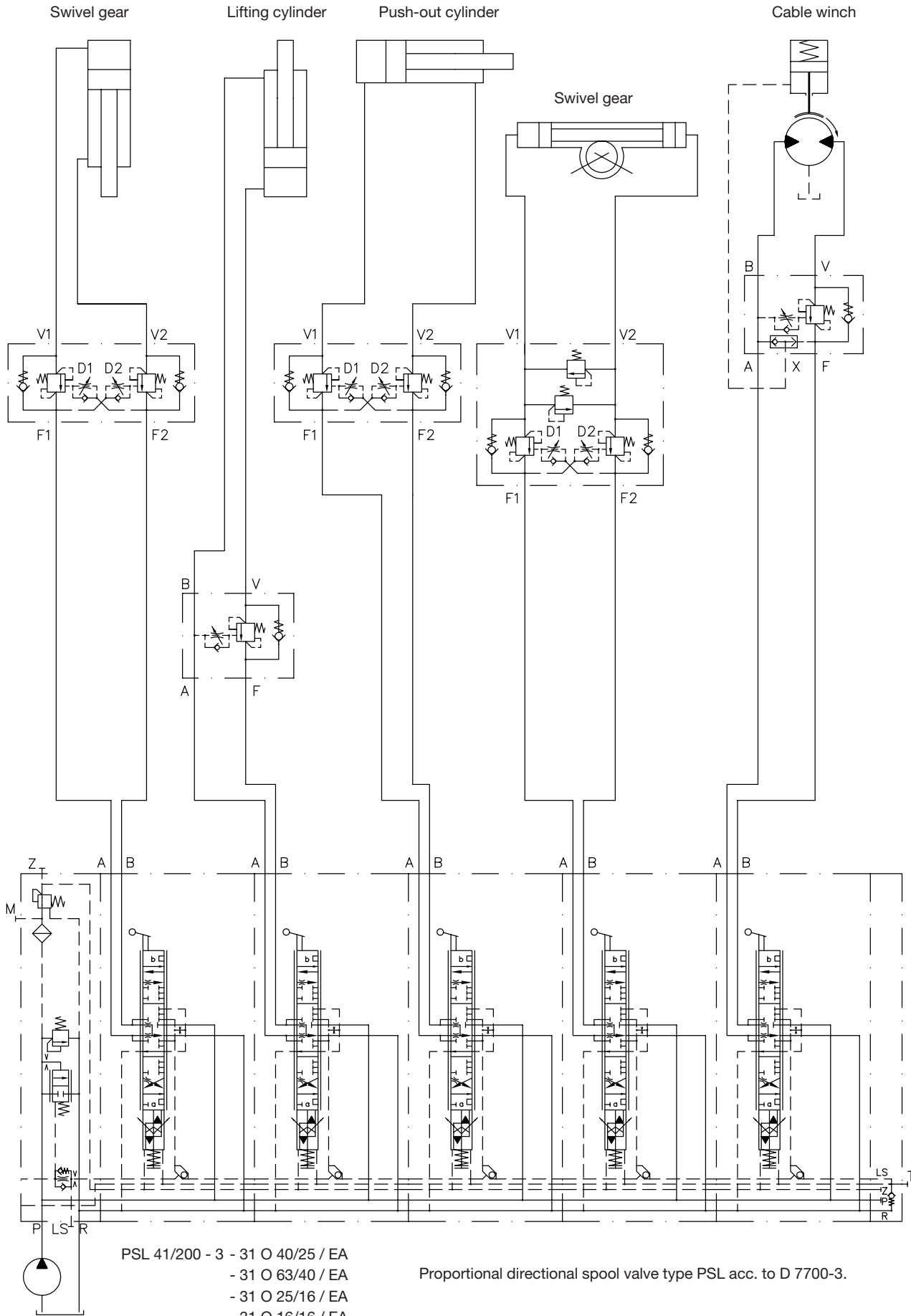
Both directions may be adjusted independently (load pressure and dampening characteristic).

Versions -21W features an additional shuttle valve (see notes for symbol -14W, in sect. 5.2 b).

f) Symbols -25, -25W, -25WD

Versions for turning, swiveling or rotating devices via hydraulic motors. A shuttle valve may be integrated like with symbol -14W (sect. 5.2 b). Additional restrictor check valve for delayed relief of the hydraulic brake (smooth engaging) with symbol -25WD.

5.3 Examples of applied circuits
5.3.1 Simplified, typical crane controller



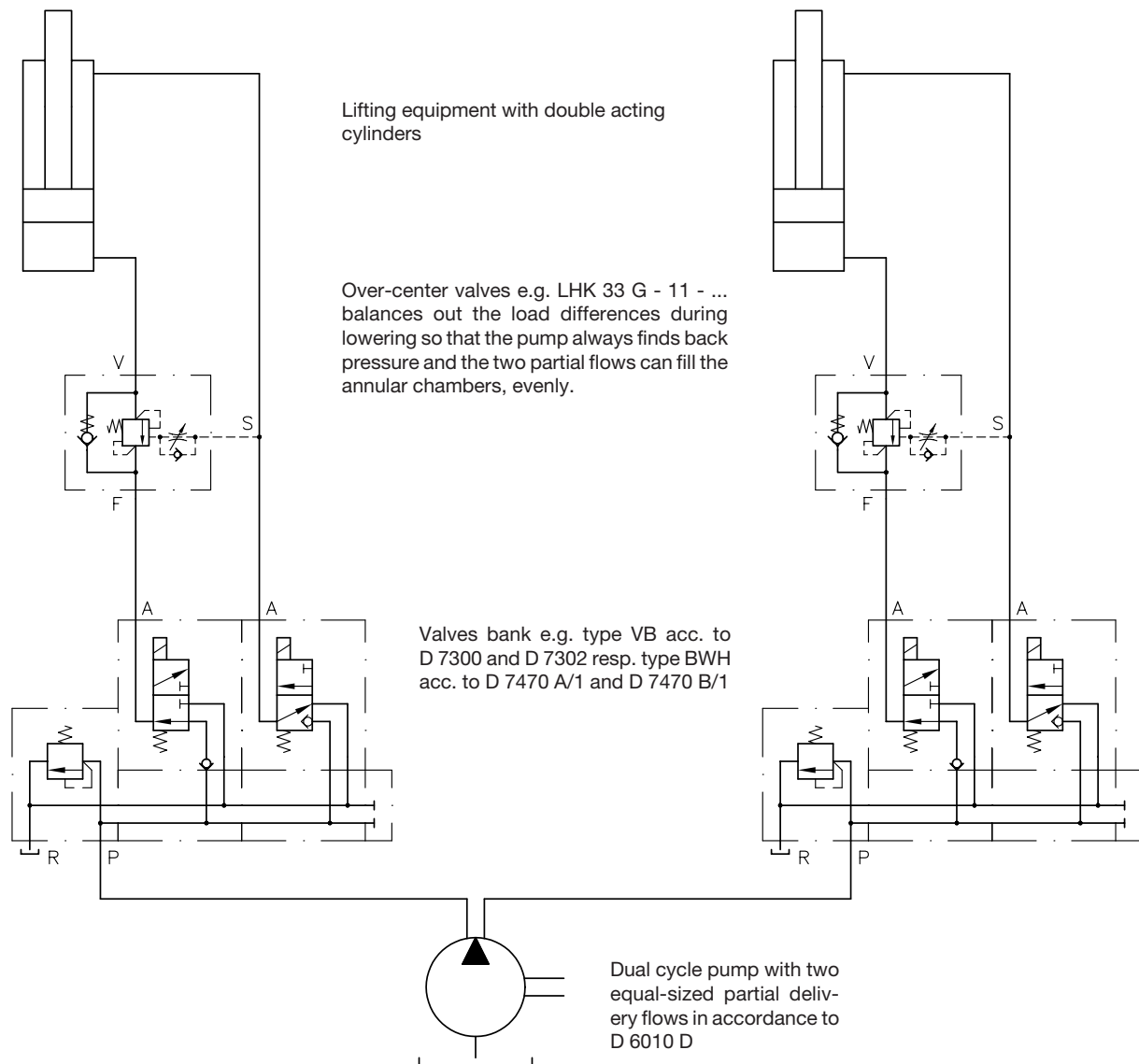
- PSL 41/200 - 3 - 31 O 40/25 / EA
- 31 O 63/40 / EA
- 31 O 25/16 / EA
- 31 O 16/16 / EA
- 31 O 63/63 / EA
- E4 - G 24

Proportional directional spool valve type PSL acc. to D 7700-3.

5.3.2 Synchronization system

Example circuit:

The load acts only in one direction. Lifting is synchronous by way of the two partial delivery flows of the pump. Lowering is against the load holding valve, synchronism being maintained by the „pushing“ of the particular flows.



However, synchronization controllers of the type shown here are only appropriate if no great demands are placed on the precision and if synchronism interruptions to the two delivery flows (e.g. incorrect switching of a solenoid valve, pump element failure due to contamination etc.) are detected and if any inclination which occurs until the equipment is switched off does not lead to risks to the operating personnel and system. During an uninterrupted operation, the synchronism accuracy is also influenced by, amongst other things, the volume elasticity of the oil and of the lines (particularly in the case of hose lines = hose expansion) etc. depending on the load distribution. There is therefore basically no works guarantee on the synchronism function of such systems.

5.4 Notes on directional spool valve controllers

If several directional spool valves are arranged in the hydraulic circuit (spool valves bank), leakage oil can seep out of the pressure-loaded pump channel into the consumer outputs of non-operated spool valves when any desired consumer is operated. Pressure can gradually build up in the connected consumer lines („leakage oil pressure“) which is eventually sufficient to block the LHK valve so that the cylinder does, in fact, begin to creep. This means series-connected valves bank (e.g. type SKH acc. to D 7230) cannot be combined with load holding valves. In practice, only spool valves connected in parallel are normally used for such controllers. Here, any leakage oil pressure at the consumer connections of the individual spool valves is more or less pronounced and is mainly dependent on the tolerance of fit and the overlapping length. Also, since the leakage oil migrates to the return outlet, this pressure is in most cases no sufficient to unlock the load holding valve since this valve is set high. Also, it has become practice to install consumer connections with throttle relief or a direct connection to the return channel instead of completely blocked consumer connections in the neutral position. This is to ensure that leakage oil which has seeped in is immediately diverted and does not reach the control line of the holding valve, see the example of the crane circuit, section 5.3.1 with proportional directional spool valve type PSL acc. to D 7700 +. At the same time, this does not hinder the closing movement of the load holding valve when the directional spool valve is quickly reset to the neutral position, because the oil from the control chamber does not have to be forced back against the valve leakage gap.

5.5 Old and new type coding

Some changes were necessary for the unification of the type coding. The table below lists all these changes.

Old	Previous SK-drawing	New (like in sect. 2.1)
LHK 22 K-11-...	Sk 7660 GP/3	LHK 22 G -11 K-...
LHK 30 GVP-11-...	Sk 7100 GVP-11	LHK 30 G -11 PV -...
LHK 30 FVP-11-...	Sk 7100 GVP-11	LHK 30 F -11 PV -...
LHK 30 GVP-11C-...	Sk 7100 GVP-11C	LHK 30 G -11C PV -...
LHK 30 FVP-11C-...	Sk 7100 GVP-11C	LHK 30 F -11C PV -...
LHK 33 OMR-17-...	Sk 7547 OMR	LHK 33 G -17 OMR
LHK 33 OMT-17-...	Sk 7547 OMT	LHK 33 G -17 OMT
LHK 33 OMV-17-...	Sk 7547 OMV	LHK 33 G -17 OMV
LHK 33 K-10..- G(F)	Sk 7100 K	LHK 333 G(F) - 11 K -...
LHK 33 K-11..- G(F)	Sk 7100 K	LHK 33 G(F) - 11 K -...
LHK 33 K-12..- G(F)	Sk 7100 K	LHK 337 G(F) - 11 K -...
LHK 33 P-11-...	Sk 7100 P-11	LHK 33 G -11P -...
LHK 33 PF-11-...	Sk 7100 P-11	LHK 33 F -11P -...
LHK 33 P-12-...	Sk 7100 P-11	LHK 337 G -11P -...
LHK 33 PF-12-...	Sk 7100 P-11	LHK 337 F -11P -...
LHK 40 GVP-11-...	Sk 7101 GVP-11	LHK 40 G -11PV -...
LHK 40 FVP-11-...	Sk 7101 GVP-11	LHK 40 F -11PV -...
LHK 40 GVP-11C-...	Sk 7101 GVP-11C	LHK 40 G -11C PV -...
LHK 40 FVP-11C-...	Sk 7101 GVP-11C	LHK 40 F -11C PV -...
LHK 44 G M1C-14W-...	Sk 7101 M1C-14W/1	LHK 44 G - 14W M1C -...
LHK 44 P-11-...	Sk 7101 P-11	LHK 44 G -11 P -...