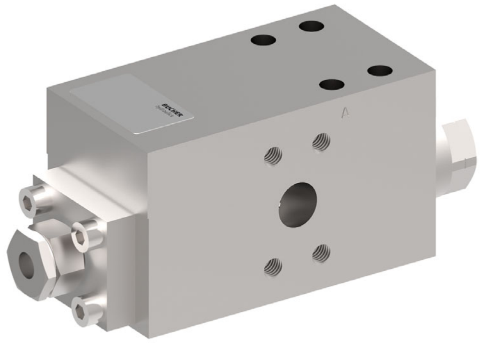
Leak-Free Load-Control Valve SAE ¾“ - 6000 psi flange

Q_{max} = 250 l/min [66 gpm], p_{max} = 420 bar [6000 psi]
leak-proof, two-stage hydraulic, SAE-flange design
Series CINDY 16-B-S...



- Two-stage load-control valve and bypass check valve are functionally combined in one coaxial valve assembly
- Leak-free load holding
- Pilot ratio 113:1
- Guaranteed closing force for the load-control assembly → reliable shut-off even with a broken spring
- Various pilot-pressure ranges can be chosen
- Satisfies exacting demands on corrosion protection thanks to zinc-nickel coating
- Various types of pilot control are available
- Pressure relief is independent of return-line pressure
- Low-noise operation thanks to specially shaped control grooves

1 Description

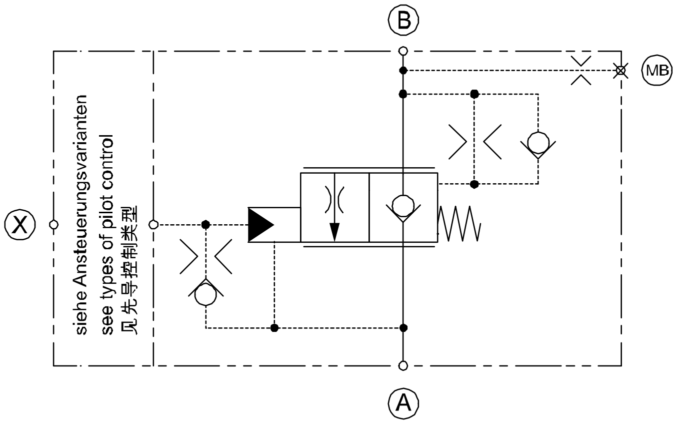
Whenever large loads are to be precisely moved, placed and held, or work access platforms must maintain their position and withstand high forces, then leak-free load-control valves from the CINDY series are the right solution.
Load-control valves in this series prevent hydraulic actuators from running ahead of the available oil supply. In one valve, they combine the functions of load-holding, safety and pipe-rupture protection. Leak-free load-control valves in this series are ideally suited for use in high-pressure applications up to 420 bar (6000 psi). With a variety of optional components, the series can be extended and adapted to the requirements of the system.

2 Symbol

2.1 SAE flange-mounted variants

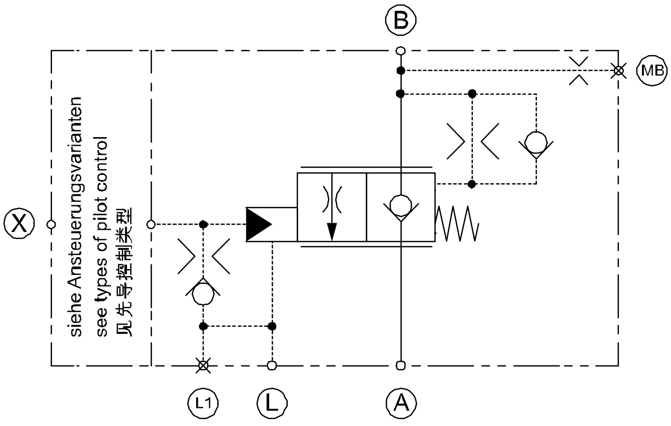
Variant A

Influenced by return-line pressure
(pressure in A is additive to opening pilot pressure).



Variant L

Not influenced by return-line pressure
(drain line is required).



3 Technical data

General characteristics	Description, value, unit
Designation	leak-free load-control valve
Design	leak-proof, two-stage hydraulic, SAE-flange design
Size	SAE ¾“, 6000 psi
Mounting method	flange mounting (4x hex. socket-head cap screws M10x100 DIN EN ISO 4762, – grade 12.9)
Main port A	SAE ¾“, 6000 psi ISO 6162-2 DN19 M10 (SAE J518 Code 62-12, M10x1.5)
Main port B	SAE ¾“, 6000 psi ISO 6162-2 DN19 M10 (SAE J518 Code 62-12, M10x1.5)
Tank port T, T1	G ¾“ ISO 1179-1
Control / drain ports X, L, L1, L2	G ¼“ ISO 1179-1
Test ports MB, MX	G ¼“ ISO 1179-1
Weight	6.7 … 7.9 kg [14.77…17.41 lbs]
Mounting attitude	unrestricted
Ambient temperature range	- 25 °C … +100 °C [-13 °F … +212 °F] (others on application)
Surface corrosion protection	zinc-nickel coating Mounting screws zinc-flake coated (e.g. with Geomet® finish)

Hydraulic characteristics	Description, value, unit
Maximum operating pressure	420 bar [6000 psi]
Maximum pressure at the flow- or return port A	420 bar [6000 psi]
Maximum pressure at the actuator- / load port B	420 bar [6000 psi]
Maximum pressure at the pilot port X	420 bar [6000 psi] (restrictions possible - see section types of pilot control ⇒ 4.4)
Maximum flow rate	250 l/min [66 gpm]
Flow direction	A → B, free flow through check valve B → A, controlled flow
Operator type	hydraulic proportional or electro proportional
Opening pilot ratio	113:1
Secondary pressure relief valve SVA / SVT	120…460 bar [1700…6670 psi] setting is factory-sealed (lower settings on request)
Factory setting tolerance of the secondary pressure relief valve	0 … + 14.0 bar [0 … + 200 psi]

Hydraulic characteristics	Description, value, unit
Thermal-expansion pressure relief SVZ	50…500 bar [700…7200 psi] setting is factory-sealed (lower settings on request)
Hydraulic fluid	HL and HLP mineral oil to DIN 51 524; for other fluids, please contact BUCHER
Hydraulic fluid temperature range	- 25 °C … + 80 °C [-13 °F … +176 °F]
Temperature rating of seals NBR FKM MIL	- 25 °C … + 100 °C [-13 °F … +212 °F] - 20 °C … + 200 °C [-4 °F … +392 °F] - 55 °C … + 80 °C [-67 °F … +176 °F]
Viscosity range	2.8…1500 mm^2/s (cSt), recommended 10…380 mm^2/s (cSt)
Minimum fluid cleanliness Cleanliness class to ISO 4406 : 1999	class 20/17/14

4 Construction and function

The functions of the control assembly are subdivided into the following positions:

4.1 Neutral position

The load pressure and the compression spring act on the control spool in the closing direction. The valve is closed with no leakage.

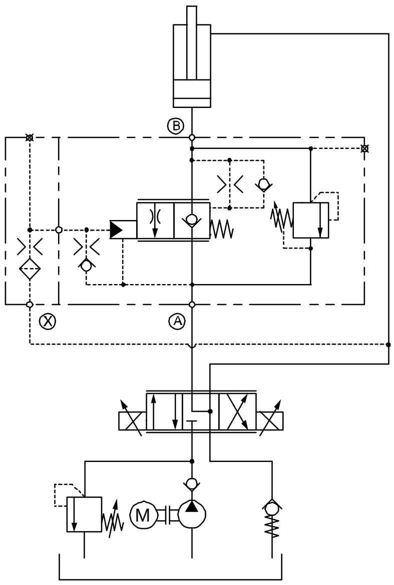
4.2 Lifting (flow direction from A → B)

The pump pressure at port A opens the valve against the "light" compression spring and the load. The pilot spool and control spool move together in the opening direction. Oil flows from A → B and the valve functions as a check valve.

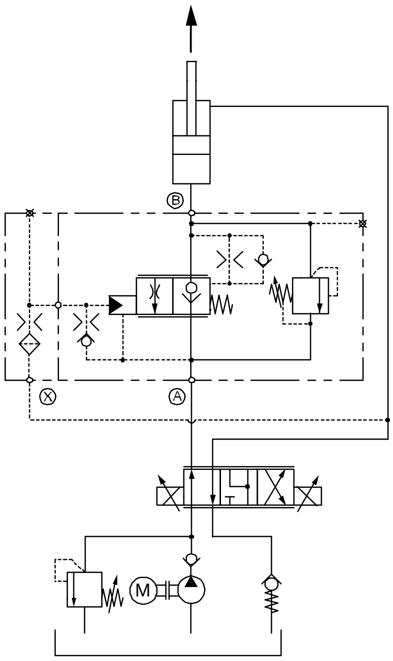
4.3 Lowering (flow direction from B → A)

The pilot pressure at port X acts on the pilot piston and against the control springs. The pilot spool opens. As a result, the load pressure B is discharged to port A via the metering grooves in the pilot spool. The progressive characteristic of the pre-opening phase ensures that lowering begins smoothly and without jerks.
If the pilot pressure at port X is increased, the pilot spool opens further. The change in the pressure conditions at the control spool means that it follows the pilot spool in the opening direction. The oil flows from B → A.

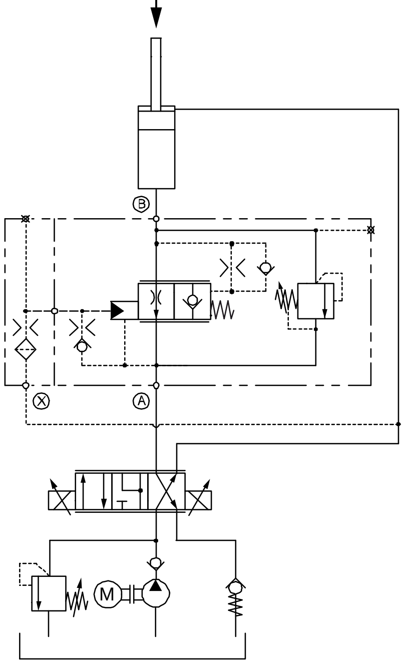
Neutral position
(Symbol for 4.1)



Lifting (A → B)
(Symbol for 4.2)



Lowering (B → A)
(Symbol for 4.3)



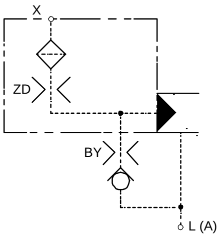
4.4 Types of pilot control

Cover types / applications	Type “G“	Type “D“	Type “H“	Type “R“	Type “E“
Cylinder application (external pilot signal)	✓✓	×	✓	✓	✓✓
Cylinder application (pilot signal from opposite line)		✓✓		×	×
Motors for slewing drives	×	✓✓	×	×	×

Explanation of symbols: ✓✓ = normal ✓ = possible × = not possible

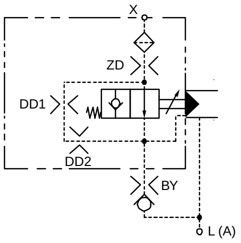
4.4.1 Standard damping cover, type “G“

Pilot control type “G“ is recommended for external control, or with low-oscillation applications. This control cover can only be damped with an inlet orifice. Stroke-dependent damping is not possible with this cover.



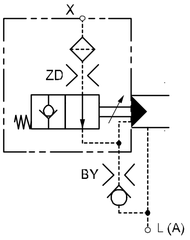
4.4.2 Stroke-dependent damping cover, type “D“

The type “D“ cover is recommended for handling pilot signals that come from the opposite actuator line and for applications that are susceptible to oscillations. Thanks to the pilot piston's stroke-dependent damping system, oscillation-prone applications can be started in a very stable manner. The starting pressure peak is reduced because in the starting zone the valve responds quickly to the pilot signal.



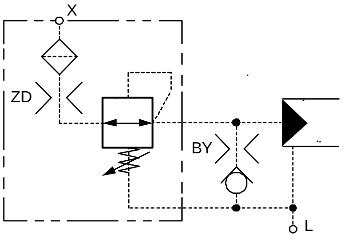
4.4.3 Hydromechanical stroke-limiting cover, type “H“

With the type “H“ pilot control, the stroke of the load-control spool can be limited from outside the valve to achieve a particular flow rate or speed. This reduces the valve resolution.



4.4.4 Hydraulic pressure-reducing valve cover, type “R“

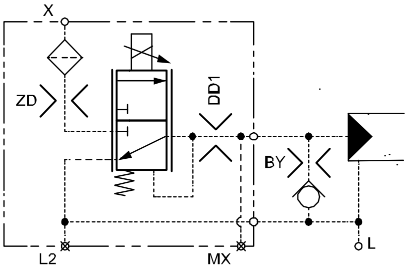
Pilot control type “R“ denotes the version in which the incoming pilot pressure is reduced to a preset level. This function is needed when working with compensated and over-compensated applications, and the actual pilot pressure in the pilot chamber must not exceed 19 bar. The small leakage flow from the pressure reducing valve is discharged through an internal drain connection. The maximum allowable inlet pressure at port X is 100 bar. Because compensated and over-compensated systems must always be externally controlled, an inlet orifice is not normally required.



IMPORTANT!: Only available in return pressure independent version (L).

4.4.5 Electroproportional pressure-reducing valve cover Type “E“

The type “E“ control can be used for electroproportional control. In this case, the inlet signal at port X is reduced to a level proportional to the applied control current. The small flow of pilot oil from the pressure reducing valve is led away through an internal drain connection or a separate drain port. This control type is only intended for external pilot oil supplies, and it is essential to use a back-pressure-independent body (L).



Hydraulic characteristics	Description, value, unit	
Pilot-oil supply at X	min. 30 bar max. 350 bar	[min. 435.11 psi] [max. 5076.32 psi] *
Permissible tank pressure at L (static)	max. 5 bar	[max. 72.51 psi]
Flow rate (pump) available at X	min. 2 l/min	[min. 0.528 gpm]
Pilot-oil consumption / Leakage flow rate	< 0.1 l/min (I = 0) < 0.5 l/min (I = max)	[< 0.026 gpm (I = 0)] [< 0.132 gpm (I = max)]
Hysteresis (with PWM control; pulse frequency 100 Hz)	0.5 bar	[7.25 psi]
Pilot-pressure control range	0…20 bar	[0…290.07 psi]

* Other values on request

Electrical characteristics	Description, value, unit	
Nominal voltage	12 V DC	24 V DC
Resistance R 20	5.3 Ω ± 5 %	21.2 Ω ± 5 %
Maximum current at 100% duty cycle	1500 mA	750 mA
Power consumption at operating temperature (with increased resistance)	18 W	18 W
Control current at start of opening	~ 600 mA	~ 300 mA
Control current when fully open	~ 1400 mA	~ 700 mA
Relative duty cycle	100 %	
Insulation class	180 °C (VDE 0580:H)	[356 °F]
Protection class	IP 65 (DIN VDE 0470)	
Connector plug type	AMP Junior Timer Deutsch Plug DT04-2P	

IMPORTANT!: Only available in return pressure independent version (L).

General:

The series-connection of the orifices allows the opening time, the closing time, the start of opening, and the full extent of opening to be matched to the requirements of the application.

4.5 Secondary pressure relief valve (SV)

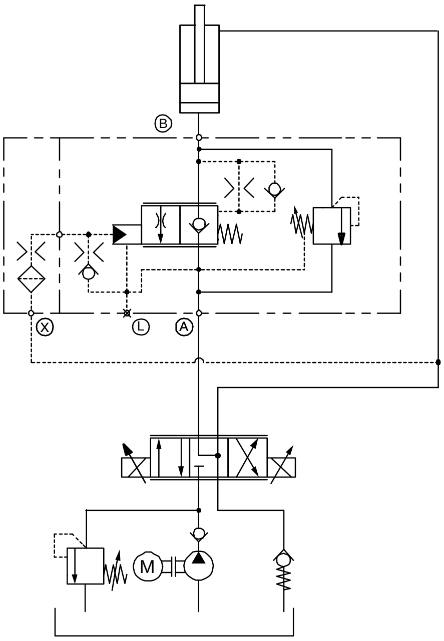
To protect the actuator from overload, a version that includes a secondary pressure relief valve is available. A direct-acting pressure relief valve, type SVT or SVA, for the whole rated flow.

☞ IMPORTANT!: With open-centre directional valves, make sure that the valve has an adequate flow rating. If the security seals or other security elements are removed, all Bucher Hydraulics' liabilities become null and void.

4.5.1 Direct-acting secondary pressure relief valve Variant: SVA (B → A)

The SVA direct-acting secondary pressure relief valve is connected directly to the load port B. When the pressure setting is reached, the relief spool opens a flow path to port A, the return line connection.
The relief setting is locked and sealed with a special lock nut.

Circuit example for SVA (B → A)
for directional valves with open-centre spool

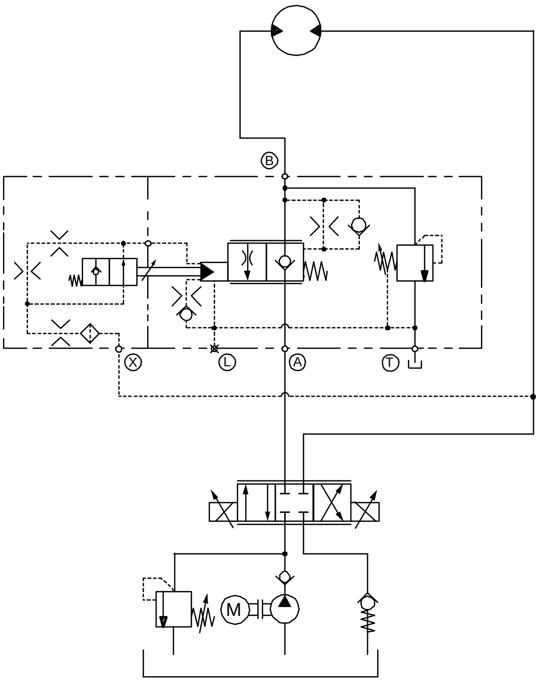


⚠ ATTENTION!:
With body variant A, the return-line pressure is additive 1:1 to the pressure setting (see Fig. at left)! With body variant L, the spring chamber in the pressure relief valve is drained to tank, so the return-line pressure does not affect the pressure setting.

4.5.2 Direct-acting secondary pressure relief valve Variant: SVT (B → T)

The SVT direct-acting secondary pressure relief valve is connected to the load port B. When the pressure setting is reached, the relief spool opens and creates a connection to the tank port T.
The relief setting is locked and sealed with a special lock nut.
This model is used when the open-centre spool cannot handle the full flow rate, or when the application causes the load to move.

Circuit example for SVT (B → T)
for directional valves with closed-centre spool



⚠ ATTENTION!:
In the case of a tank-line preload, the pressure is additive 1:1 to the pressure setting!

4.5.3 Overview table for secondary pressure relief valves

IMPORTANT!:
Please refer to the technical design sheets 300-D-9050101 for cylinder applications and 300-D-9050102 for motor applications.

	SV variants / spool variants	SVA ** Back-pressure dependent (CINDY 16-B-P__-S___-A)	SVA Back-pressure independent (CINDY 16-B-P__-S___-L)	SVT Back-pressure dependent (CINDY 16-B-P__-S___-A)	SVT *** Back-pressure independent (CINDY 16-B-P__-S___-L)
Cylinder applications	Directional valve spool with open centre	✓	✓✓		
	Directional valve spool with closed centre	×		✓	✓
Motor applications *	Directional valve spool with open centre	✓	✓✓		
	Directional valve spool with closed centre	×		✓	✓

Explanation of symbols: ✓✓ = normal ✓ = possible × = not possible

Supplements / Notes:

* In motor applications, to prevent cavitation at the hydraulic motor it is essential to ensure that sufficient oil is always available at the supply side under all operating conditions!

** Return-line pressure from line A is additive to the secondary pressure relief valve's pressure setting!

*** Leakage/drain gallery (L) is internally connected within the body to the tank gallery (T)!

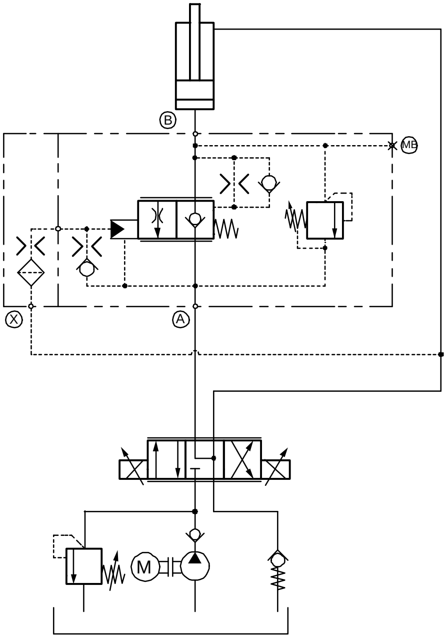
4.6 Thermal-expansion pressure relief valve (SVZ)

The SVZ pressure relief valve is used to protect against thermal-expansion effects (Q_{max} 10 l/min / [2.6 gpm]). The expansion in the volume of the hydraulic oil in a cylinder (e.g. with long exposure to sunlight), and the resulting increase in pressure, can be reduced with this design.

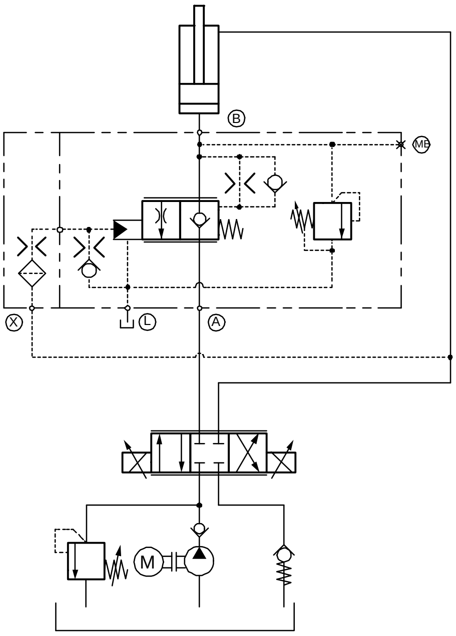
IMPORTANT!: With open-centre directional valves, make sure that the valve has an adequate flow rating. If the security seals or other security elements are removed, all Bucher Hydraulics' liabilities become null and void.

When the load pressure reaches the setting, the relief valve opens. With back-pressure-independent valves, it creates a connection to the drain port L (see circuit at right). With back-pressure-dependent valves, it creates a connection to port A (see circuit at left).
The relief setting is locked with a special plastic cap.

Circuit example for SVZ (B → A), influenced by return-line pressure, for directional valves with open-centre spool



Circuit example for SVZ (B → L), not influenced by return-line pressure, for directional valves with closed-centre spool



ATTENTION!:
With body variant A, the return-line pressure is additive 1:1 to the pressure setting (see Fig. at left)! With body variant L, the spring chamber in the pressure relief valve is drained to tank, so the return-line pressure does not affect the pressure setting.

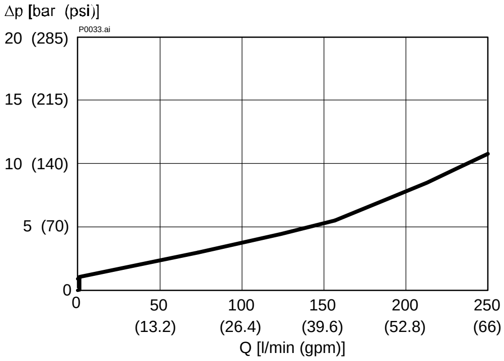
IMPORTANT!:
For more information on the pressure relief valve for protection against thermal influences, see documentation 300-P-9050065

5 Performance graphs

measured with oil viscosity 33 mm^2/s (cSt)

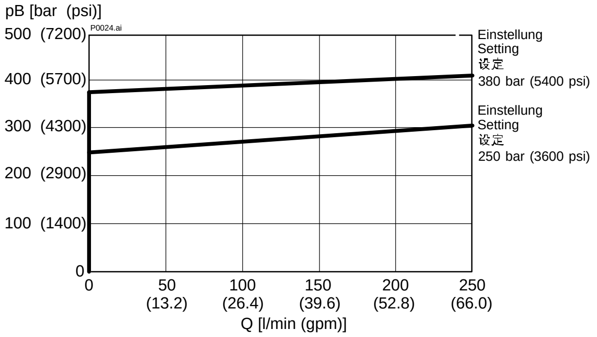
Δp = f (Q) Pressure drop - Flow rate characteristic

Lifting A → B

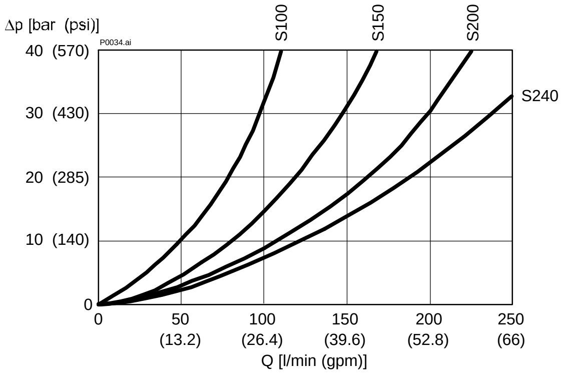


p = f (Q) Pressure - Flow rate characteristic

Secondary pressure relief valve SVA / SVT



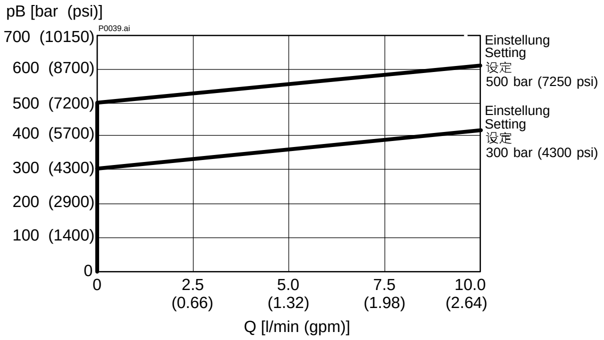
Δp = f (Q) Pressure drop - Flow rate characteristic



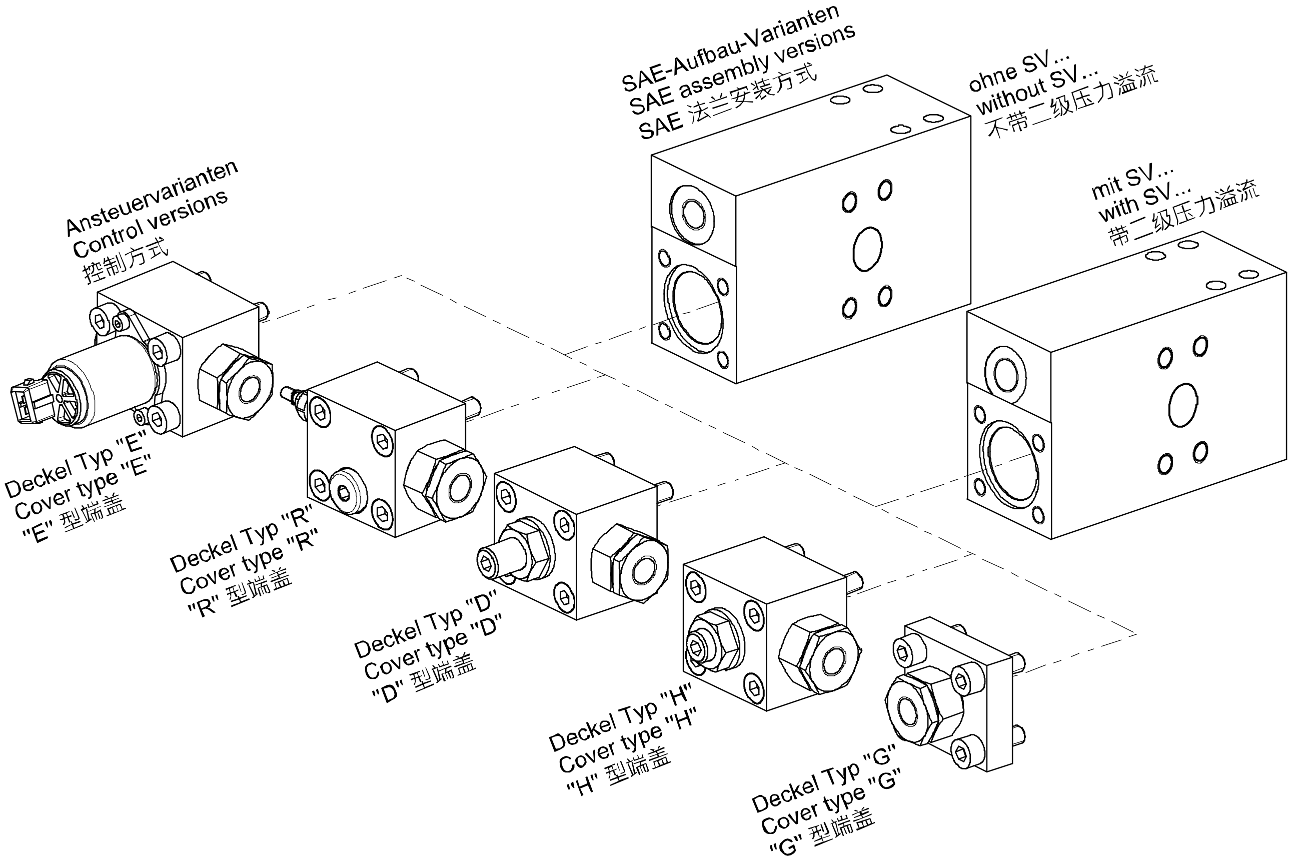
Lowering B → A

p = f (Q) Pressure - Flow rate characteristic

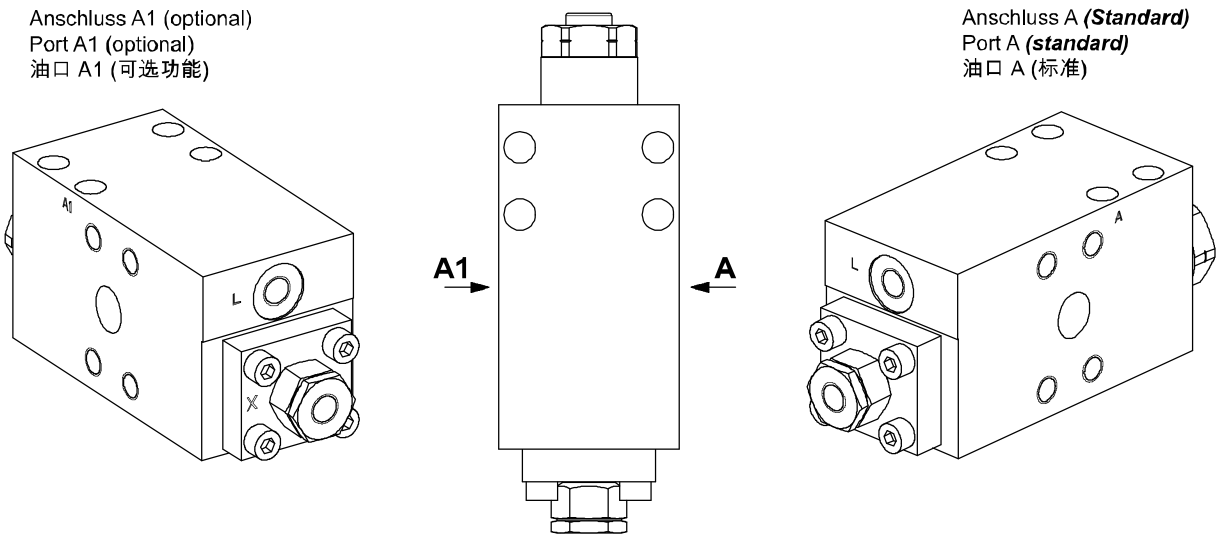
Thermal-expansion pressure relief SVZ



6 Available modules


Ansteuervarianten
Control versions
控制方式
SAE-Aufbau-Varianten
SAE assembly versions
SAE 法兰安装方式
ohne SV...
without SV...
不带二级压力溢流
mit SV...
with SV...
带二级压力溢流
Deckel Typ "E"
Cover type "E"
"E" 型端盖
Deckel Typ "R"
Cover type "R"
"R" 型端盖
Deckel Typ "D"
Cover type "D"
"D" 型端盖
Deckel Typ "H"
Cover type "H"
"H" 型端盖
Deckel Typ "G"
Cover type "G"
"G" 型端盖

6.1 Definition of the connection types A or A1


Anschluss A1 (optional)
Port A1 (optional)
油口 A1 (可选功能)
Anschluss A ***(Standard)***
Port A ***(standard)***
油口 A (标准)
A1
L
X
A1
A
L
A

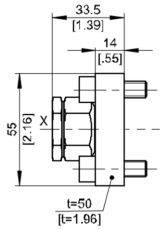
The main port is defined as seen from the perspective of the cover. As standard, the main port A is located on the right side. A variant with main port A1 is available as an option.

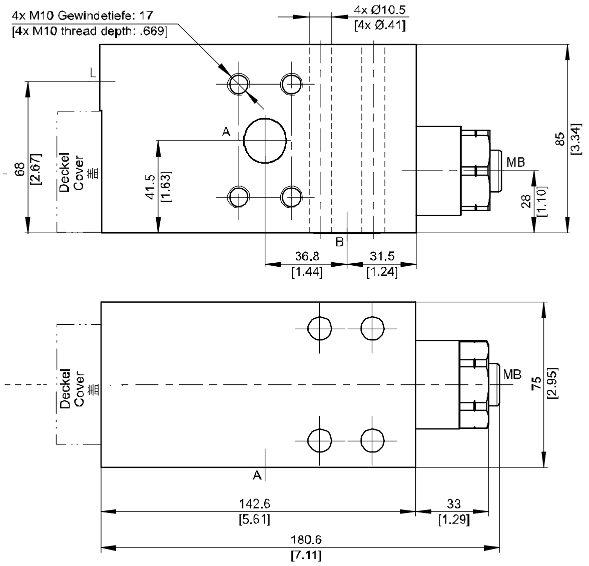
This port is located on the left side. Either port A or A1 is available. Dimensions for port A or A1 are identical.

7 Dimensions & sectional view

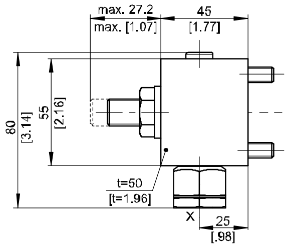
Beispiel für die Masseinheit: Example for the dimensional units: 尺寸单位举例:				
	0.79	=	0.79 mm	millimeter
	[.031]	=	0.031 ″	inch

Standarddämpfungsdeckel Typ "G"
Standard damping cover type "G"
"G" 型标准阻尼功能端盖


33.5
[1.39]
14
[.55]
55
[2.16]
X
t=50
[t=1.96]

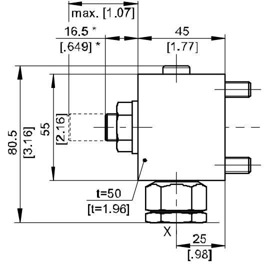

4x M10 Gewindetiefe: 17
[4x M10 thread depth: .669]
4x Ø10.5
[4x Ø.41]
L
A
68
[2.67]
Deckel
Cover
盖
41.5
[1.63]
MB
85
[3.34]
28
[1.10]
B
36.8
[1.44]
31.5
[1.24]
75
[2.95]
A
142.6
[5.61]
33
[1.29]
180.6
[7.11]

Hubabhängiger Dämpfungsdeckel Typ "D"
Stroke-dependent damping cover type "D"
"D" 型行程相关阻尼功能端盖

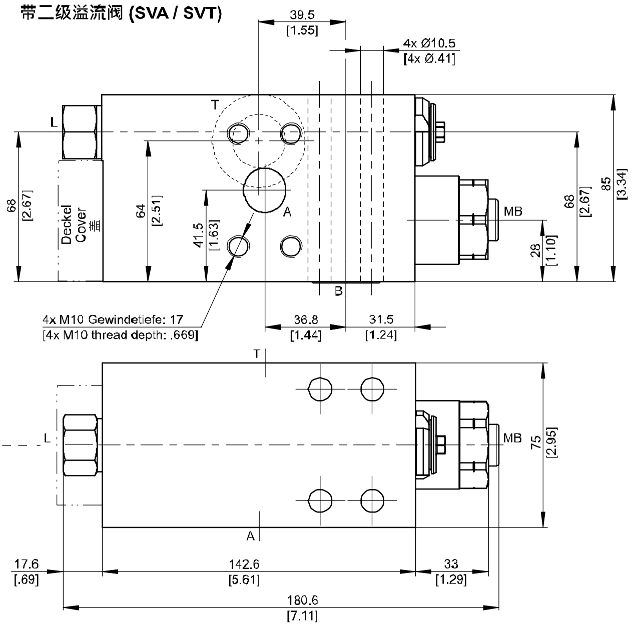

max. 27.2
max. [1.07]
45
[1.77]
80
[3.14]
55
[2.16]
t=50
[t=1.96]
X
25
[.98]

Hydromechanischer Hubbegrenzungsdeckel Typ "H"
Hydromechanical stroke-limiting cover type "H"
"H" 型机-液行程限制功能端盖

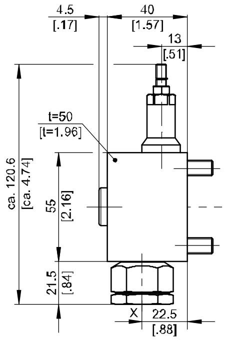
* = werkseitige Einstellung
* = factory setting
* = 工厂设定


max. 27.2
max. [1.07]
16.5 *
[.649] *
45
[1.77]
80.5
[3.16]
55
[2.16]
t=50
[t=1.96]
X
25
[.98]

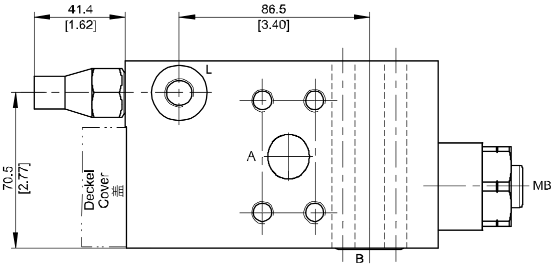
Mit Sekundärdruckbegrenzungsventil (SVA / SVT)
With secondary pressure relief valve (SVA / SVT)
带二级溢流阀 (SVA / SVT)


39.5
[1.55]
4x Ø10.5
[4x Ø.41]
T
L
68
[2.67]
Deckel
Cover
盖
64
[2.51]
41.5
[1.63]
A
MB
68
[2.67]
85
[3.34]
28
[1.10]
B
4x M10 Gewindetiefe: 17
[4x M10 thread depth: .669]
36.8
[1.44]
31.5
[1.24]
T
L
MB
75
[2.95]
A
17.6
[.69]
142.6
[5.61]
33
[1.29]
180.6
[7.11]

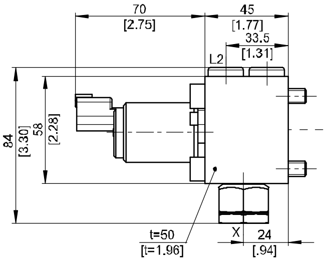
Hydraulischer Druckminderventildeckel Typ "R"
Hydraulic pressure-reducing valve cover type "R"
"R" 型减压阀功能端盖


4.5
[.17]
40
[1.57]
13
[.51]
t=50
[t=1.96]
ca. 120.6
[ca. 4.74]
55
[2.16]
21.5
[.84]
X
22.5
[.88]

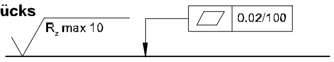
Mit Thermischer Druckbegrenzung (SVZ)
With thermal pressure relief valve (SVZ)
带热敏保护溢流阀 (SVZ)


41.4
[1.62]
86.5
[3.40]
L
A
70.5
[2.77]
Deckel
Cover
盖
MB
B

Elektronischer proportional Druckminderventildeckel Typ "E"
Electronic proportional pressure reducing valve cover type "E"
"E" 型电比例减压阀功能端盖


70
[2.75]
45
[1.77]
33.5
[1.31]
L2
84
[3.30]
58
[2.28]
t=50
[t=1.96]
X
24
[.94]

Erforderliche Oberfläche des Gegenstücks
Required surface of the counterpart
需要配对的表面


R_z max 10
0.02/100

8 Options

8.1 Load-pressure-overcompensated model

This version with compensation orifice (KD) is recommended for long boom systems, e.g. the telescopic booms of mobile cranes. The compensation, alternatively the overcompensation, has the effect of limiting the speed as the load pressure increases, and this in turn raises machine safety levels.
During the lowering function B → A (with a maximum pilot pressure of 19.8 bar), the cylinder's retraction speed is influenced by the compensation orifice KD. In spite of the constantly changing kinematics and the resulting increase in the load pressure, the lowering speed:

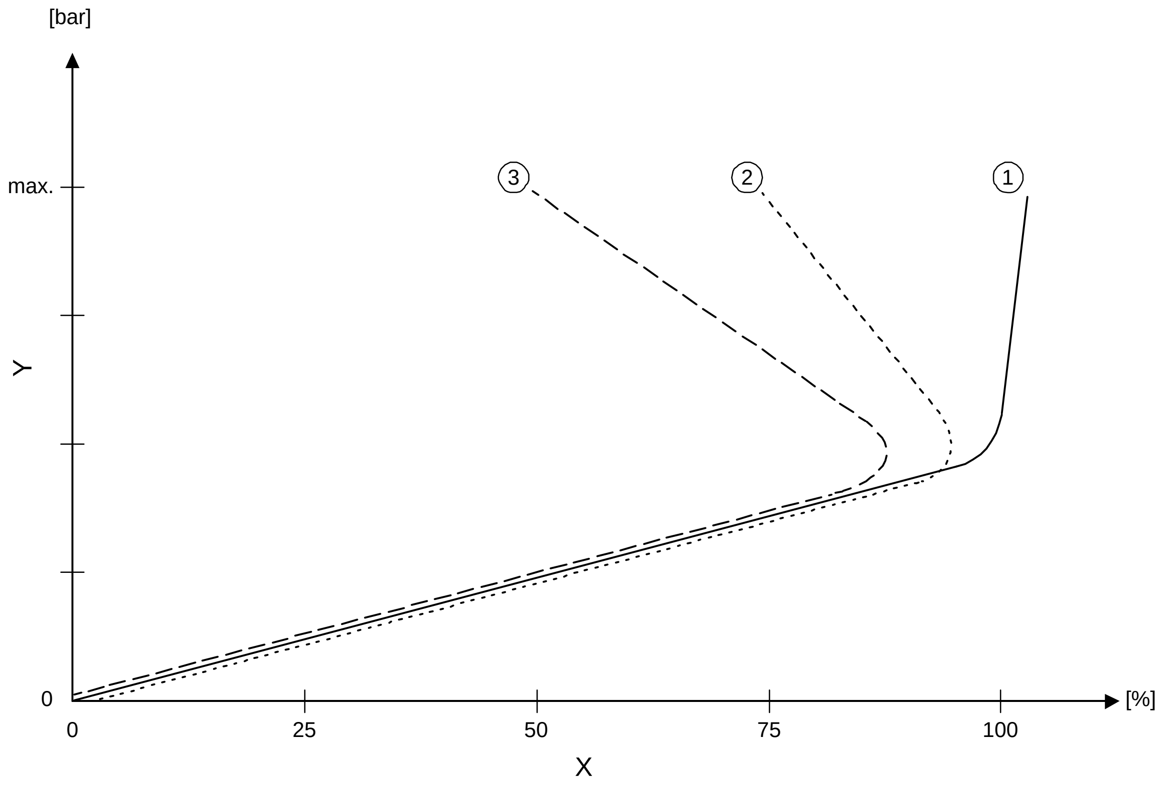
- is held almost constant even without a compensation orifice (standard model)
- is reduced with a compensation orifice (overcompensated model)

The compensation orifice in the pilot spool has the effect that, as the load pressure increases, the pressure acting on the control spool in the closing direction also rises. As a result, the control spool throttles the B → A flow area. To ensure that this function operates properly, these valve types must always be externally piloted.

⚠ **ATTENTION!:**
A prerequisite is that the pilot pressure acting on the pilot piston is limited to max 19.8 bar. A higher pressure will prevent the speed-limiting function from working.

☞ **IMPORTANT!:**
To ensure that this function operates properly, the back-pressure-independent variant L should be used.

Characteristic curves (examples)



X	Flow B → A
Y	Load pressure

1	Load-pressure-compensated model (without compensation orifice, KD)
2	Approx. 25 % overcompensated (KD Ø 1.8)
3	Approx. 50 % overcompensated (KD Ø 1.5)

9 Safety instructions

IMPORTANT!:
Designing load-control valves requires specialist technical knowledge and product knowledge. Safety applications must be verified by adequate tests to ensure safety in actual use.

9.1 Assembly / disassembly

IMPORTANT!:
The valve may only be used for its intended purpose within its nominal rating. If you plan to use it outside the nominal rating, you must contact the valve manufacturer. The ultimate responsibility for safety in the installation and use rests with the end-machine manufacturer of the mobile application.

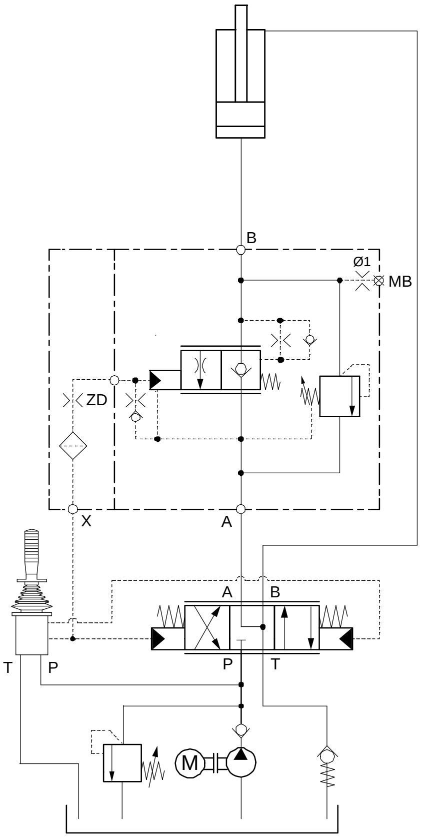
IMPORTANT!:
Seal kit with the external seals is available on application.

IMPORTANT!:
The port threads conform to DIN 3852-2.
Use screws to DIN EN ISO 4762, grade 12.9, to mount the valve.
Tightening torques as per the manufacturer's instructions. These can be found on our website:
www.bucherhydraulics.com
(LOGIntern area; registration required)

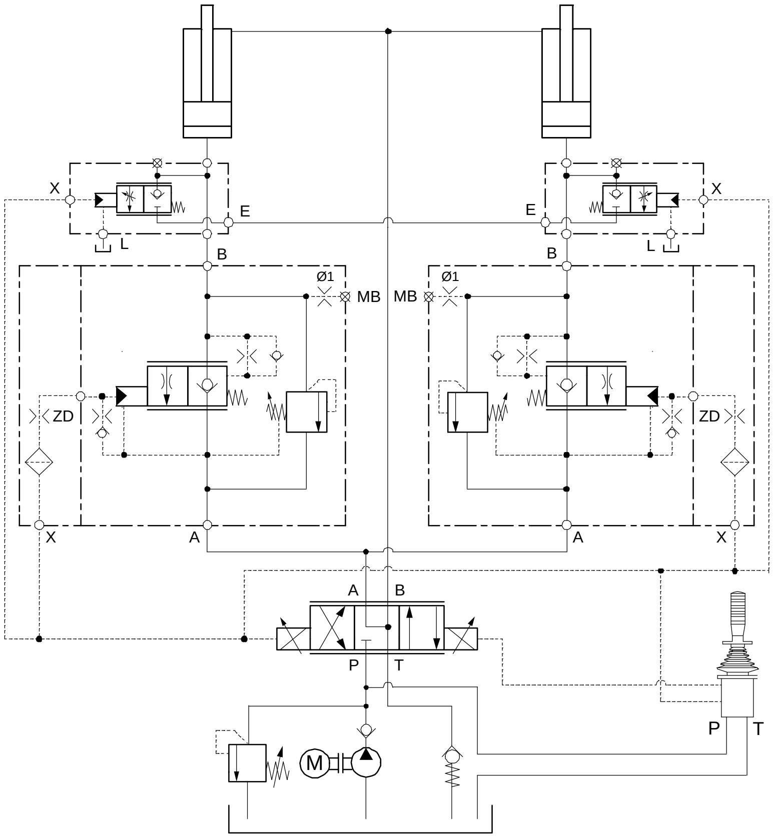
IMPORTANT!:
Protect seals and flange faces from damage.
The mating flange face must be of the quality specified in the data sheet!
Pay attention to the port designations.

10 Application examples

10.1 Cylinder application



10.2 Tandem application



11 Ordering code

e.g. CINDY 16 – B – S N O – S050 – A – G… – __ – … – ___ – … – _ – ___

CINDY = type

16 = size 16

B = model / version

S = SAE-flange design

N = NBR (Nitrile) seals **(standard)**
V = FKM (Viton) seals
T = MIL (low temperature) seals

O = without mounting screws **(stand.)**
D = incl. mounting screws

S050 = standard spool, B → A 50 l/min *
S100 = standard spool, B → A 100 l/min *
S150 = standard spool, B → A 150 l/min *
S200 = standard spool, B → A 200 l/min *
S240 = standard spool, B → A 240 l/min *

A = influenced by return-line pressure in A
L = not influenced by return-line pressure

G… = standard damping cover
D… = stroke-dependent damping cover
H… = hydromechanical stroke-limiting cover
R… = hydraulic pressure-reducing valve cover [1)]
E… = Electroproportional pressure-reducing valve cover [1)]

... = orifice combination (is factory-defined)

(blank) = without load pressure overcompensation
25 = with load pressure overcomp. 25% / compensation orifice KD Ø 1.8
50 = with load pressure overcomp. 50% / compensation orifice KD Ø 1.5
52 = with load pressure overcomp. 52% / compensation orifice KD Ø 1.4
54 = with load pressure overcomp. 54% / compensation orifice KD Ø 1.3

(blank) = without secondary pressure relief
SVA = secondary pressure relief valve B → A
SVT = secondary pressure relief valve B → T
SVZ = Thermal-expansion pressure relief

… = setting of the secondary pressure relief valve
SVA 120…420 bar [1700…6000 psi]
SVT 120…420 bar [1700…6000 psi]
SVZ 50…500 bar [700…7200 psi]

(blank) = port A: SAE ¾“ - 6000 psi **(standard)**
1 = port A1: SAE ¾“ - 6000 psi

24DI = data for “E” cover only: AMP Junior Timer, 24 VDC **(standard)**
12DI = data for “E” cover only: AMP Junior Timer, 12 VDC
24DT = data for “E” cover only: Deutsch plug DT04-2P, 24 VDC
12DT = data for “E” cover only: Deutsch plug DT04-2P, 12 VDC

*) measured at 33 bar [478 psi] Δp from B → A.

[1)] Only available in return pressure independent version (L).

12 Related data sheets

Reference	Description
300-D-9050098	Project Engineering & User Information, Series CINDY, SAE-flange, manifold and cartridge design
300-D-9050102	Technical design sheet for CINDY load-control valves in cylinder applications
300-S-9050006	Spare Parts Information, Series CINDY as SAE flange design

IMPORTANT!:
Additional documentation and 3D models (.stp or .igs format) can be downloaded from *www.bucherhydraulics.com* (LOGintern area; registration is necessary)

We also offer customised solutions.
Please talk to our sales team.

info.ch@bucherhydraulics.com
www.bucherhydraulics.com

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Classification: 430.325.360.315.330.325.305.310