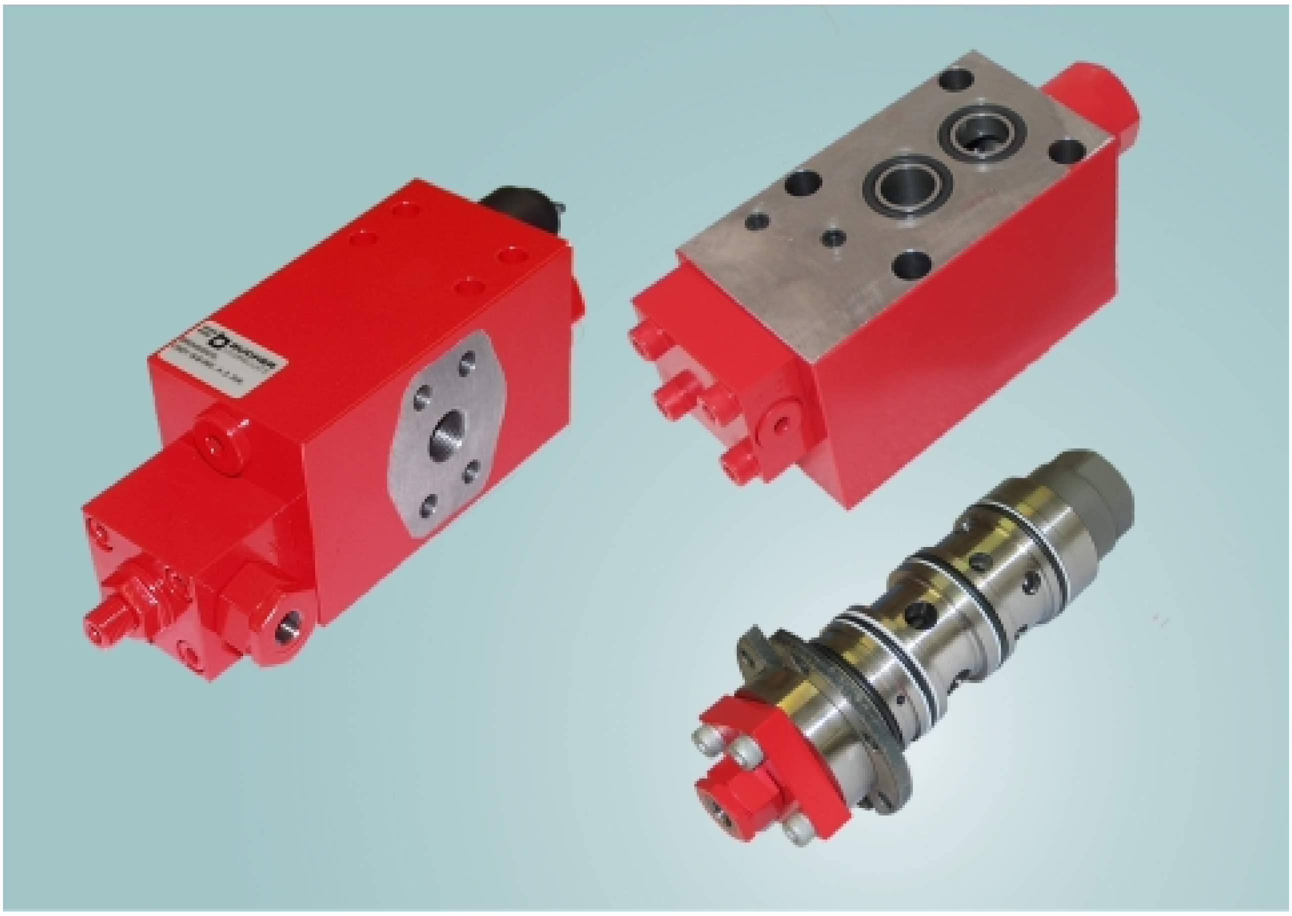
Safety for Hydraulics
General Information on "Cindy" Leak-Free Load Control Valves



motion and progress

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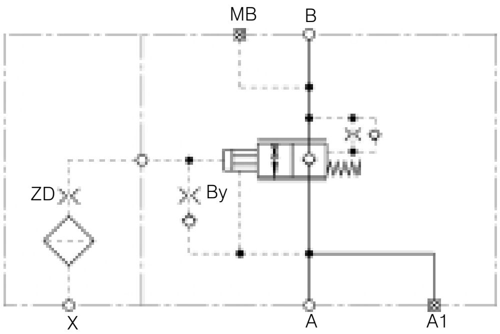
1. Symbol

Standard – model



A, A1	=	inlet
B	=	actuator
X	=	pilot pressure
MB	=	test port
ZD	=	inlet orifice
By	=	bypass orifice

2. General description

- prevents a hydraulic actuator from running ahead of the available oil supply in the event of external driving forces i.e. negative, or over-running loads
- takes over the load control-, load holding- and safety functions
- provides leak-free load holding in the neutral position
- for sensitive control and precision movement of actuators under load
- mounted directly on the hydraulic cylinder for the highest security against unintentional movements
- for controlling the speed of hydraulic cylinders and motors, for example on cranes, lifting platforms, etc.

3. Advantages of the Cindy load control valve

- absolutely zero-leakage load holding
- 420 bar working pressure with 3-fold safety
- pilot operated load-control valve and bypass check valve both combined in one axis
- Load does not accelerate in the event of a hose burst(with back pressure-independent models)
- the opening action is almost entirely independent of the load pressure (area ratio 1:113)
- above 100 bar load pressure, it controls like a compensated 2-way flow controller (patented follower principle)
- fully compensated pressure relief valve opens independently of tank- or return line back-pressure
- over-compensated models are available with various reducing stages
- outstanding fine control from optimised, low-flow control notches
- high resolution, thanks to the long control stroke
- the valve is guaranteed to close, even with a broken spring
- hardened, ground and lapped seat valve omponents ensure permanent leaktightness and long service life
- low-noise operation thanks to multiple, specially shaped notches
- very low hysteresis
- various pilot pressure ranges can be chosen
- various types of pilot-control are available
- damping properties guarantee a stable system even in sensitive applications
- additional asymmetric damping properties can be provided
- high power density
- wide choice of build types can be supplied

4. Main characteristics

(for application outside these parameters, contact Bucher Hydraulics)

4.1 General:

Type	seat valve with hydraulic pre-opening
Mounting method	flange mounting, line mounting or supplied as a cartridge
Mounting attitude	unrestricted
Flow direction	A ⇒ B free flow B ⇒ A controllable flow
Secondary pressure relief valve	optional
Thermal expansion protection	optional

4.2 Hydr. characteristics

Nominal size (mm)	12/ 16/ 20/ 25
Nominal flow rate	20 to 500 l/min
Opening pressure	from 6 bar
Operating pressure, max.	420 bar
Secondary pressure relief valve	80 to 460 bar
Thermal expansion relief	250 to 500 bar
Hydraulic fluids	HL and HLP mineral oils to DIN 51524 and DIN 51525 Other fluids – contact Bucher
Operating temperature range	-20°C...+80°C
Temperature rating – seal materials	
Nitrile	-20°C...+80°C
Viton	-20°C...+200°C
Low Temp. N7T40	-50°C...+80°C
Viscosity range	10 - 380mm^2/s (cSt) recommended
min. viscosity	2.8 mm^2/s (cSt)
max. viscosity	1500 mm^2/s (cSt)
Filtration / cleanliness class	NAS 1638 class 9, $\beta_{10} \geq 75$ ISO 4406 class 18/15

5. Safety information

- the valve may only be used for its intended purpose, and only within the parameters defined in section 4
- the valve may only be adjusted or opened by competent, manufactu-rer-trained personnel
- before removing or dismantling the valve, all hydraulic pressure must be released from the system
- the ultimate responsibility for safety in the installation and use of the load lowering valve lies with the machine manufacturer

6. Installation information

- observe the port markings
- protect seals and flange faces from damage
- use fixing screws of the correct strength class, and the correct tightening torques
- at commissioning, bleed all air from the hydraulic system

General tightening torques for fixing screws when using a torque spanner

Permissible variation of torque: 0... –20%

cap head screws DIN 912	Max. tightening torque MA in Nm		SAE 6000 psi
	12.9 DAC*	12.9 SCHW*	
M8	28	40	½”
M 10	55	81	¾”
M 12	100	140	1”
M 14	155	220	1 ¼“

These datas are valid for non greased fixing screws.

* DAC = ‘Dacromate’ (zinc) plated

* SCHW = black finish

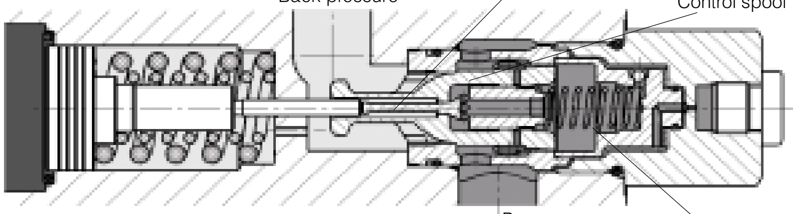
Fixing screws to DIN 912, strength class 12.9, must be used to mount the valve.

As a customer option, these screws can be supplied with the valve.Port threads are formed in accordance with DIN 3852 T1.

7. The load control assembly - description of operation

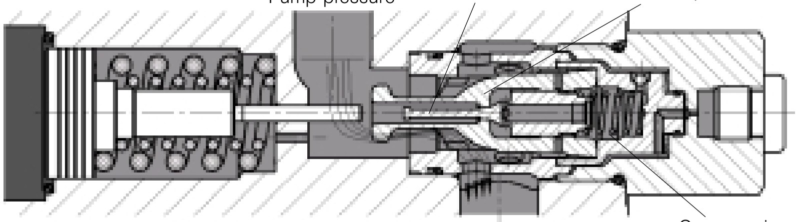
7.1 Neutral position (load pressure at port B; no pressure at A, X)

- In the neutral position, the valve is kept closed with zero leakage by the load pressure and the compression spring, both of which act on the control spool in the closing direction.



7.2 The “Lift” function (flow A → B)

- the valve functions as a check valve
- pump pressure at port A opens the valve against the light compression spring and the load, and oil flows from A to B.
- Due to the small effective area of the pilot spool, it does not lift from its seat but moves together with the main spool in the opening direction.



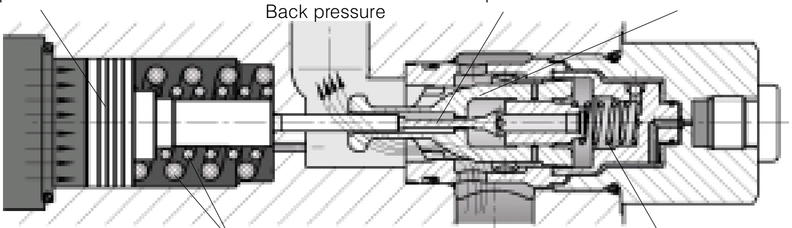
7.3 The ”Lower” function (flow B → A)

7.3.1 Pre–opening

The pilot pressure at port X moves the pilot piston in opposition to the control springs and opens the pilot spool. The progressive characteristic of the pre-opening phase ensures that lowering motions begin smoothly and without jerks.

7.3.2 Opening of the control spool

Further increase in the pressure at port X causes the pilot spool to open still more. The load pressure now acts on the resulting ring area and causes the control spool to follow the pilot spool in the opening direction.



8. Load pressure-compensated and over-compensated models

In its general construction and size, this type of load control valve is very similar to the standard Cindy valve. This particular design, however, is specifically intended for controlling the cylinders of mobile crane derricks and of similar boom-type systems, because it offers an additional function while lowering.

While the derrick/boom is being lowered, the constantly changing geometry results in a steadily increasing load pressure.

In spite of this, the speed of cylinder retraction:

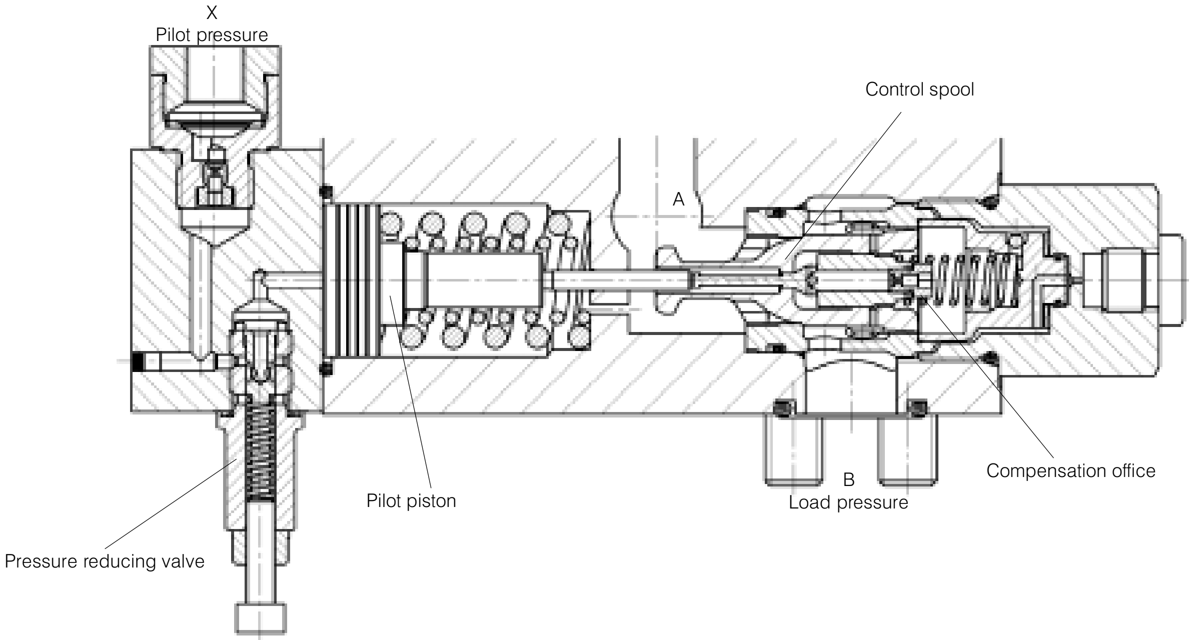
- remains constant if the compensated valve model is used and
- actually reduces if the over-compensated valve model is used, even as the load pressure increases.

The compensation orifice causes pressure to build up behind the control spool, the amount of the increase being influenced by the size of the orifice. As the load pressure increases, the control spool now constricts the B → A flow area.

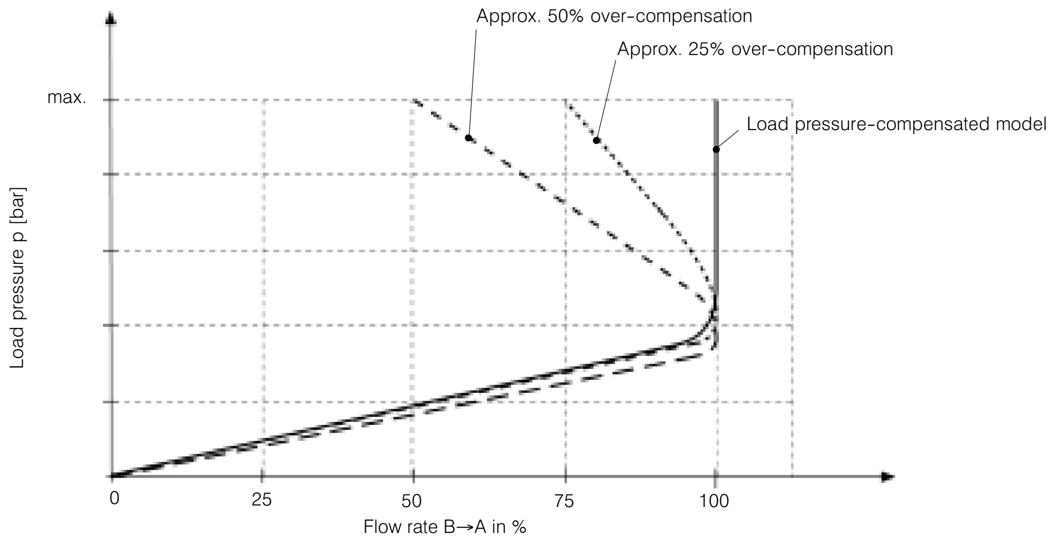
To ensure the proper functioning of this feature, the valve must always be externally controlled. The design of the control system must ensure that the pilot piston never travels far enough to reach its end stop.

☞ Note: for compensated and over-compensated models, we therefore recommend the use of the "hydraulic pressure reducing valve" control (see section 9.5).

8.1 Sectional view: over-compensated model

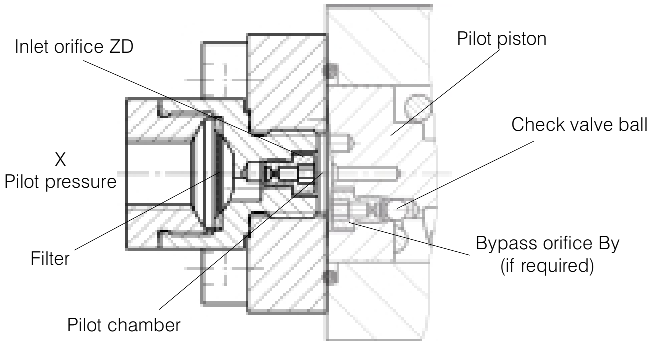


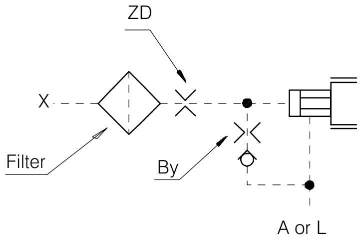
8.2 Performance curves (examples)



9. Controlling the valve (damping, opening pressure)

9.1 Pilot-control with the "standard cover" (G)

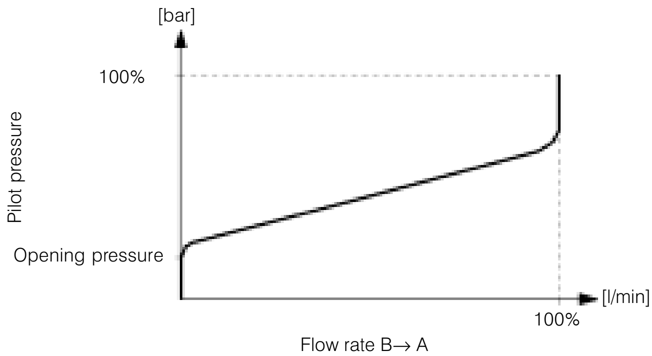




For lowering from B → A, a pilot signal is applied at port X in the valve cover. The signal passes through the inlet damping orifice into the valve's pilot chamber. The valve starts to open at approximately 6 bar and is fully open at 20 bar. The entire pilot circuit is protected against contamination particles by a mesh filter.The required level of pilot pressure can be raised by means of a bypass orifice. This bypass orifice is situated in the pilot piston and connects the pilot pressure to the return port A or, via the drain port L, to tank. The bypass orifice functions as a flow or pressure divider. On the one hand, it raises the required level of pilot pressure and on the other, it enables the valve to close more rapidly. It also provides an automatic air bleed function for the pilot oil circuit. A ball-type check valve prevents flow in the reverse direction and gives protection against contamination.

⚠ Caution: when changing the bypass orifice, make sure that the check valve ball is re-fitted

By varying the relationship of the sizes of the inlet and bypass orifices, the control characteristics of the valve can be altered. See the following Table 9.1.1



9.1.1 Table: orifice combinations for pilot–control with "standard cover"

Effective opeining pressure ***	Orifice combination ***	Pilot pressure at "X" pX start of opening (bar) **	pX fully open (bar)**	Opening times (s)* up to max. flow	Closing times (s)* from maximum flow to zero	Inlet orifice ZD (ø mm)	Bypass orifice By (ø mm)	Q, bypass flow at 150 bar pilot pressure (l/min)
G6	0	6	20	0.02	0.02	None	No bypass	0
	1	6	20	0.02	0.02	None	0.3	0.55
	2	6	20	0.02	0.02	None	0.4	1
	3	6	20	0.8	2.8	0.3	No bypass	0
	4	6	20	0.6	2.1	0.35	No bypass	0
	5	6	20	0.5	1.6	0.4	No bypass	0
	6	6	20	0.3	1	0.5	No bypass	0
	7	6	20	0.2	0.7	0.6	No bypass	0
	8	6	20	0.2	0.5	0.7	No bypass	0
	9	6	20	0.1	0.4	0.8	No bypass	0
	10	6	20	0.1	0.3	0.8	0.3	0.55
	11	6.5	21	0.1	0.3	0.8	0.4	0.95
	12	6	20	0.1	0.2	1.0	0.4	1
G7	1	7.2	24	0.2	0.5	0.6	0.4	0.9
	2	7	23	0.3	0.7	0.5	0.3	0.5
	3	7	22	0.2	0.5	0.6	0.35	0.7
G8	1	8	28	0.6	1	0.4	0.3	0.5
	2	8.5	28	0.4	0.6	0.5	0.4	0.85
G9	1	9	31	0.8	1.2	0.35	0.3	0.45
	2	9	30	0.3	0.4	0.6	0.5	1.3
G10	1	10	33	0.5	0.7	0.45	0.4	0.8
G12	1	12	40	1.2	1.4	0.3	0.3	0.4
	2	12	40	0.7	0.8	0.4	0.4	0.7
	3	12	40	0.3	0.3	0.6	0.6	1.6
	4	12	40	0.2	0.2	0.8	0.8	2.8
	5	12	40	0.1	0.1	1.0	1.0	4.4
G16	1	16	52	0.8	0.7	0.4	0.45	0.8
G17	1	17	57	1.4	1.2	0.3	0.35	0.45
G18	1	18	61	0.5	0.4	0.5	0.6	1.3
G21	1	21	69	0.9	0.6	0.4	0.5	0.85
G22	1	22	75	0.3	0.2	0.7	0.9	2.6
	2	22	75	1.3	0.8	0.35	0.45	0.65
G25	1	25	83	1.9	1	0.3	0.4	0.5
G29	1	29	97	0.8	0.3	0.5	0.7	1.4
G36	1	36	121	3.2	0.9	0.3	0.45	0.5
G52	1	52	174	21.4	0.7	0.3	0.5	0.55

(measured at 33cSt [mm^2/s])

* Opening times:
for sudden pilot pressure rise from 0 to 150 bar

* Closing times:
for sudden pilot pressure drop to 0 bar.

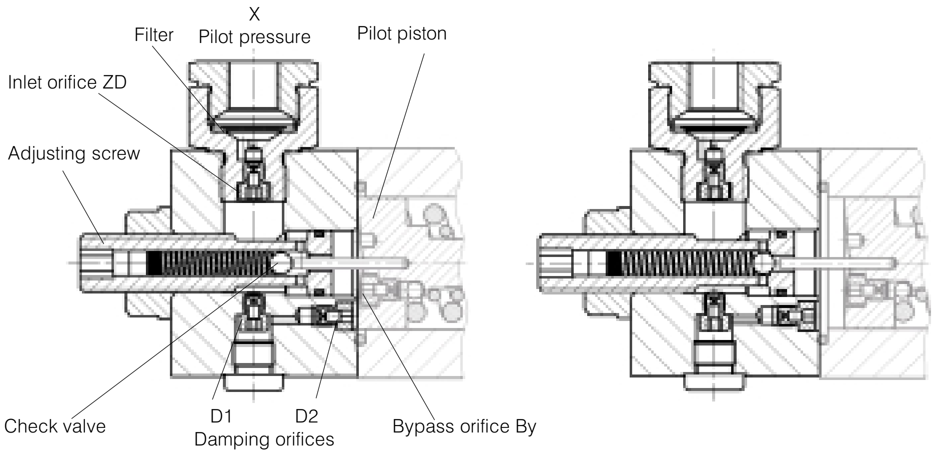
** Note:
the pressure in the control spring chamber must be added to the pilot pressure X

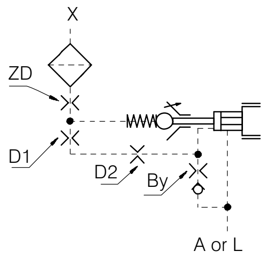
*** details in model code

9.2 Pilot-control with the “damping cover” (D)

Damping function inactive.
Pilot oil flows through inlet orifice
and check valve

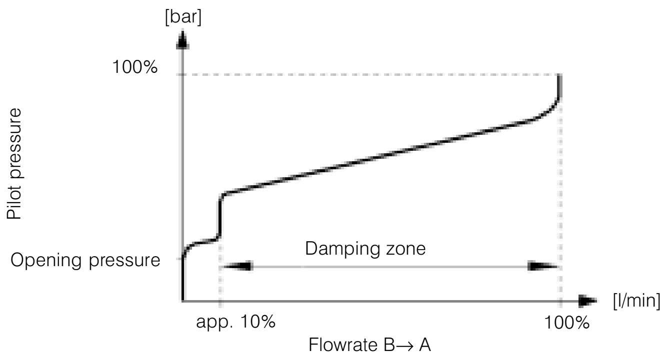
Damping function active.
Pilot oil flows through inlet orifice
and damping orifice(s)





Fundamentally, this control operates in the same way as the standard cover. We recommend that this control be used where the pilot pressure is taken from the opposite side of the actuator. The pilot signal can be further stabilised by a maximum of two additional damping orifices. With the adjusting screw, the user can alter the point at which the additional damping comes into effect (standard plant setting = 10% of the nominal flow rate). The effect of this stroke-dependent setting is to reduce the starting pressure peaks that are common with heavily damped valves. In the initial stages, the valve can respond quickly to the control signal, the stronger damping not coming into play until the set value is reached. Once the damping has been ”activated”, the pilot pressure characteristic changes in accordance with the damping orifices that have been used. The heavy damping has no effect on the closing time, since oil in the pilot chamber can flow out freely through the check valve in the adjusting screw.

☞ Note: for mechanical override/ lowering with the adjusting screw, see section 9.4



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9.2.1 Table: orifice combinations for pilot–control with “damping cover”

Effective opening pressure ***	Orifice combination ***	Pilot pressure at “X“: pX start of opening (bar)**	Pilot pressure at “X“: pX fully open (bar)**	Opening times (s)* up to max. flow	Closing times (s)* from maximum flow to zero	Inlet orifice ZD (ø mm)	Bypass orifice By (ø mm)	1st damping orifice D1 (ø mm)	2nd damping orifice D2 (ø mm)	Q, bypass flow at 150 bar pilot pressure (l/min)
D6	1	6	20	1.2	2.8	0.3	No bypass	0.3	None	0
	2	6	20	0.9	1.6	0.4	No bypass	0.3	None	0
	3	6	57	1.4	0.1	2.0	0.35	keine	0.3	0.45
	4	6	31	0.8	0	None	0.3	0.35	None	0.45
	5	6	57	1.4	0.2	1.2	0.35	0.3	None	0.45
	6	6	20	0.9	1.6	0.6	No bypass	0.3	None	0
	7	6	41	0.5	0.2	1.0	0.45	0.45	None	0.9
D7	1	7	47	1.3	0.7	0.5	0.3	0.3	None	0.4
	2	7.5	45	1.0	0.7	0.5	0.35	0.35	None	0.5
	3	7	42	0.6	0.3	0.8	0.45	0.45	None	0.85
	4	7	33	0.3	0.3	0.8	0.5	0.6	None	1.2
	5	7	43	0.6	0.4	0.7	0.45	0.45	None	0.85
D8	1	8	40	0.5	0.4	0.6	0.45	0.5	None	0.9
	2	8	46	0.7	0.4	0.6	0.45	0.45	None	0.85
	3	8	46	1.5	1.0	0.4	0.3	0.3	None	0.35
D9	1	9	72	2.7	1.2	0.35	0.3	0.25	None	0.3
	2	9	42	1.3	1.2	0.35	0.3	0.35	None	0.4
	3	9	52	1.7	1.2	0.35	0.3	0.35	0.35	0.35
	4	9.5	52	1.3	0.9	0.4	0.35	0.35	None	0.5
	5	9	60	0.8	0.4	0.6	0.5	0.45	None	0.9
D12	1	12	60	2.1	1.4	0.3	0.3	0.3	None	0.3
	2	12	60	1.5	1.0	0.35	0.35	0.35	None	0.45
	3	12	60	0.8	0.5	0.5	0.5	0.5	None	0.9
	4	12	60	0.5	0.3	0.6	0.6	0.6	None	1.3
D15	1	15	94	1.2	0.5	0.5	0.55	0.45	None	0.9
D16	1	16	74	1.6	0.9	0.35	0.4	0.4	None	0.5
	2	16	88	2.1	0.9	0.35	0.4	0.35	None	0.5
D17	1	17	94	3.0	1.2	0.3	0.35	0.3	None	0.35
	2	17	77	2.2	1.2	0.3	0.35	0.35	None	0.4
D18	1	18.5	103	1.2	0.4	0.5	0.6	0.5	None	1.0
D22	1	22	125	1.4	0.3	0.55	0.7	0.55	None	1.2
D25	1	25	146	10.0	1.0	0.3	0.4	0.3	None	0.35
	2	25	117	3.7	1.0	0.3	0.4	0.35	None	0.4

(measured at 33 cSt [mm^2/s])

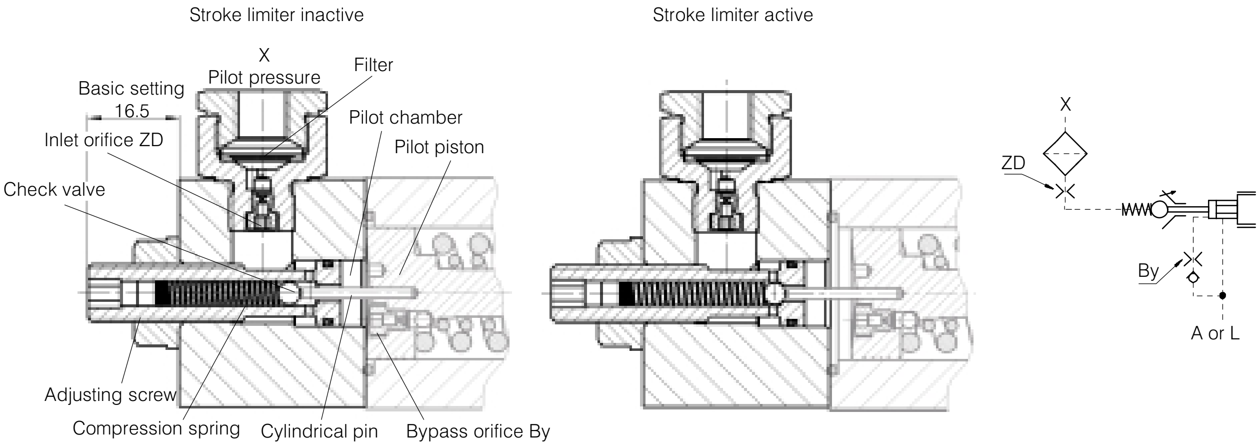
*Opening times:
for sudden pilot pressure rise from 0 to 150 bar.

* Closing times:
for sudden pilot pressure drop to 0 bar.

** Note:
the pressure in the control spring chamber must be added to the pilot pressure X

*** details in model code

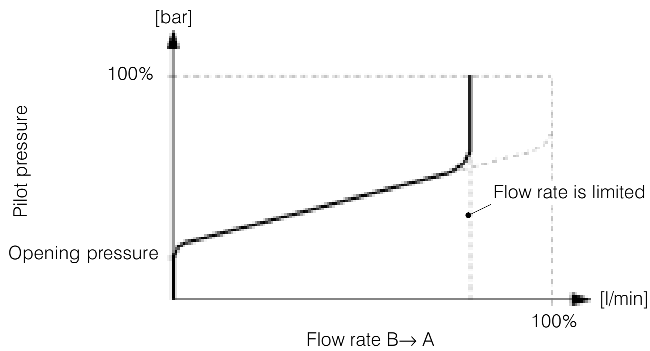
9.3 Pilot-control with the “hydro-mechanical stroke limiter” (H)



The stroke of the control spool can be restricted with the hydro-mechanical stroke limiter, thus creating the effect of intermediate sizes in the control spool programme. This is at the expense of valve resolution, however. This control is similar to the standard control, with the addition of an adjusting screw (basic factory setting of 16.5 mm ensures that full stroke is still possible). The screw contains a check valve, which is held open by the cylindrical pin that is secured in the pilot piston. The pilot oil flows through this check valve into the pilot chamber of the valve. When the pilot piston has advanced through the required stroke, the check valve ball blocks the flow and the control assembly does not open any further. When the pilot pressure drops, the cylindrical pin opens the check valve and the load-control valve closes.

Note: pilot-control with ”damping cover” and pilot-control with ”hydro-mechanical stroke limiter” cannot be combined with each other

Note: for mechanical override/lowering with the adjusting screw, see section 9.4



9.3.1 Table: orifice combinations for pilot–control with “hydro–mechanical stroke limiter”

Effective opening pressure ***	Orifice combination ***	Pilot pressure at “X“ pX start of opening (bar)**	Pilot pressure at “X“ pX fully open (bar)**	Opening times (s)* up to max. flow	Closing times (s)* from maximum flow to zero	Inlet orifice ZD (ø mm)	Bypass orifice By (ø mm)	Q, bypass flow at 150 bar pilot pressure (l/min)
H6	0	6	20	0.02	0.02	None	No bypass	0
	1	6	20	0.02	0.02	None	0.3	0.55
	2	6	20	0.02	0.02	None	0.4	1
	3	6	20	0.8	2.8	0.3	No bypass	0
	4	6	20	0.6	2.1	0.35	No bypass	0
	5	6	20	0.5	1.6	0.4	No bypass	0
	6	6	20	0.3	1	0.5	No bypass	0
	7	6	20	0.2	0.7	0.6	No bypass	0
	8	6	20	0.2	0.5	0.7	No bypass	0
	9	6	20	0.1	0.4	0.8	No bypass	0
	10	6	20	0.1	0.3	0.8	0.3	0.55
	11	6.5	21	0.1	0.3	0.8	0.4	0.95
	12	6	20	0.1	0.2	1.0	0.4	1
H7	1	7.2	24	0.2	0.5	0.6	0.4	0.9
	2	7	23	0.3	0.7	0.5	0.3	0.5
	3	7	22	0.2	0.5	0.6	0.35	0.7
H8	1	8	28	0.6	1	0.4	0.3	0.5
	2	8.5	28	0.4	0.6	0.5	0.4	0.85
H9	1	9	31	0.8	1.2	0.35	0.3	0.45
	2	9	30	0.3	0.4	0.6	0.5	1.3
H10	1	10	33	0.5	0.7	0.45	0.4	0.8
H12	1	12	40	1.2	1.4	0.3	0.3	0.4
	2	12	40	0.7	0.8	0.4	0.4	0.7
	3	12	40	0.3	0.3	0.6	0.6	1.6
	4	12	40	0.2	0.2	0.8	0.8	2.8
	5	12	40	0.1	0.1	1.0	1.0	4.4
H16	1	16	52	0.8	0.7	0.4	0.45	0.8
H17	1	17	57	1.4	1.2	0.3	0.35	0.45
H18	1	18	61	0.5	0.4	0.5	0.6	1.3
H21	1	21	69	0.9	0.6	0.4	0.5	0.85
H22	1	22	75	0.3	0.2	0.7	0.9	2.6
	2	22	75	1.3	0.8	0.35	0.45	0.65
H25	1	25	83	1.9	1	0.3	0.4	0.5
H29	1	29	97	0.8	0.3	0.5	0.7	1.4
H36	1	36	121	3.2	0.9	0.3	0.45	0.5
H52	1	52	174	21.4	0.7	0.3	0.5	0.55

(measured at 33 cSt [mm^2/s])

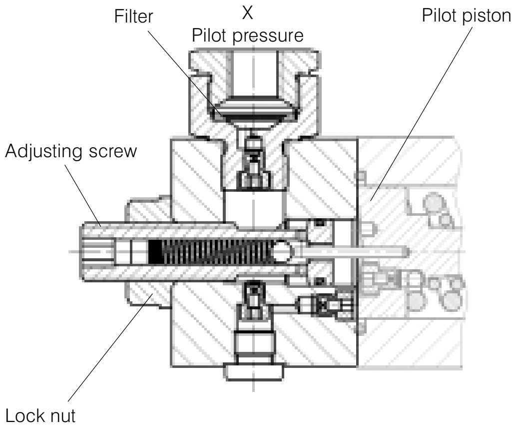
*Opening times:
for sudden pilot pressure rise from 0 to 150 bar.

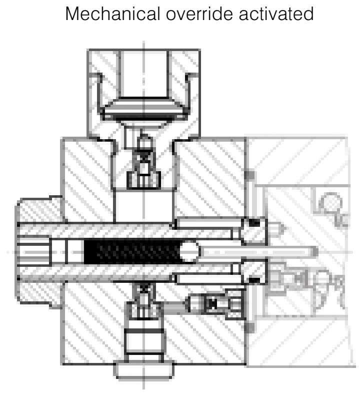
* Closing times:
for sudden pilot pressure drop to 0 bar.

** Note:
the pressure in the control spring chamber must be added to the pilot pressure X

*** details in model code

9.4 Pilot-control with “mechanical override”





The function of the mechanical override is to open the load control valve manually so that the actuator can be moved freely. This is an emergency function, to be used when there is no pilot signal but the actuator must nevertheless be moved to its home position. To enjoy the benefit of the mechanical override, either the ”damping cover” pilot-control or the ”hydro-mechanical stroke limiter” pi-lot-control must be selected. By screwing in the adjusting screw, the pilot piston will be displaced and the control assembly will be opened.

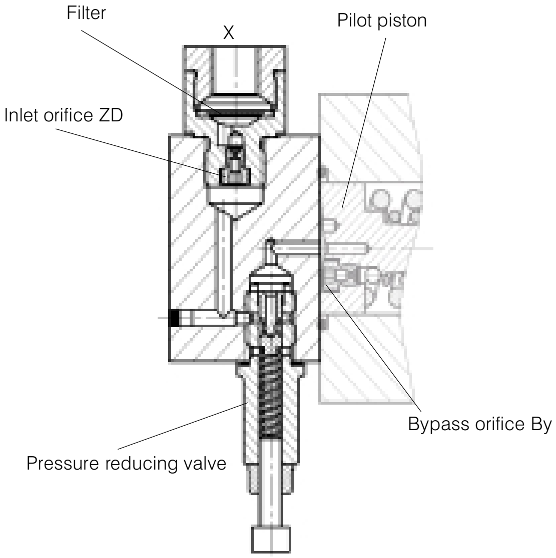
⚠ Caution: varying with the size of the valve, a small adjustment can result in high speeds.

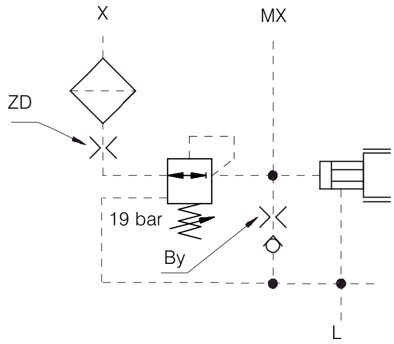
Function:

Slacken the lock nut and screw the adjusting screw in against the pilot piston until the load slowly sinks.

☞ Note: before beginning the override procedure, record the position of the adjusting screw so that it can be reset to this po-sition afterwards.After re-set-ting the adjusting screw, re-tighten the lock nut.

9.5 Pilot-control with the “hydraulic pressure reducing valve” (R)

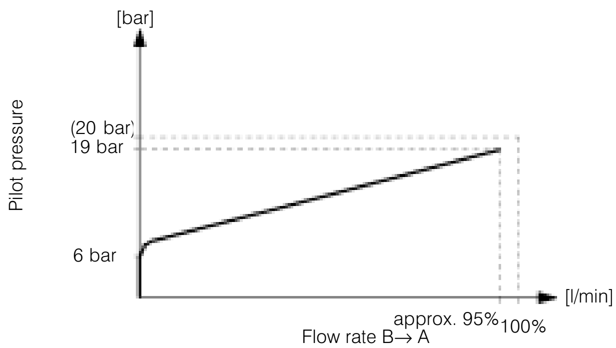




Note: this type of pilot-control requires a drain line.

We recommend this pilot-control for the compensated and over-compensated versions of the valve. To ensure that the compensation function of these models works correctly, the effective pressure in the pilot chamber must not exceed 19 bar (measured at MX). This cover is only used with external pilot pressure supplies. The mandatory limitation of the pilot pressure is already taken care of by the integral reducing valve and thus does not have to be provided for in the external system. Due to the external control, an inlet orifice is not normally required. We recommend the use of a 0.30 mm dia. bypass orifice, however, to ensure that air is bled from the pilot circuit automatically and that the valve closes quickly.

Caution: the maximum allowable inlet pressure at port X is 100 bar!



9.5.1 Table: orifice combinations for pilot–control with “hydraulic pressure reducing valve”

Effective opening pressure ***	Orifice combination ***	Pilot pressure at “X“ pX start of opening (bar)**	pX fully open (bar)**	Opening times (s)* up to max. flow	Closing times (s)* from maximum flow to zero	Inlet orifice ZD (ø mm)	Bypass orifice By (ø mm)	Q, bypass flow at 40 bar pilot pressure (l/min)
R6	0	6	20	0	0	None	No bypass	0
	1	6	30	0	0	None	0.3	0.2
	2	6	30	0	0	None	0.4	0.35
	10	6	20	0.4	0.3	0.8	0.3	0.2
	12	6	20	0.3	0.2	1.0	0.4	0.35
R7	2	7	23	1.0	0.7	0.5	0.3	0.2
R8	2	8.5	28	1.4	0.6	0.5	0.4	0.35
R9	2	9	30	1.1	0.4	0.6	0.5	0.6
R12	3	12	40	1.5	0.3	0.6	0.6	0.8

(measured at 33 cSt [mm²/s])

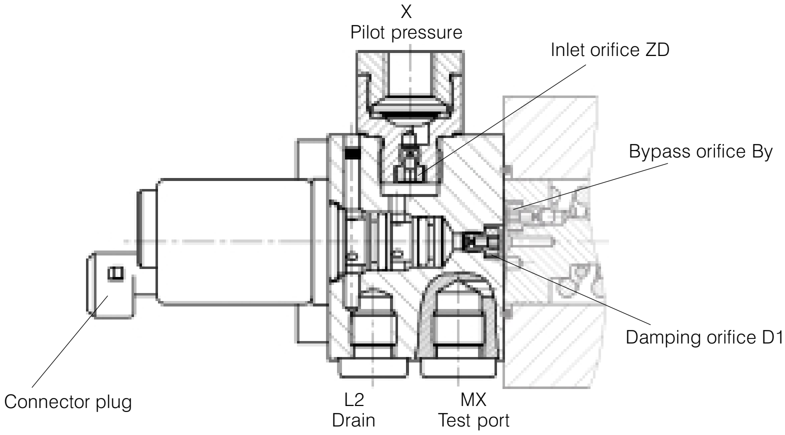
*Opening times:
for sudden pilot pressure rise from 0 to 40bar.

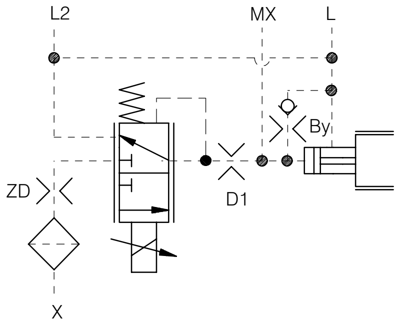
* Closing times:
for sudden pilot pressure drop to 0 bar.

** Note:
the pressure in the control spring chamber must be added to the pilot pressure X

*** details in model code

9.6 Pilot-control with the “electro-proportional pressure reducing valve” (E)



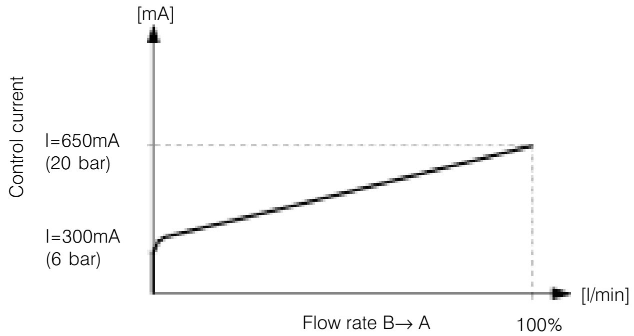


Note: this type of pilot-control requires a drain line.

This model gives the benefit of electro-proportional control of the load control valve. The constant pressure at port X is reduced in proportion to the electrical input signal. For supplying the electrical signal, we recommend a current-compensated, pulse width-modulated amplifier with I_{max} cut-off i.e. with a facility for limiting the maximum current output. We also recommend the use of a 0.30 mm dia. bypass orifice to ensure that air is bled from the pilot circuit automatically and that the valve closes quickly.

Caution: the maximum allowable inlet pressure at port X is 50 bar!

Note: this pilot-control is only available with Nitrile seals



9.6.1 Hydraulic characteristics

Pilot oil supply at X	min. 30 bar max. 50 bar
Permissible tank pressure at L/L2	max. 5 bar static
Flow rate (pump) available at X	min. 2 l/ min max. 4 l/ min
Pilot oil consumption	< 0.1 l/ min at I = 0 < 0.5 l/ min at I = max.
Hysteresis	0.5 bar with PWM control; pulse frequency 100 Hz
Pilot pressure control range	0 - 20 bar
Drain line connection	direct in end cover, or in the valve body

9.6.2 Electrical characteristics

Nominal voltage	24 V DC
Resistance R 20	21.2 Ohm ±5%
Max. current I at 100% duty cycle	750 mA
Power consumption	10.4 VA
Control current - start of opening	300 mA
Control current - fully open	650 mA
Duty cycle	100 %
Insulation class	180 °C(class H to VDE 0580)
Protection class	IP 65 to DIN- VDE 0470
Connector plug	AMP Junior- Timer

9.6.3 Table: orifice combinations for pilot–control with “electro–proportional pressure reducing valve”

Effective opening pressure ***	Orifice combination ***	Opening times (s)* up to max. flow	Closing times (s)* from maximum flow to zero	Inlet orifice ZD (ø mm)	Damping orifice D1 (ø mm)	Bypass orifice By (ø mm)	Q, bypass flow at 40 bar pilot pressure (l/min)
E6	1	0.8	0.7	0.5	0.6	No bypass	0
	2	0.8	1.0	0.6	0.5	No bypass	0
	3	0.7	1.0	None	0.5	No bypass	0
	4	0.6	0.6	None	0.6	0.3	0.2
E7	1	0.9	0.7	None	0.5	0.3	0.2

(measured at 33 cSt [mm^2/s])

*Opening times:
for sudden pilot pressure rise from 0 to 40 bar.

* Closing times:
for sudden pilot pressure drop to 0 bar.

Note:
the pressure in the control spring chamber must be added to the pilot pressure X

*** details in model code

10. Pressure relief functions

Secondary pressure relief valves are used to protect actuators against overload. The relief-valves are aligned parallel to the load control assembly.

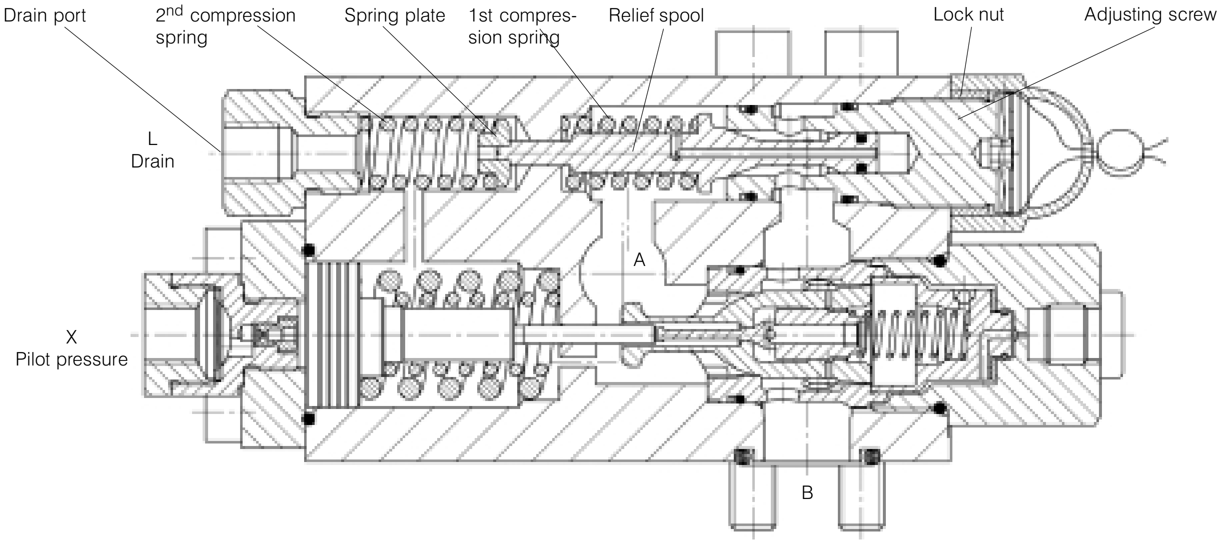
10.1 Direct acting, secondary pressure relief valve, B → A (SVA)

The SVA secondary pressure relief valve is connected directly to port B. When the pressure setting is reached, the relief spool opens a flow path to port A, the return line connection. A separate tank return line is thus not required. The relief spool is pressure balanced, so that forces resulting from back pressure in the return line cancel each other out.

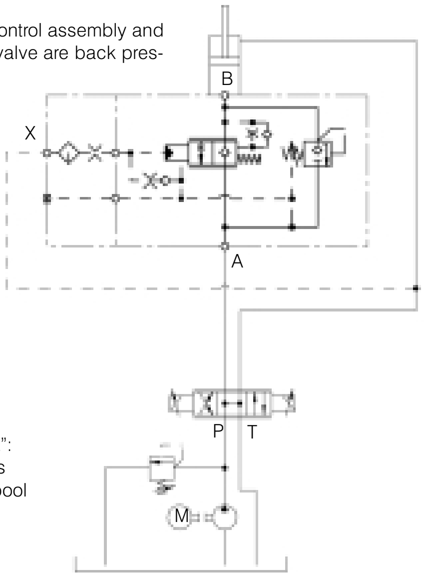
This relief valve can therefore be used with a closed-centre directional valve without producing any pressure-summing at the relief valve located after the directional valve (see circuit example below right). In this case, the spring chamber of the second compression spring drains through port L. With open-centre directional valves, the spring chamber of the second compression spring drains to port A (drain hole not shown in drawing below) and a separate drain line is not required (see circuit example below left).

⚠ Caution: with open-centre spools, make sure that the directional valve has an adequate flow rating!

☛ Note: for relief settings from 80 to 220 bar, the second compression spring and the spring plate are not fitted.

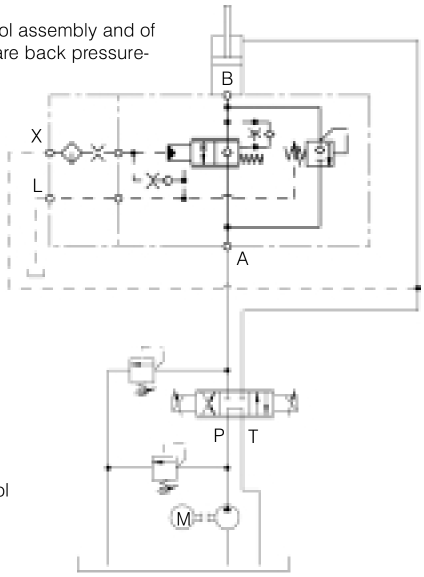


Circuit example B→ A
without drain line
(operation of load control assembly and of secondary relief valve are back pressure-dependent)



Without drain line “L”:
for directional valves
with open-centre spool

Circuit example B→ A
with drain line
(operation of load control assembly and of secondary relief valve are back pressure-independent)



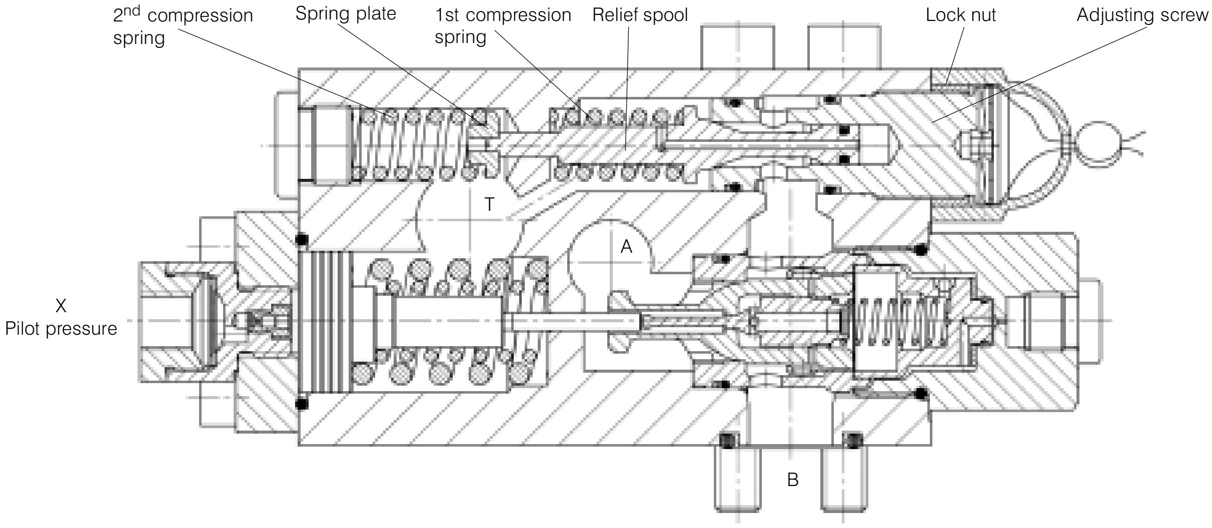
With drain line “L”:
for directional valves
with closed-centre spool

10.2 Direct acting, secondary pressure relief valve, B → T (SVT)

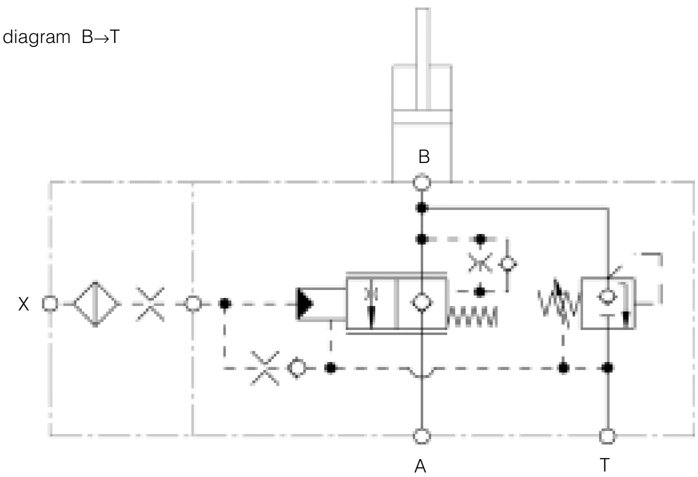
The SVT secondary pressure relief valve is connected directly to port B, the load or cylinder connection. When the pressure setting is reached, the relief spool opens a flow path to port T, the tank line. This valve is used when the open-centre spool of the main directional valve cannot pass the full relief flow..

Caution: the spring chamber of the control assembly is also connected to the tank line. Any tank line back pressure is additive to relief valve setting.

Note: for relief settings from 80 to 220 bar, the second compression spring and the spring plate are not fitted.

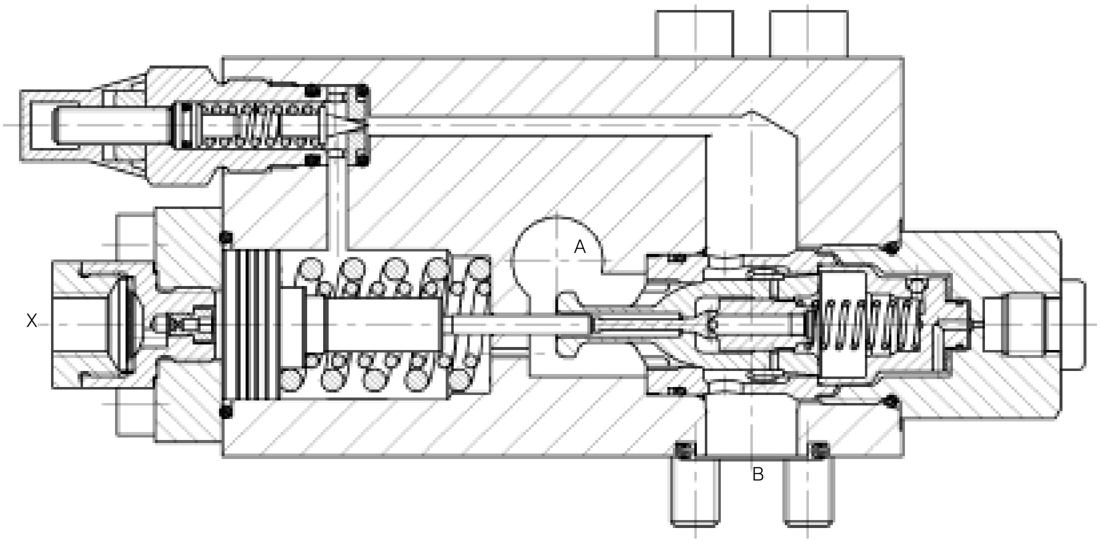


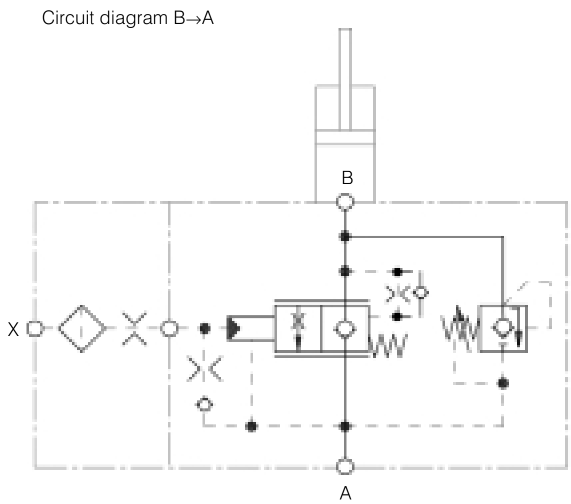
Circuit diagram B→T

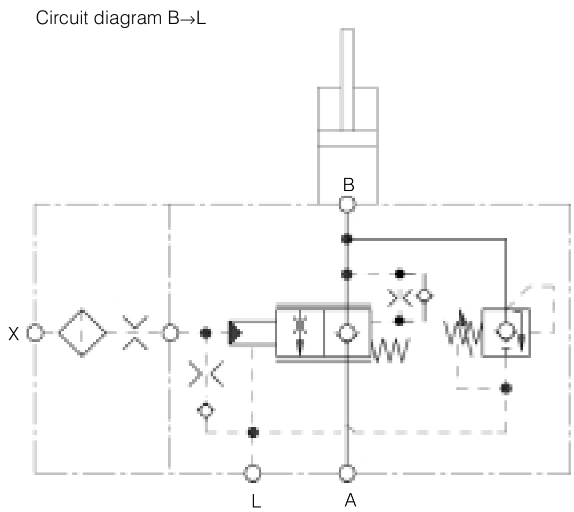


10.3 Thermal expansion pressure relief, B → L or B → A (SVZ)

The expansion in volume (e.g. caused by intense sunshine) and the resulting pressure increase only produce a very short-lived pressure peak, with a very small relieved volume. To protect a cylinder just against such thermal influences, a small relief valve of nominal size 2.5 mm can be used. When the load pressure at port B reaches the setting, the relief valve opens. With back pressure-independent valves, the relief valve opens a path to the drain port L (circuit diagram below right). With back pressure-dependent valves, it opens a path to the return line A (circuit diagram below left).



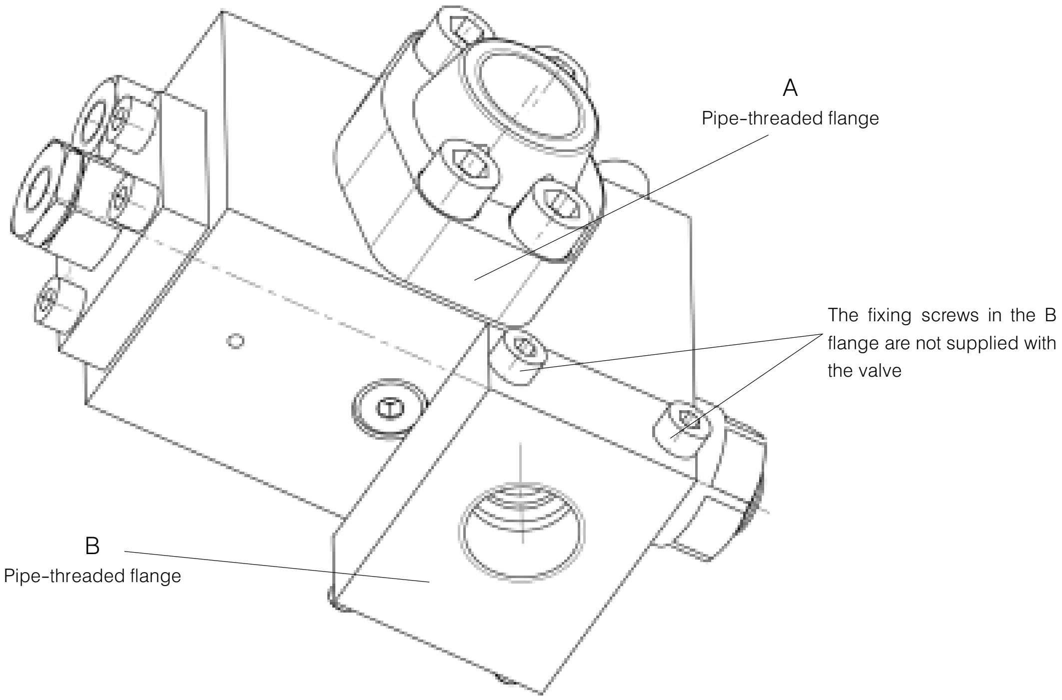




11. Optional connections (adapter from SAE to pipe thread)

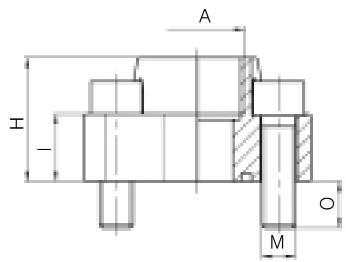
General note:

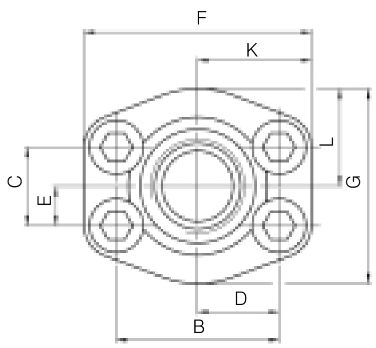
- SAE-pattern A and B ports on Cindy valves can be fitted with pipe-threaded flanges either before dispatch or later.



11.1 Pipe-threaded flange at port A

If pipe threads are required at port A, we recommend the optional type "A" flange. Any normal SAE flange can be used, however.

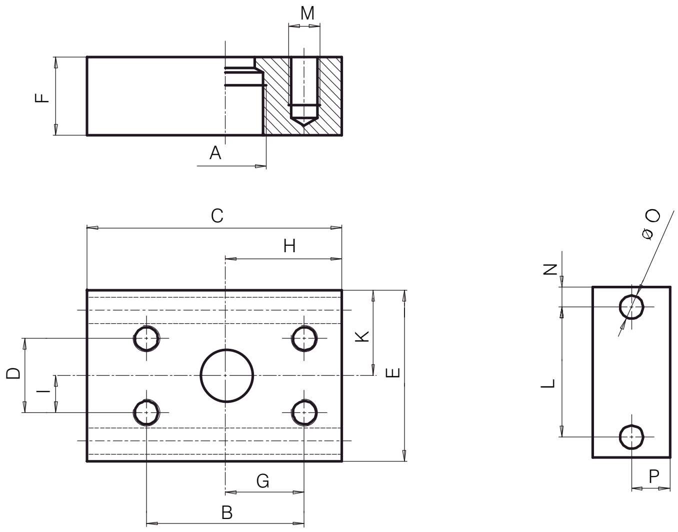




	SAE 6000 psi	A	B	C	D	E	F	G	H	I	K	L	M	O	Flange type A
Cindy 16	3/4"	G 3/4"	50.8	23.8	25.4	11.9	71	53	36	19	35.5	26.5	M10x35	16	G 3/4
Cindy 20	1"	G 1"	57.15	27.76	28.58	13.88	80	69	44	24	40	34.5	M12x40	16	G 1
Cindy 25	1 1/4"	G 1 1/4"	66.68	31.75	33.34	15.88	94	77	44	27	47	38.5	M14x45	18	G 1 1/4

11.2 Pipe-threaded flange at port B

If pipe threads are required at port B, we recommend the optional type "B" flange. The lateral drillings in this flange also offer a possibility for mounting the valve.



	SAE 6000 psi	A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Flange type B
Cindy 12	1/2"	G 1/2"	40.49	63	18.24	44	22	20.5	28	9.12	22	34	M 8	5	6.4	11	G 1/2
Cindy 16	3/4"	G 3/4"	50.8	82	23.8	56	25	25.4	37.5	11.9	28	43	M10	6.5	8.4	12.5	G 3/4
Cindy 20	1"	G 1"	57.15	82	27.76	63	28	28.58	37.5	13.88	31.5	50	M12	6.5	8.4	15	G 1
Cindy 25	1 1/4"	G 1 1/4"	66.68	100	31.75	74	30	33.34	46	15.88	37	58	M14	8	10.5	15	G 1 1/4

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