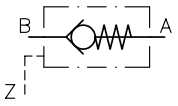
Hydraulically pilot operated cartridge check valves Type RHC and RHCE

without and with hydraulic pre-relief

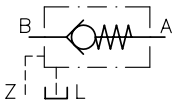
Pressure p_{max} = 700 bar
Flow Q_{max} = 200 lpm

Symbols

Type RHC



Type RHCE



1. General

These devices are designed as seated valves and belong to the group of stop valves according to ISO 1219-1. Flow is blocked in the direction A → B and possible in the direction B → A. The closed passage, flow direction A → B, can be opened (released) by hydraulic control.

Application

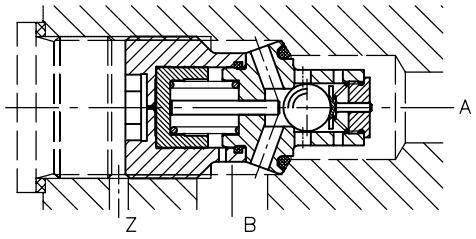
- Blockage of zero-leakage cylinders when used together with leakage prone directional spool valves
- Return relief for directional valves during retraction of double acting cylinders
- as a hydraulically operated drain or circulation valve

The valve housings are designed as screw-in cartridges. These valves are to be screwed into simply shaped tapped holes of a manifold body. The sealing of the consumer side A and B is via an O-ring and takes place at the contact area between the stepped valve body and the stepped shoulder of the core diameter at the location thread. Any standard steel drill (point angle 118°) automatically forms this stepped shoulder when the core diameter is drilled. Therefore reaming of the hole and bevels to help the seals slip in are not necessary. The control side Z is generally sufficiently sealed to the consumer side B via an appropriate thread tolerances of valve screw and core hole (see table with dimensions).
There are versions with sealed thread and control piston available if this (minimum) leakage is disturbing.
Another version features a control piston relief where a an additional leakage port is apparent. This enables opening without any damping via the pressure apparent at port A (see examples in sect. 5).
The following schematic illustrations show the design and a typical installation example where the mounting hole is blocked to the outside with a tapped plug (conf. DIN 908 or 910) and seal ring (conf. DIN 7603).

Versions

- Valves without a pre-relief (type RHC..)

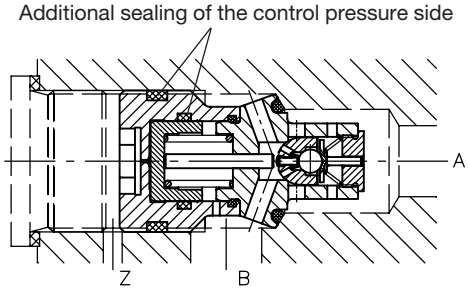
  The valve element is a ball. These valves allow full flow through the complete cross section A → B once they are released. The rate of operation of the piston is moderated. Abrupt opening and possible resultant relief shocks are substantially avoided. If shocks do occur during the trial run, however, an auxiliary restrictor must be provided in the control oil inlet, or a valve with a pre-relieving system must be used.



- Valves with a pre-relieving system (type RHC..V)

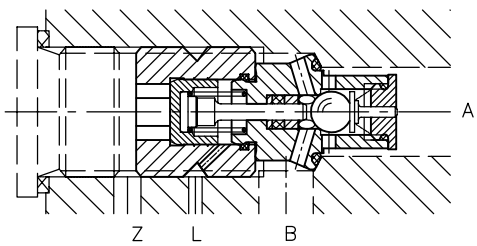
  The valve component is a spherically ground piston (ball seat) with a built-in ball check valve which opens during valve relief prior to the main piston, thereby releasing a restrictor cross section for the shock-free relief, of the consumer capacities. They are used predominantly for high operating pressures and for large consumer capacities. An auxiliary restrictor in the control oil inlet amplifies the efficacy of the pre-relieving feature.

Additional sealing of the control pressure side



- Valves with control piston relief (type RHCE..)

  Available with/without pre-relief (see above).
  The opening pressure is rather independent from the return pressure (p_B) with this version. This is possible because of the additional control piston relief via leakage port L.



HAWE HYDRAULIK SE
STREITFELDSTR. 25 • 81673 MÜNCHEN

D 7165
Check valves type RHC, RHCE

June 2012-01

2. Types available, main data

2.1 Type RHC

Order example: **RHC 4 V**

Basic type — Optionally with pre-relief

Size and version		Nominal pilot operation ratio 2.5:1						Nominal pilot operation ratio 4.5:1				
		Standard version										
Without pre-relief		**1**	**2**	**3**	**4**	**5**	**6**	**1/0**	**2/1**	**3/2**	**4/3**	**5/4**
With pre-relief		**--**	**--**	**3V**	**4V**	**5V**	**6V**	**--**	**--**	**--**	**4/3V**	**5/4V**
		Version with thread and control piston sealing (direct replacement for standard versions)										
Without pre-relief		**11**	**21**	**31**	**41**	**51**	**--**	**11/0**	**21/1**	**31/2**	**41/3**	**51/4**
With pre-relief		**--**	**--**	**31V**	**41V**	**51V**	**--**	**--**	**--**	**--**	**41/3V**	**51/4V**
		Version with thread and control piston sealing (simple installation, non standard mounting hole)										
Without pre-relief		**13** [1])	**23**	**33**	**43**	**53**	**--**	**13/0**	**23/1**	**33/2**	**43/3**	**53/4**
With pre-relief		**--**	**--**	**33V**	**43V**	**53V**	**--**	**--**	**--**	**--**	**43/3V**	**53/4V**
Flow Q_{max}	(lpm)	15	35	55	100	150	200	8	15	35	55	100
Pressure p_{max} (bar) at port	A, B, Z	700	700	700	500	500	500	700	700	700	500	500
True pilot operation ratio ψ	Main valve	2.6:1	2.6:1	2.5:1	2.5:1	2.8:1	2.5:1	4.2:1	4.3:1	4.5:1	4.3:1	4.3:1
	Pre-relief	--	--	10:1	12:1	19:1	12.9:1	--	--	--	26:1	21:1
Control volume	(cm^3)	0.1	0.2	0.4	0.8	1.5	2.65	0.1	0.2	0.4	0.8	1.5
Mass (weight) approx.	(g)	20	40	70	140	250	500	20	40	70	140	250

[1]) Type RHC 13 also available with thread M18x1.5; Order coding: RHC 13 M18x1.5

2.2 Type RHCE with control piston relief via additional leakage port

Order example: **RHCE 33 V**

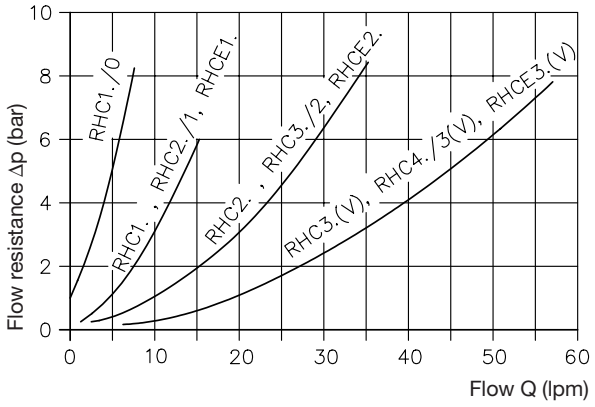
Basic type — Optionally with pre-relief

Size and version		Nominal pilot operation ratio 2.5:1					
		Standard version					
Without pre-relief		**1**	**2**	**3**	**4**	**5**	**6**
With pre-relief		**--**	**--**	**3V**	**4V**	**5V**	**6V**
		Version with thread and control piston sealing (simple installation, non standard mounting hole)					
Without pre-relief		**13**	**23**	**33**	**43**	**53**	**63**
With pre-relief		**--**	**--**	**33V**	**43V**	**53V**	**63V**
Flow Q_{max}	(lpm)	15	35	55	100	150	200
Pressure p_{max} (bar) at port	A, B, Z	700	700	700	500	500	500
	L	Non-pressurized to the tank					
True pilot operation ratio ψ	Main valve	2.6:1	2.6:1	2.5:1	2.5:1	2.8:1	2.5:1
	Pre-relief	--	--	10:1	12:1	19:1	12.9:1
Control volume	(cm^3)	0.1	0.2	0.4	0.8	1.5	2.65
Mass (weight) approx.	(g)	20	40	70	140	250	500

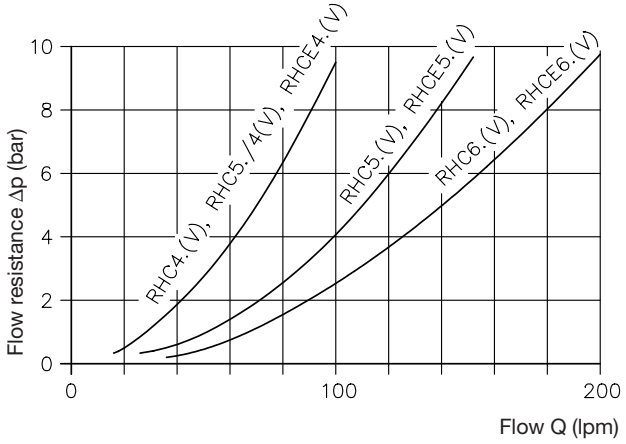
3. Additional data

Type	Spring-loaded seated ball valve
Material	All steel design; housing part on the valve side hardened, valve seat ground
Mounting	Screwed into location hole of a housing element Observe the dimensional tolerance of the thread core diameter D_1 in sect. 4, as well as footnote [1])
Installation position	Any
Connections	A, B = Main opening Z = Control oil connection L = Leakage oil connection, non-pressurized to the tank
Flow direction	B → A Free A → B Blocked with zero leakage in neutral position (connection Z non-pressurized) if there is no pressure at B or a lower pressure than at A A → B Open, if the valve is pilot operated by a control pressure at Z (also see control pressure p_{St})
Opening pressure	B → A approx. 0.5 bar; approx. 1 bar for RHC 1/0
Control pressure p_{st} (bar) (Recommended value calculation)	for pilot operation $p_{St} = \frac{p_A}{\psi} + 2.5$ for holding open $p_{St} \approx kp_B + \frac{\Delta p}{\psi} + 4.5$ ψ Pilot-operation ratio see table Section 2 p_A = Pressure at A p_B = Pressure at B Δp see following characteristic k = 1 for Type RHC = 0.05 ... 0.1 for Type RHCE
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 curves



Oil viscosity during the measurement approx. 60 mm²/s

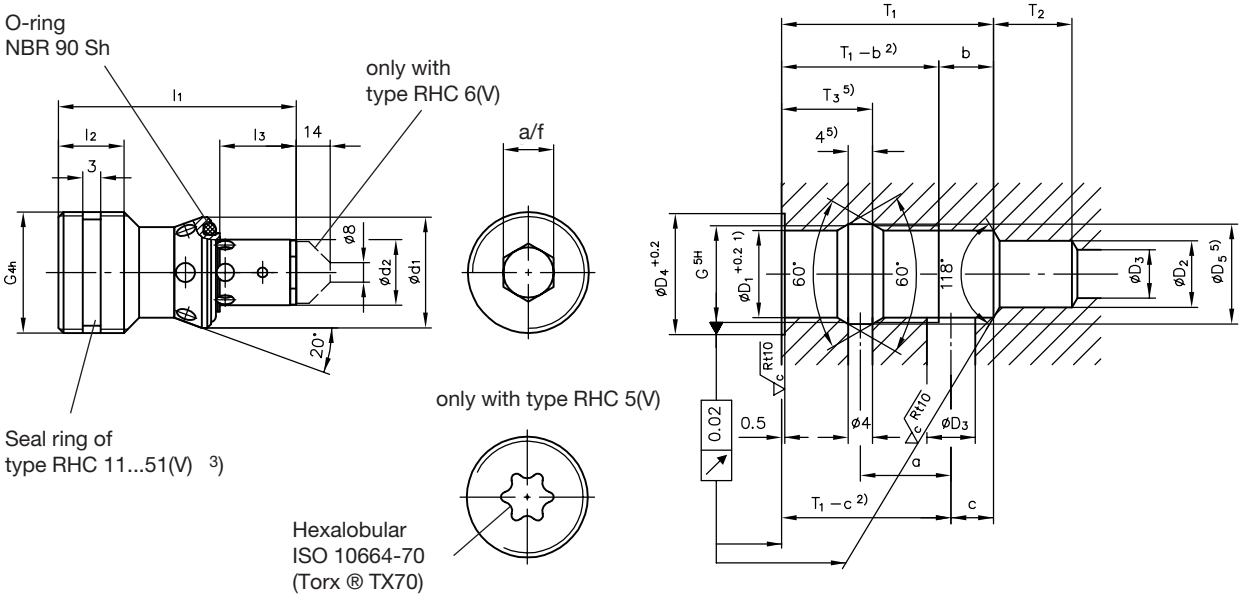


4. Unit dimensions

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

4.1 Type RHC 1 ... 6(V), RHC 11 ... 51(V) RHC 1/0 ... 5/4V and RHC 11/0 ... 51/4(V)

Location hole
The mounting hole is blocked to the outside via a tapped plug (conf. DIN 908 or 910) and seal ring (conf. DIN 7603).



Type		G 4)	l_1	l_2	l_3	d_1	d_2	a/f	O-ring	Max. torque M_{max} (Nm)
RHC 1,	RHC 11	M 16x1.5	32.2	10	10.7	14	9	6	10x1.5	40
RHC 1/0,	RHC 11/0		29.5		7.7					
RHC 2,	RHC 21	M 20x1.5	37.9	12	12.9	18	11	8	12.42x1.78	75
RHC 2/1,	RHC 21/1		36.2		11.2		10			
RHC 3(V),	RHC 31(V)	M 24x1.5	47.2	13.5	15.2	22	13	10	15.3x2.4	120
RHC 3/2,	RHC 31/2		45.4		13.4		11			
RHC 4(V),	RHC 41(V)	M 30x1.5	56	15	20.5	28	17.5	12	20.29x2.62	140
RHC 4/3(V),	RHC 41/3(V)		51.7		16.2		16			
RHC 5(V),	RHC 51(V)	M 36x1.5	67.5	18.5	24	34	21.5	Torx ® TX70	25.07x2.62	200
RHC 5/4(V),	RHC 51/4(V)		64.2		20.7		20			
RHC 6(V)		M 42x1.5	83	23	29	39.5	27	19	31.42x2.62	350

Type	a	b	c	D_1 1)	D_2	D_3	D_4	D_5 5)	T_1	T_2	T_3 5)	Seal ring at the tapped plug
RHC 1(11) RHC 1/0(11/0)	15	9	7	14.4	11	8	20	16.5	35	13	15	16x20x1.5
RHC 2(21) RHC 2/1(21/1)	18	10	6	18.4	14	10	24	20.5	38	17	16	20x24x1.5
RHC 3(31) (V) RHC 3/2(31/2)	22	15	9	22.4	16	12	29	24.5	45	19	16	24x29x2
RHC 4(41) (V) RHC 4/3(41/3) (V)	24	15	10	28.4	22	15	36	30.5	50	24	18	30x36x2
RHC 5(51) (V) RHC 5/4(51/4) (V)	30	18	12	34.4	27	18	42	36.5	58	27	18	36x42x2
RHC 6 (V)	42	28	12	40.4	32	20	50	42.5	71	42	19	42x49x2

1) D_1 determines the leakage of the control line with type RHC 1...6(V)
Leakage 0.05 lpm at 300 bar, when all tolerances are maintained.

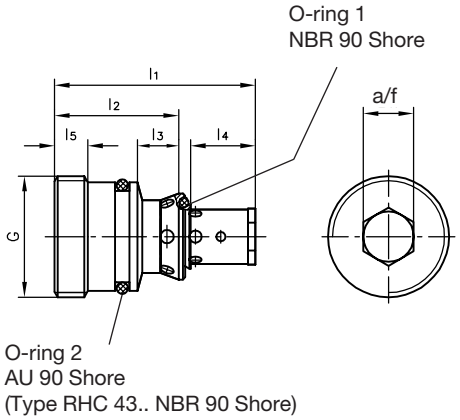
2) The thread depth T_1-b and the distance of the hole ∅D_3 (connection side B) T_1-c depend on the thread core hole depth T_1.
The fixed dimensions b, c, and a have to be maintained therefore.

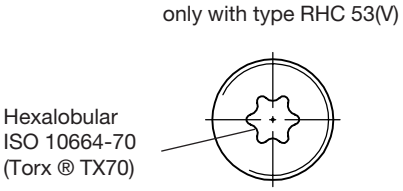
3) **Attention:** Applies to type RHC 11 ... 51(V)
All PTFE-swarf generated while screwing the valve in have to be thoroughly removed

4) Thread G fine tolerance 4h/5H DIN 13 pages 21/22

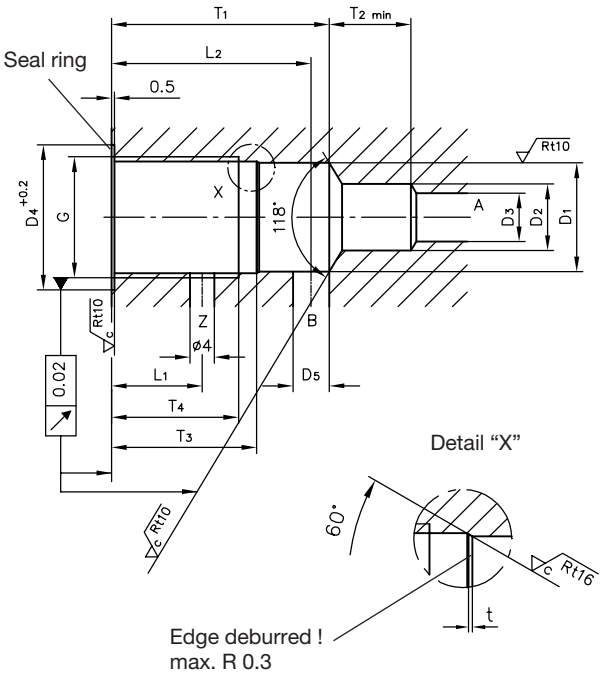
5) This recess is only required with type RHC .1 to prevent damage of the seal ring

4.2 Type RHC 13 ... 53(V) and RHC 13/0 ... 53/4(V)





Location hole
The mounting hole is blocked to the outside via a tapped plug (conf. DIN 908 or 910) and seal ring (conf. DIN 7603).

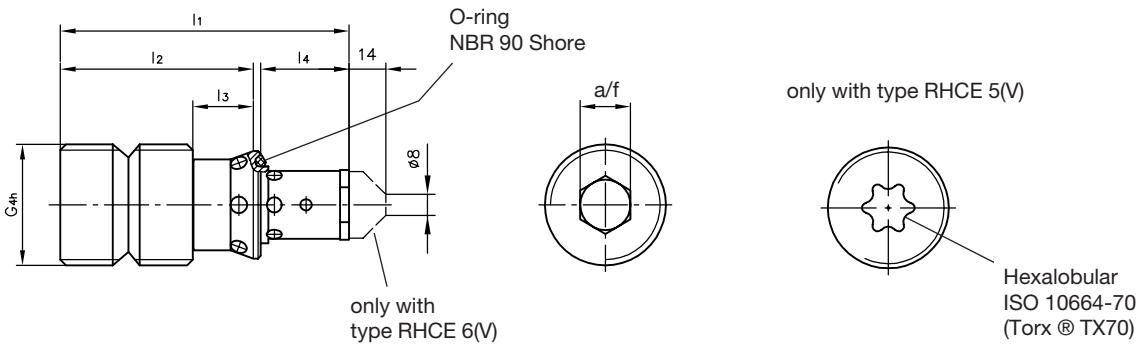


Type	G [1]	l_1	l_2	l_3	l_4	l_5	a/f	O-ring 1	O-ring 2	Max. torque M_{max} (Nm)
RHC 13	M 20x1.5	33	21.5	7.5	10.5	5.5	6	10x1.5	14x1.78	40
RHC 13/0		29	20.5	6.5	7	5				
RHC 23	M 22x1.5	38.5	25	9	13	6.5	8	12.42x1.78	15.6x1.78	75
RHC 23/1		36	23	8.5	11	5.5				
RHC 33(V)	M 26x1.5	47	30	12	15	7.5	10	15.3x2.4	20.35x1.78	120
RHC 33/2		46	28.5	11	13.5					
RHC 43(V)	M 36x1.5	55.5	33	14	20.5	9	12	20.29x2.62	28.3x1.78	140
RHC 43/3(V)		52	32.5	13	16					
RHC 53(V)	M 38x1.5	67.5	41.5	18.5	24	12	Torx ® TX70	25.07x2.62	29.82x2.62	200
RHC 53/4(V)		65	40	16	21					

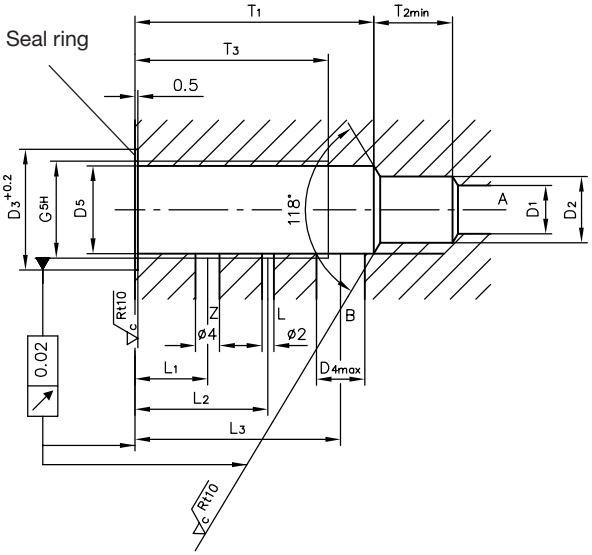
[1] Core diameter = G -1.5

Type	L_1	L_2	D_1 H8	D_2	D_3	D_4	$D_{5\,max}$	T_1	T_2	T_3 +0.5	T_4	t	Seal ring at the tapped plug
RHC 13	15	33	18	11	8	24	6	36	13.5	24	21	0.5	20x24x1.5
RHC 13/0		33											
RHC 23	14	34	19	14	10	27	8.5	39	17	24	21	1	22x27x1.5
RHC 23/1	13	33						38		23	20		
RHC 33(V)	16	40	24	16	12	31	11	46.5	20	28	25	0.5	26x31x2
RHC 33/2		40											
RHC 43(V)	18	45	32	22	15	42	13	52	28	32	29	1	36x42x2
RHC 43/3(V)		45							24				
RHC 53(V)	16	49.5	35	27	18	44	15	58	27	32	29	1	38x44x2
RHC 53/4(V)		49.5											

4.3 Type RHCE 1 ... 6(V)



Location hole
The mounting hole is blocked to the outside via a tapped plug (conf. DIN 908 or 910) and seal ring (conf. DIN 7603).

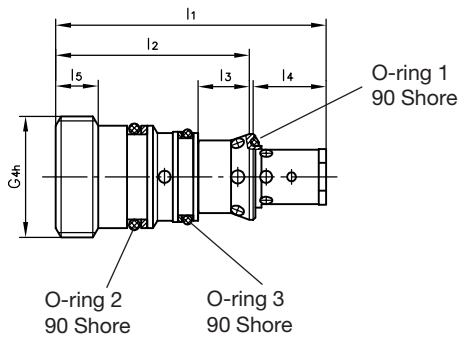


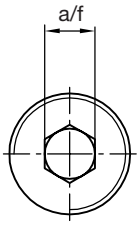
Type	G [1]	l_1	l_2	l_3	l_4	a/f	O-ring	Max. torque M_{max} (Nm)
RHCE 1	M 16x1.5	38	26	8.5	11	6	10x1.5	40
RHCE 2	M 20x1.5	45	30.5	10.5	12	8	12x2	75
RHCE 3(V)	M 24x1.5	56	38	14	16	10	15.3x2.4	120
RHCE 4(V)	M 30x1.5	63	40.5	14.5	20	12	20.29x2.62	140
RHCE 5(V)	M 36x1.5	77	50.5	16.5	25	Torx ® TX70	25.07x2.62	200
RHCE 6(V)	M 42x1.5	99	59	15	29	19	31.42x2.62	350

Type	L_1 ±0.1	L_2 ±0.1	L_3 ±0.1	T_1 +0.5	T_2	T_3 +0.5	D_1	D_2	D_3	D_4	D_5	Seal ring at the tapped plug
RHCE 1	12	22	35	39.5	13	32	8	11	20	8	14.4	16x20x1.5
RHCE 2	14	24	41	46	16	36	10	14	25	10	18.4	20x24x1.5
RHCE 3(V)	16	29	48	55	19	42	12	16	29	12	22.5	24x29x2
RHCE 4(V)	16	31	50	58	24	45	14	22	36	14	28.4	30x36x2
RHCE 5(V)	16	36.5	59	68.5	28	52	18	27	42	18	34.4	36x42x2
RHCE 6(V)	16	43	67	77.5	42	60	20	32	50	20	40.4	42x49x2

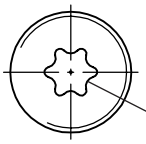
[1] Thread G
Fine tolerance 4h/5H DIN 13, pages 21/22

4.4 Type RHCE 13 ... 63(V)



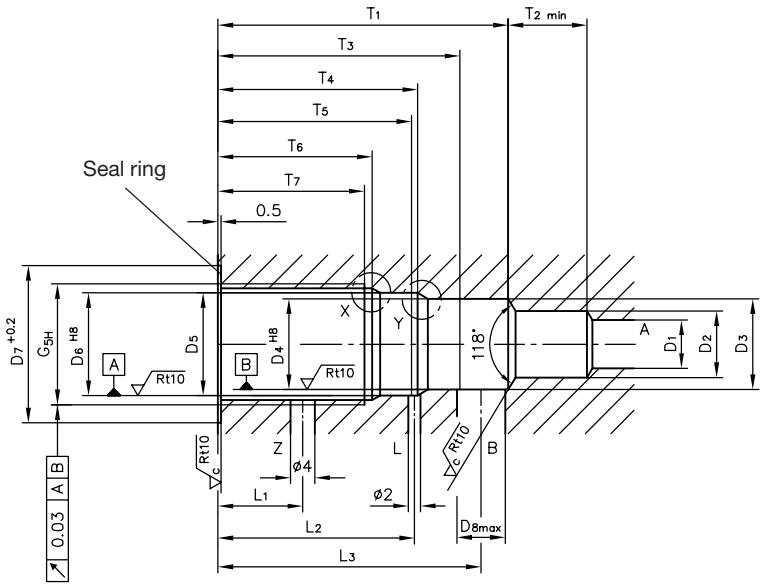


only with type RHCE 53(V)

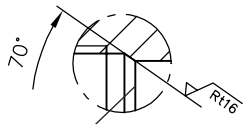


Hexalobular
ISO 10664-70
(Torx ® TX70)

Location hole
The mounting hole is blocked to the outside via a tapped plug (conf. DIN 908 or 910) and seal ring (conf. DIN 7603).

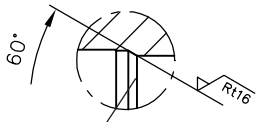


Detail “X”



Edge deburred !
max. R 0.3

Detail “Y”



Edge deburred !
max. R 0.3

Type	G [1]	l_1	l_2	l_3	l_4	l_5	a/f	O-ring 1	O-ring 2	O-ring 3	Max. torque M_{max} (Nm)
RHCE 13	M 20x1.5	45	32.5	8.5	11	7	8	10x1.5	14x1.78	12x1.5	40
RHCE 23	M 24x1.5	52	37	10.5	12	7.5	8	12x2	15.55x2.62	15.6x1.78	75
RHCE 33(V)	M 27x2	59	41.5	14	16	7.5	10	15.3x2.4	18.72x2.62	18x2.5	120
RHCE 43(V)	M 33x2	65	43.5	14.5	20	8	12	20.29x2.62	25.07x2.62	23.47x2.62	140
RHCE 53(V)	M 42x1.5	78	50	16.5	25	11	Torx ® TX70	25.07x2.62	31.42x2.62	29.82x2.62	200
RHCE 63(V)	M 45x1.5	103	59	15	41	15.5	19	31.42x2.62	36x3	34x3	350

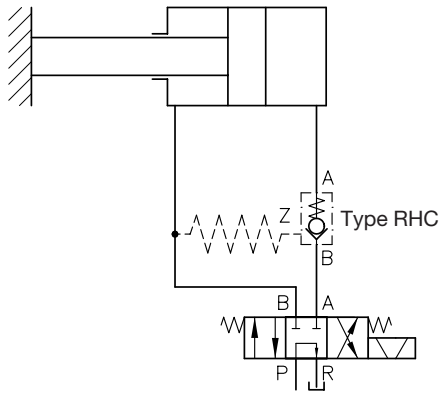
Type	L_1	L_2	L_3	T_1	T_2	T_3	T_4	T_5	T_6	T_7	D_1	D_2	D_3	D_4
RHCE 13	14	32.5	43.5	48	13	40	33	32	25.5	22.5	8	11	14.7	15
RHCE 23	14	34	47	52	16	43	35	34	26.5	22.5	10	14	18.7	19
RHCE 33(V)	16	36.5	52	59	19	46	38.5	37.5	29	25	12	16	22.7	23
RHCE 43(V)	16	37	53	60	24	48	38	37	30	25.5	14	22	27.7	28
RHCE 53(V)	16	42	59	68.5	28	52	43	41	31	28	18	27	34.7	35
RHCE 63(V)	16	48	67	77.5	42	59	49	47.5	38.5	33.5	20	32	39.7	40

Type	D_5	D_6	D_7	D_8	Seal ring at the tapped plug
RHCE 13	16.7	17	26	8	20x24x1.5
RHCE 23	20.7	21	29	10	24x29x2
RHCE 33(V)	23.7	24	32	12	27x32x2
RHCE 43(V)	29.7	30	39	14	33x39x2
RHCE 53(V)	36.7	37	49	18	42x49x2
RHCE 63(V)	41.7	42	52	20	52x45x2

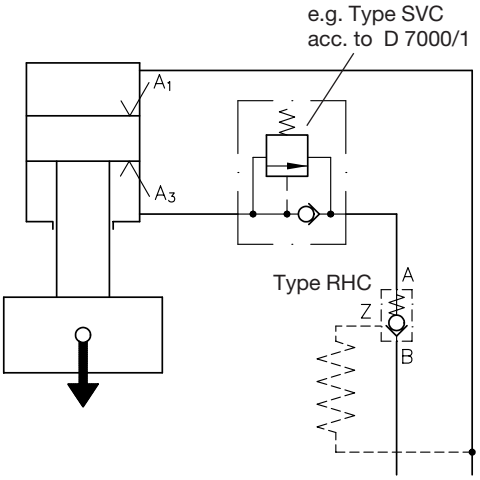
[1] Thread G
Fine tolerance 4h/5H DIN 13, pages 21/22

5. Examples

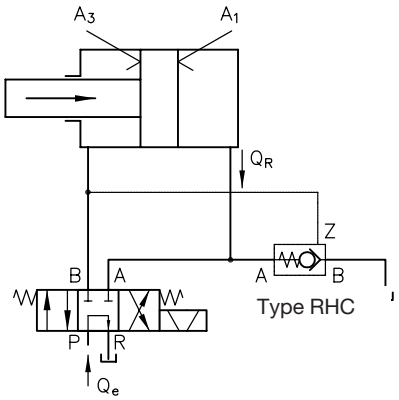
For blocking hydraulic cylinders with zero leakage
(illustrated here with additional damping of the control line)



Use at dragging loads



Additional return relief for high flow
(A_1/A_3 are very big)



Use as idle circulation valve