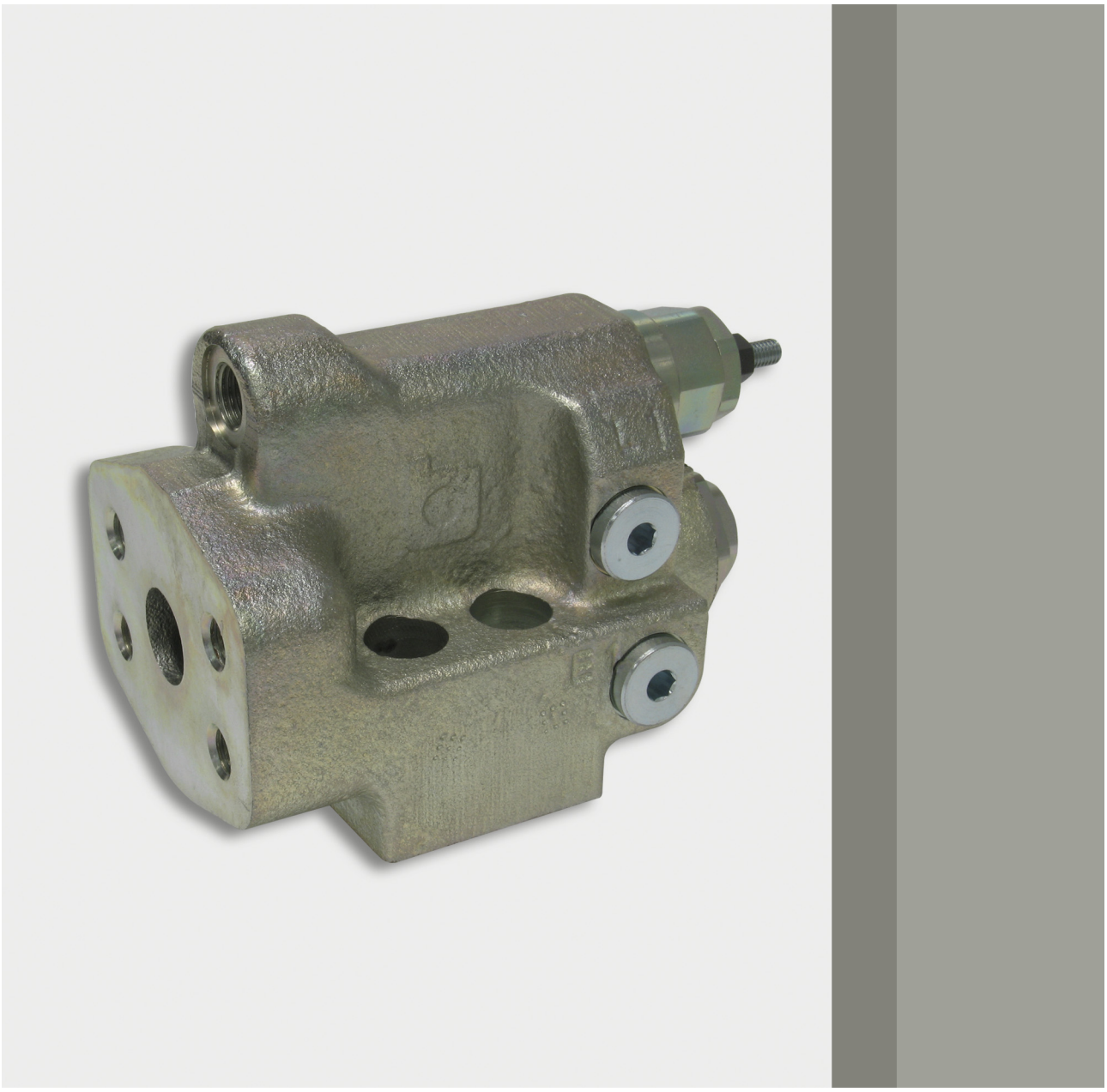
Compact Excavator Pipe-Rupture Valve

Series CFS



motion and progress

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BUCHER HYDRAULICS

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1 General description

In accordance with standard EN 474-5 ”Safety of earth-moving machinery - Requirements for hydraulic excavators”, the excavator pipe-rupture valve, type CFS (**C**ompact **F**low Control and **S**afety Valve), prevents uncontrolled lowering of the actuator in the event of a pipe- or hose-rupture. In addition, the CFS valve holds the actuator in its position when the main valve is centred. The valve also includes a secondary pressure relief function, which protects the actuator against overload.

2 Advantages

The inlet and actuator ports on the CSF excavator pipe-rupture valve are standard SAE flanged ports, and the valve can therefore be retrofitted to existing equipment without any difficulty.

Thanks to its load-independent, pilot-operated opening principle, variations in load pressure - even right up to the maximum - have no effect on the fine-control characteristics and the hydraulic performance of the valve. The design of the valve means that it can be operated by very small lowering pressures.

The CSF is set at the machine in a way that ensures that the excavator pipe-rupture function has no effect on the hydraulic values that have already been set in the machine (pre-opening principle). This means that excavators with and without a lifting function can be equipped with the same basic hydraulic system; the machines’ work cycles remain unchanged.

The secondary pressure-relief function can handle the full rated flow. When the main spool valve is a closed-centre model and a secondary valve is connected in parallel, no pressure summing occurs. The secondary pressure-relief valve in the excavator pipe-rupture valve opens at exactly the opening pressure that has been set. There is no need for a large-bore, external tank return line.

3 Application

The excavator pipe-rupture valve is used wherever so required by the standards EN 474, ISO 8643 and DIN 24093 for excavators with a lifting device (e.g. a load hook on the bucket. The actuators concerned are the lift cylinder, the stick cylinder and the adjusting cylinder.

It is also possible to envisage machine applications in which a pipe-rupture on the actuators could produce dangerous situations e.g. machines for materials handling and demolition.

Attention: the excavator pipe-rupture valve may only be used for the purpose for which it has been designed!

4 Technical data

General characteristics	Description, value, unit
Design	2-stage proportionally-controlled seat valve, with initial hydraulic decompression patented follower principle
Mounting method	flange-mounting, SAE 6000 psi
Mounting attitude	unrestricted
Flow direction	A → B free flow through check valve B → A controlled flow
Weight/Material	3.6 kg, body material = SG iron GGG40
Surface treatment	Valve is zinc plated (Cr6-free, thick-film passivation) mounting bolts are zinc-flake coated

Hydraulic characteristics	Description, value, unit
Nominal sizes	16 20
Nominal flow rate	size 16 = 250 l/min size 20 = 350 l/min
Pilot pressure range	opening pressure 4.4 … 10 bar (setting ex-work at 20 l/min (B → A) and 100 bar load pressure; with this flow and load pressure the pilot pressure can be adjusted within the range 11 … 16.5 bar) full opening opening pressure + 18 bar + leakage oil pressure
Operating pressure	max. 420 bar
Secondary PRV - adjustment range	min. 320 … 420 bar (max. up to 460 bar also possible); settings are sealed other models - consult Bucher Hydraulics
Ambient temperature range	-40 °C … +100 °C
Operating fluid	mineral oil to DIN 51524 and DIN 51525 (HL/ HLP), other fluids - consult Bucher Hydraulics
Fluid temperature range	-20 °C … +90 °C
Viscosity range	• minimum 2.8 mm^2/s (cSt)... maximum 1500 mm^2/s (cSt) • recommended 10 mm^2/s (cSt) … 380 mm^2/s (cSt)
Temperature range, seal material	• Nitrile = -20 °C … +90 °C • Viton = -20 °C … +200 °C • Low (N7T40) = -50 °C … +80 °C
Filtration	NAS 1638 class 9, ß10 ≥ 75 ISO 4406 class 18/15 (valves do not have any internal filters)
Internal leakage values (HLP 46 at 40 °C)	A → L = 100 cm^3/min (dynamic) X → L = 20 cm^3/min (dynamic) B → A = 0.15 cm^3/min (static) B → L = 0.15 cm^3/min (static)

Ports	Description, value, unit
SAE	to SAE J518 DEC87, ports fitted with a plastic protector
Threads	to DIN 3852, Parts 1 and 2, open ports fitted with a plastic protector
Fittings	to ISO 8434-1

5 Installation/startup

5.1 Installation information

Attention: only trained and competent personnel may carry out any work on the excavator pipe-rupture valve!

The valve must not be opened without the manufacturer's express permission!

Mounting bolts can be supplied as an optional extra and are grade 12.9 to DIN 912, with "Geomet" surface finish.

Protect flange faces from damage and before installing the valve check that all the seals are present. The mating flange face must be of the quality specified in the catalogue.

Before initial start-up, bleed all air from the hydraulic system. Do not use any pipe fittings that have tapered threads.

Attention: before removing or disassembling the valve, vent all hydraulic pressure from the system - double check!

Before fitting the valve, remove all plastic protectors and plastic residues.

5.2 Adjustment information

Pilot valve for main function

The pilot valve for the lowering function is factory-set during testing to the opening pressure stipulated by the customer and then sealed.

- clockwise → increases the pressure
- counterclockwise → decreases the pressure

The change in pressure is approx. 5.8 bar per turn.

Attention: the adjusting screw can be completely unscrewed - it has no end-stop!

Important: if the adjustment seal is broken, the warranty is null and void!

Pilot valve for pressure-relief function

The pilot valve for the pressure-relief function is factory-set during testing to the pressure stipulated by the customer and then sealed. The pressure is set with flow Q = approx. 0.75 l/min.

- clockwise → increases the pressure
- counterclockwise → decreases the pressure

The change in pressure is approx. 94 bar per turn. (with the spring for 320…420 bar)

6 Description of function

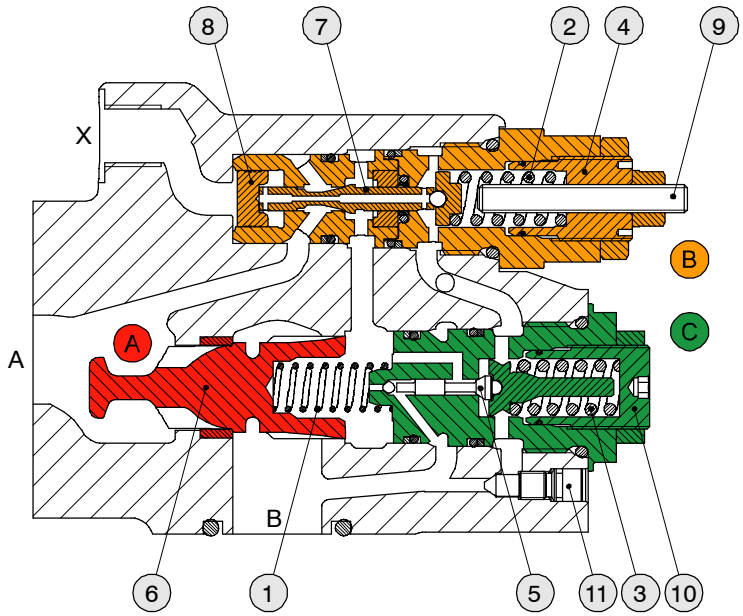


Fig. 1 300-4-10012929

1	CV spring	**8**	Pilot piston
2	Control spring	**9**	Stroke limiter
3	Spring for secondary valve	**10**	Adjusting screw for secondary valve
4	Adjusting screw for pilot valve	**11**	Emergency-lowering screw
5	Poppet for secondary valve	**A**	Load-control assembly
6	Control spool	**B**	Pilot valve for load-control assembly
7	Pilot spool	**C**	Pilot valve for secondary pressure relief

The neutral position (load pressure at B; A and X unpressurised)

In the neutral position, the excavator pipe-rupture valve is held closed by the spring (1), which acts on the control spool (6), and also by the load pressure, which acts on the rear side of the control spool.

The check-valve function (flow A → B)

To raise the actuator, pump pressure is applied via port A to the valve seat area of the control spool (6) and causes the control spool to open, pushing against the light spring (1).

The control function (flow B → A)

1. Decompression

The pilot pressure at port X moves the pilot piston (8) in opposition to the springs (2) and the pilot spool (7) opens at the set pressure. The load pressure behind the control spool (6) now decays as it escapes past the pilot spool to port A. The progressive characteristic of the decompression phase ensures that the actuator motion begins smoothly and without jerks.

2. Main opening

With further increase in the pilot pressure at X, the pilot spool opens further and the reduced pressure behind the control spool falls still more. The load pressure acting on the differential area of the control spool now pushes the spool off its valve seat in the opening direction until the pressures of the oilflows into, and out of, the control spool have changed enough to produce a situation of force balance.

The pilot pressure acting on the pilot piston therefore controls the open metering area of the control spool, and consequently the flow rate from B → A. The pilot valve is compensated and is unaffected by any back-pressure in port A that may occur.

The opening point of each excavator pipe-rupture valve is precisely matched to the particular make/model of excavator and is set to the required value on the test stand with adjusting screw (4). With the optional stroke limiter (9), the pilot spool stroke can also be restricted. This in turn influences the lowering speed.

Function of the secondary pressure-relief valve

The pilot valve for the pressure-relief valve is connected directly to actuator port B. When the pressure set with spring (3) is reached, the poppet (5) opens and unloads the rear side of the control spool (6) to port L. The load pressure, acting on the differential area of the control spool, now pushes the spool fully open and opens the B-to-A flow path for the full rated flow. The pilot valve is not connected to the return line and is therefore unaffected by any back-pressure in port A that may occur. With a closed-centre directional valve, no pressure summing occurs with the necessary series-connected downstream pressure-relief valve. The secondary pressure can be set at any desired level with the adjusting screw (10).

Attention: when the pilot valve for the secondary pressure relief function opens, there is a pilot flow of 9 l/min per valve to port L. The pressure in the L-line has a 1:1 effect on the setting of the pressure-relief valve. To ensure that the performance characteristics are not affected, the drain line should be sized so that the back-pressure never exceeds 10 bar.

Leakage-oil drain

The leakage oil from both pilot cartridges as well as their spring chambers is drained to port L. This port should be drained to tank with the least possible back-pressure. Any tank preload- or back-pressure in the drain line has a 1:1 effect on the opening values of both pilot valves.

Emergency-lowering screw BL

An optional emergency-lowering screw (11) can be incorporated. The actuator is vented to port L through a ø3 connecting drilling that is normally shut off. The screw cannot be completely unscrewed.

Attention: when emergency lowering has been completed, the screw must be screwed in again to reestablish the valve's function!

7 Port designations

Port	Description
B	Actuator/load port
A	Flow or return port
X	Pilot port
L, L1	Drain port
E, E1	Port for balance pipe in parallel-cylinder applications; protected by a ø1 fixed orifice

8 Circuit example

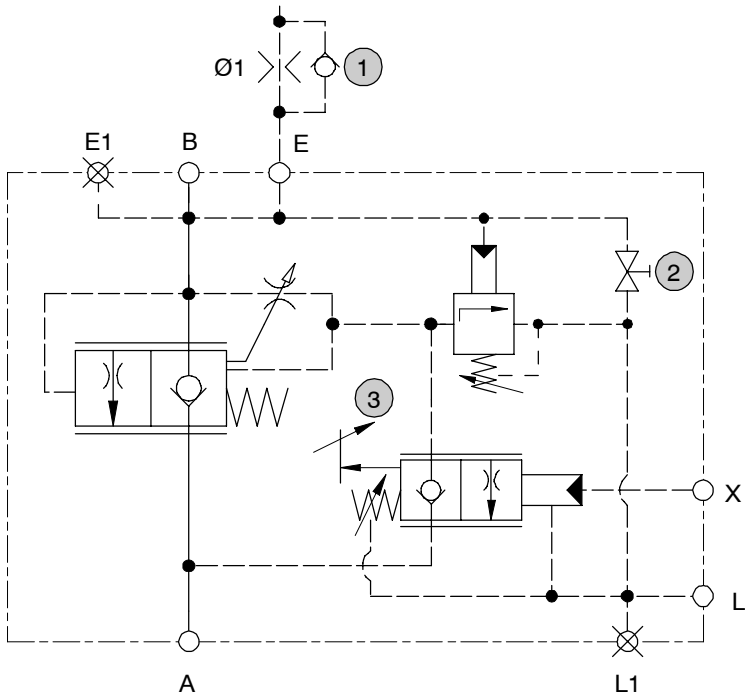


Fig. 2 300-4-10012146

1	Version with optional pressure balance valve, for parallel-cylinder application
2	Version with optional emergency lowering
3	Version with optional stroke limiter

9 Standard design, sizes 16/20

9.1 Dimensions

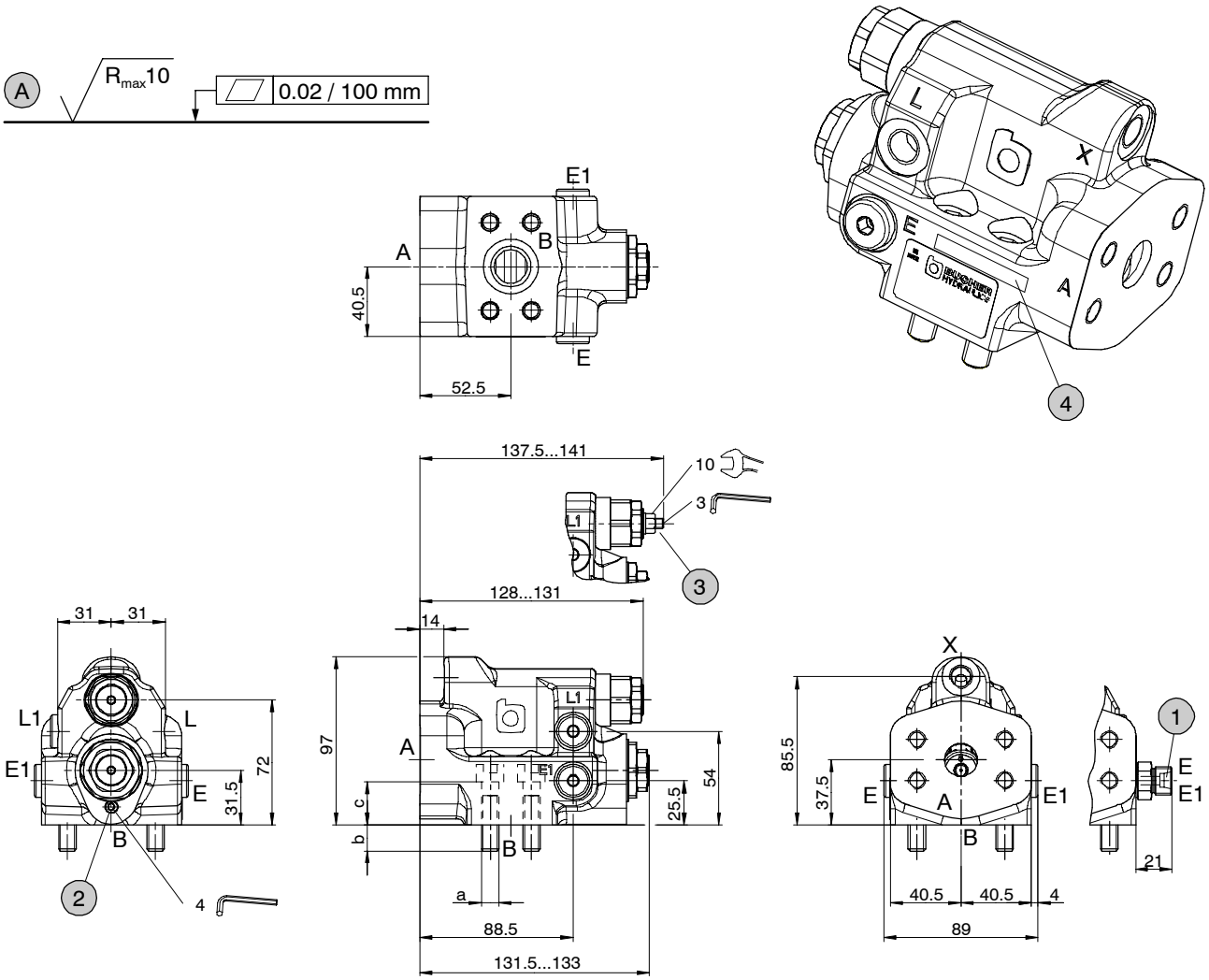


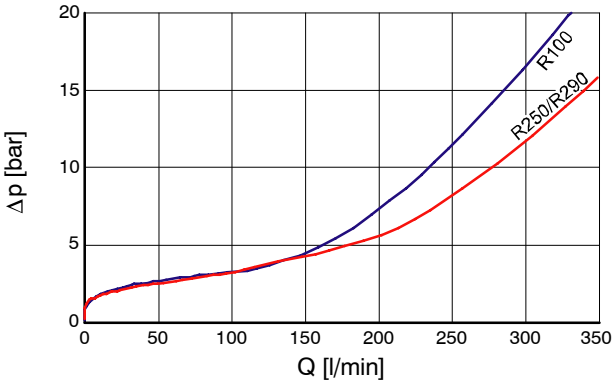
Fig. 3 300-4-10012889

1	Version with optional balance valve Fitting, type 8S, for cutting ring to DIN 3861
2	Version with optional emergency lowering
3	Version with optional stroke limiter
4	Serial number
A	Required quality of the mating surface

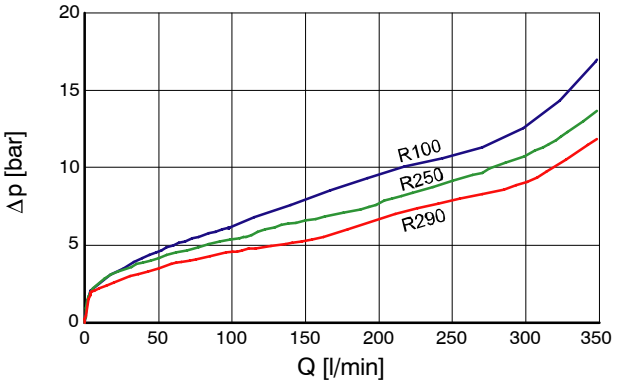
Design	**Ports**			**Dimensions**		
	A	B	X, L, L1, E, E1	a	b	c
CFS 16-A	SAE 3/4” 6000 psi	SAE 3/4” 6000 psi	G 1/4”	M10	15	25
CFS 20-A	SAE 1” 6000 psi	SAE 1” 6000 psi	G 1/4”	M12	16	24

9.2 Performance graphs

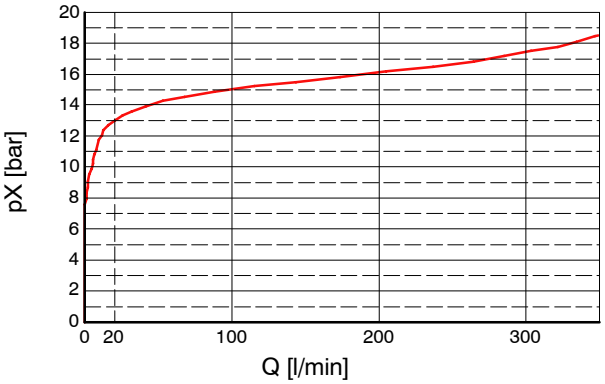
Δp A to B = ƒ (Q)



Δp B to A = ƒ (Q)

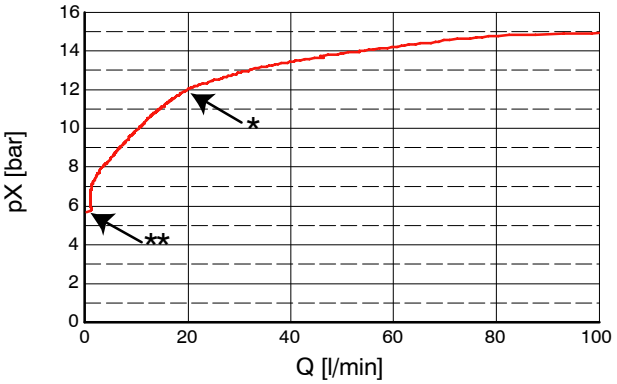


Opening curve, Q = ƒ (pX) at 33 bar load pressure



pX = pilot pressure [bar]

Opening curve, Q = ƒ (pX) at 100 bar load pressure

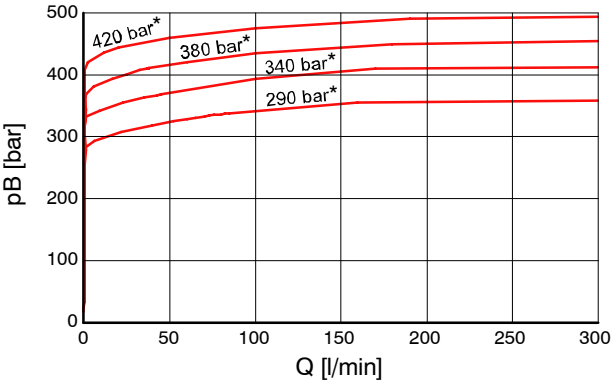


pX = pilot pressure [bar]

* = pilot pressure setting ex-works

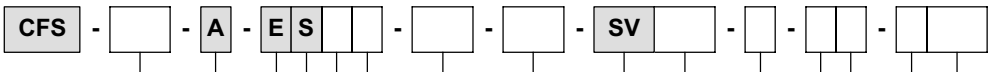
** = effective opening pressure

Pressure-relief valve, secondary PRV, Q = ƒ (Load)
(Example curve)



* pressure setting

9.3 Model code key



Nominal size

16	= 16
20	= 20

Model series

Series A	= A

Application

Earth-moving machines to EN 474, ISO 8643	= E

Design

Standard design	= S

Seal material

	Temperature range	
Nitrile (standard)	-20 °C to +90 °C	= N
Nitrile (low temperature)	-50 °C to +80 °C	= T
Viton (special fluids)	-20 °C to +200 °C	= V

Mounting bolts

Without mounting bolts		= O
With mounting bolts, surface-treated	t	= D

Control spool

100 l/min.	= R100
250 l/min.	= R250
290 l/min.	= R290

Opening-point setting

Pilot pressure ... bar at 20 l/min and 100 bar load pressure (determined by Bucher Hydraulics in the range 11 … 16.5 bar)	= ... [bar]

Secondary pressure relief

Pressure relief at port B	= SV

Setting of the secondary pressure-relief valve

Pressure setting ... bar at approx. 0.75 l/min	= ... [bar]

Ports X, L, E

To DIN 3852 Part 2 (Imperial)	= Z
Fittings package for X and L (optional)	= V

Optional accessories

Without balance valve (single cylinder)	
Balance valve in port E (parallel cylinders), port L open	= R
Balance valve in port E1 (parallel cylinders), port L1 open	= L

Optional mechanical emergency lowering

Without emergency lowering	=
With mechanical emergency lowering	= N

Optional stroke limiter

Without stroke limiter	=
Adjustable stroke limiter	= H

Stroke-limiter setting

Q setting at 33 bar load pressure	= ... [l/min]

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