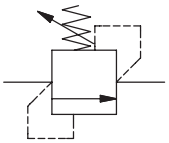
HYDRAULIC CARTRIDGES

PRESSURE CONTROL VALVES

INTRODUCTION



PRESSURE RELIEF VALVES

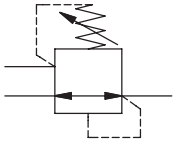
Pressure relief valves are normally closed hydraulic valves. They will open when a certain pressure is reached in order to dump the necessary flow to keep the hydraulics' ducts pressurized.
Their primary function is to protect circuits and/or components (pumps, motors, actuators and pipes) from overloads and pressure peaks.
Pressure relief valves can be classified into two categories: direct acting and pilot operated valves.

Direct Acting Pressure Relief Valves are characterized by the presence of conical or differential poppets on which acts directly the pressure to be regulated.
These valves are simple, reliable and tough (the spring acts directly on the poppet). Their external dimensions result bigger than the pilot operated ones for flows over 50 lt/min.
Direct Acting Pressure Relief Valves find their application in circuits having less than 50 lt/min flows. They are particularly indicated for all those applications in which a good hydraulic sealing level is demanded (eg: hydraulic motors or actuators).

2

Pilot Operated Pressure Relief Valves are characterized by the presence of a logic element controller by a pilot stage.
These are valves able to control big flows combining reduced dimensions. A certain leakage, due to the coupling of the logic element, must be taken into account.
Pilot Operated Pressure Relief Valves are generally installed on pumps or hydraulic lines to control the maximum pressure.

Pressure Relief Valves must be considered also under the point of view of their reaction to the back-pressure.
Generally these valves equilibrate the differential ratio on the basis of their setting (pin-pout).
When a pressure relief valve is mounted before a pressurized line we must consider the effects of the back-pressure on its setting. In these cases the installation of compensated valves is advisable.
These valves, thanks to their internal design, will not be affected by the back-pressure on the return line, guaranteeing a control of the maximum feeding pressure considering only their setting (Pin).



PRESSURE REDUCING VALVES

Pressure reducing valves are 3 ways normally open hydraulic valves able to feed a secondary circuit with a lower pressure than the main one.

The reduced pressure acts on a cylindric spool kept in open position by a spring.
When the pressure of the secondary circuit overcomes the force of the spring the spool will move, assuring so that the pressure in the secondary line will not increase above its setting.

The third way, typical of pressure reducing valves, is connected to the tank in the direct acted type, and sometimes in the pilot operated ones as well.
This connection is necessary to unload the exceeding flow in case the pressure of the secondary circuit would increase above its setting.

There are two different types of design for these valves as well: direct acted and pilot operated.

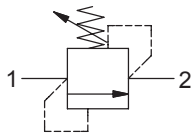
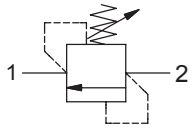
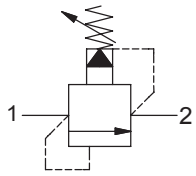
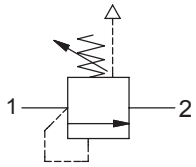
Direct acted pressure reducing valves are characterized by the presence of a cylindric spool on which the pressure to be regulated acts directly.
Thanks to their simple design they are very tough and reliable, particularly indicated for feeding the pilot circuits that do not imply a continous oil flow.
Their main application is on feeding units for earth moving servo-controls.

Pilot operated pressure reducing valves are characterized by the presence of a logic element controller by a pilot stage.
Thanks to the logic element it is possible to guarantee a reduced pressure even when big amounts of flow are present.
Depending on the type of spool it is possible to design the cartridge both in the basic way and in the way that combines the pressure reducing to the pressure relieving process.

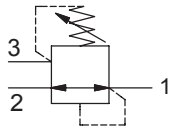
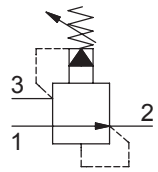
It is very important to consider that the setting pressure of the pressure reducing valves increases when some backpressure is present in the drain line.
To avoid this we advise to connect the drain line directly to the tank just in case some pressure losses due to filters and heat exchangers would be present.

PRESSURE CONTROL VALVES

PRESSURE RELIEF VALVES

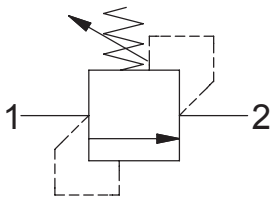
		Flow l/min	Pmax bar	SIZE	CAVITY	PAGE
	M-021	1,5	450	M16x1,5	S000020	1.01.001
	CT-022	20	350	SAE-08	C220000	1.01.002
	CT-042-0	30	350	SAE-08	C220000	1.01.003
	CT-023	40	410	SAE-10	C230000	1.01.004a
	CT-023-HD	40	410	SAE-10	C230000	1.01.005
	CT-024	90	350	SAE-12	C240000	1.01.006
	CT-042-6	30	350	SAE-08	C220000	1.01.003
	CT-033	100	350	SAE-10	C230000	1.01.007
	CT-023-HD-C	40	410	SAE-10	C230000	1.01.008

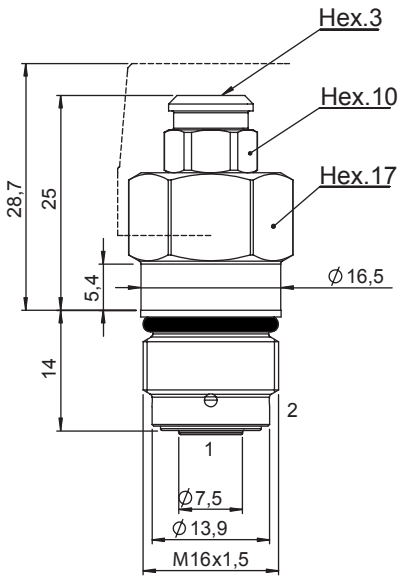
PRESSURE REDUCING VALVES

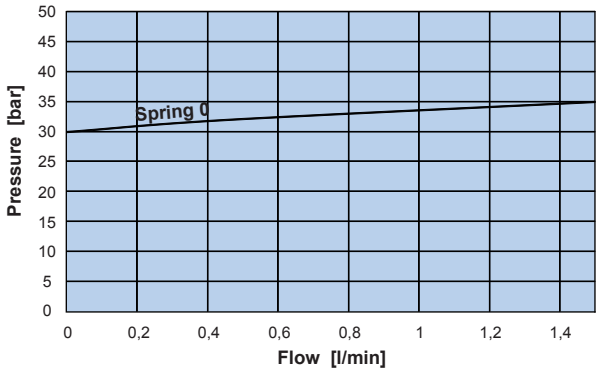
	CT-121	2	350	SAE-6	C310000	1.01.009
	CT-122	10	350	SAE-08	C320000	1.01.010
	CT-123	30	350	SAE-10	C320000	1.01.011
	CT-133	30	350	SAE-10		in development

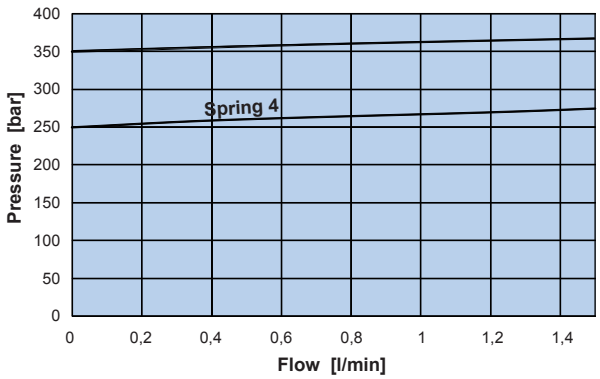
DIRECT ACTING RELIEF VALVE

- Flow . . . . . **1,5 l/min**
- Max working pressure. . . . . **450 bar**
- Seals . . . . . **NBR**
- Cavity . . . . . **S 000020**
- Cartridge thightening torque. . . . . **40 Nm**
- Weight . . . . . **0,05 Kg**
- Tamper proof cap. **cod.9021015101**









5

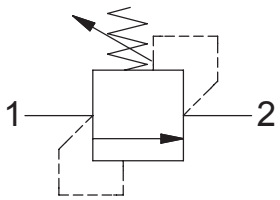
Ordering code

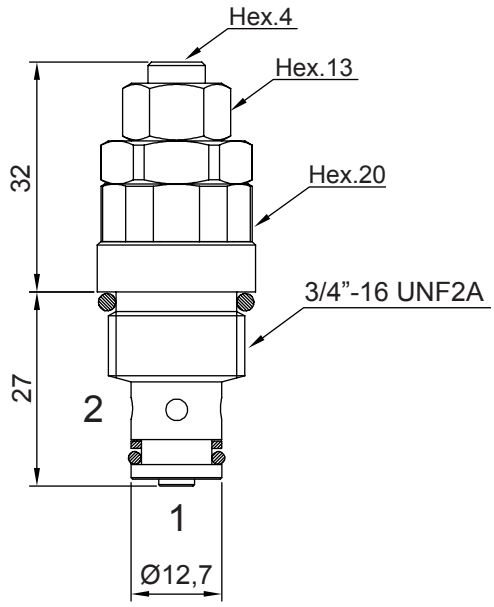
M 0 2 1 0 ☐ 0 0 0 0

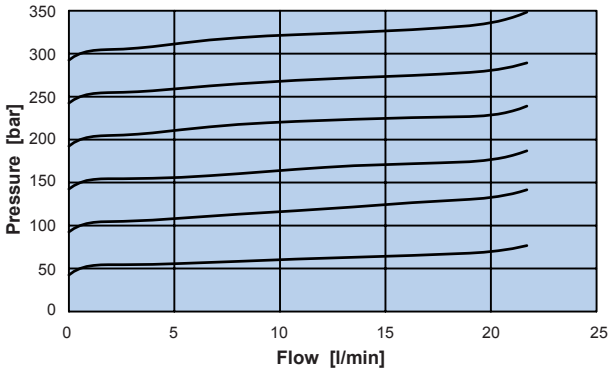
SPRINGS	0	4
Setting range min.-max. [bar]	5 - 30	250 - 450
Pressure Increase [bar/by turn]	10	250
Standard setting 20 cc/min [bar]	30	100

DIRECT ACTING RELIEF VALVE

- Flow . . . . . **20 l/min**
- Max working pressure. . . . . **350 bar**
- Seals . . . . . **NBR e PTFE**
- Cavity . . . . . **C 220000**
- Cartridge thightening torque. . . . . **30 Nm**
- Weight . . . . . **0,085 Kg**







6

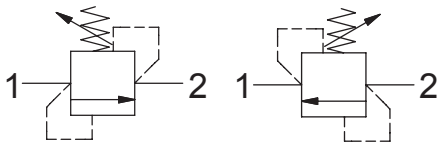
Ordering code

0 0 2 2 0 ☐ 0 0 0 0

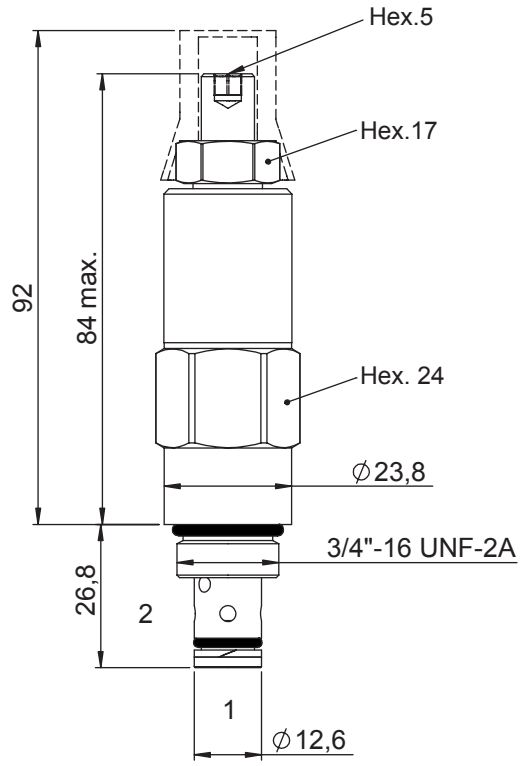
SPRINGS	1	2	3
Setting range min.-max. [bar]	20 - 100	40 - 220	50 - 350
Pressure Increase [bar/by turn]	29	84	127
Standard setting 4 l/min [bar]	50	100	100

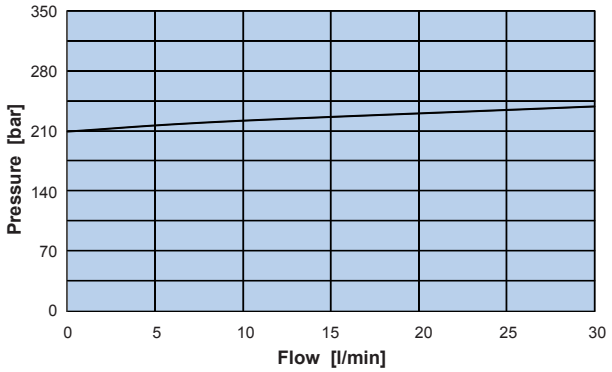
DIFFERENTIAL AREA RELIEF VALVE

- Flow. . . . . **30 l/min**
- Max working pressure. . . . . **350 bar**
- Seals. . . . . **NBR**
- Cavity . . . . . **C 220000**
- Cartridge thightening torque . . . . . **30 Nm**
- Weight . . . . . **0,25 Kg**
- Tamper proof cap. . . . . **cod. 4029250280**



Scheme 0 **Scheme 6**





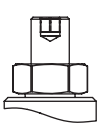
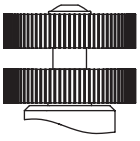
7

Ordering code

0 0 4 2 ☐ 0 ☐ ☐ 0 0

0	**6**	**Hydraulic scheme**

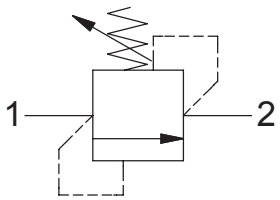
SPRINGS	1	2	3
Setting range min.-max. [bar]	20 - 80	30 - 150	50 - 250
Pressure Increase [bar/turn]	13	26	43
Standard setting 4 l/min [bar]	50	100	100

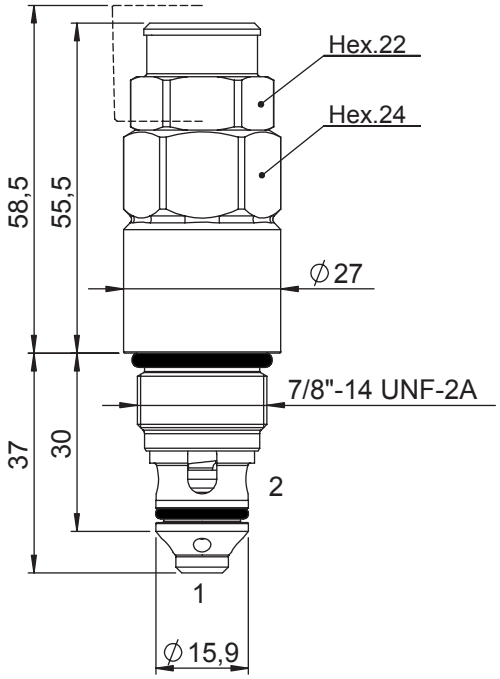
0	**2**
	
Hex socket screw	**Handknob**

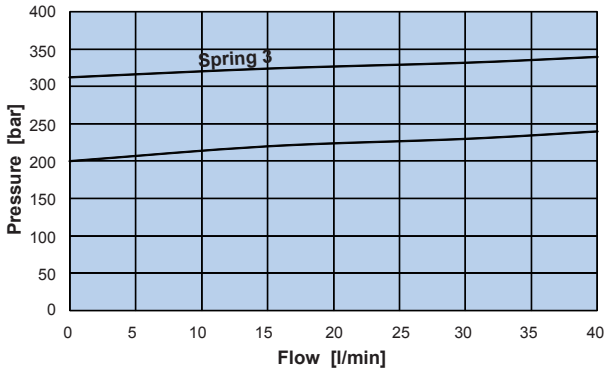
Adjustments

DIRECT ACTING RELIEF VALVE

- Flow . . . . . **40 l/min**
- Max working pressure . . . . . **410 bar**
- Seals . . . . . **NBR e PTFE**
- Cavity **C230000**
- Cartridge thightening torque . . . . . **40 Nm**
- Weight. . . . . **0,23 Kg**
- Tamper proof cap. . . . . **cod. 9021030190**







8

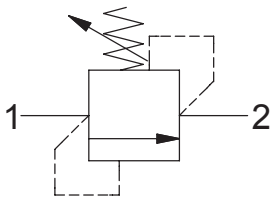
Ordering code

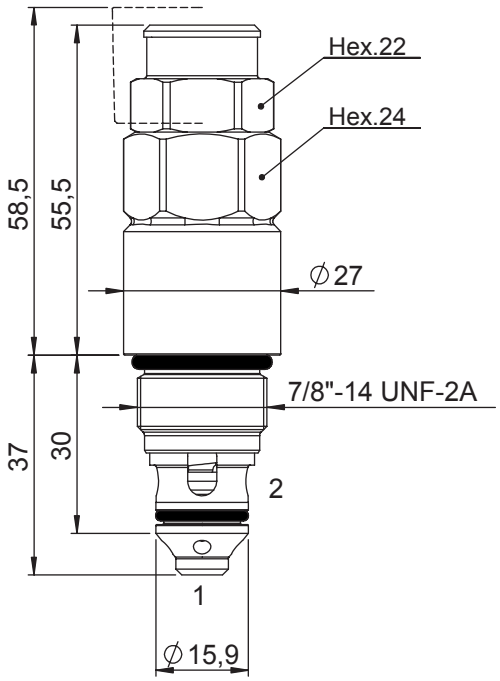
0 0 2 3 3 ☐ 0 0 0 0

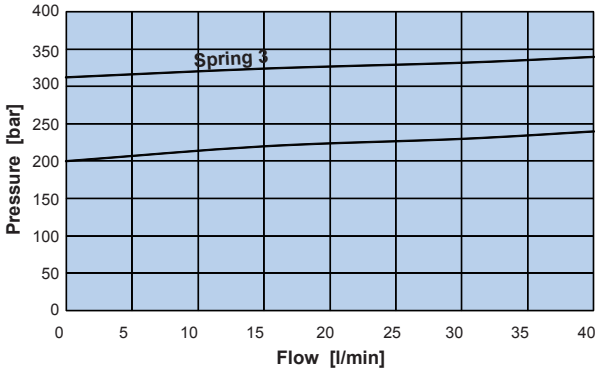
SPRINGS	1	2	3
Setting range min.-max. [bar]	40 - 140	120 - 250	220 - 410
Pressure Increase [bar/by turn]	23	31	53
Standard setting 4 l/min [bar]	50	150	250

HARDNED SEALING BODY RELIEF VALVE

- Flow . . . . . **40 l/min**
- Max working pressure. . . . . **410 bar**
- Seals . . . . . **NBR e PTFE**
- Cavity . . . . . **C 230000**
- Cartridge thightening torque. . . . . **40 Nm**
- Weight . . . . . **0,23 Kg**
- Tamper proof cap. . . . . **cod. 9021030190**







9

Note:
Hardned body cartridge, suggested for heavy duty applications (HD) and for lifting equipment.

For lifting equipments, cleanliness class ISO 4406 17/14 (NAS 1653 class 8) or better is recommended.

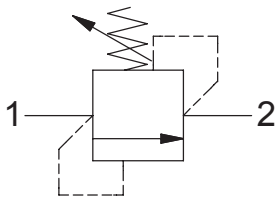
Ordering code

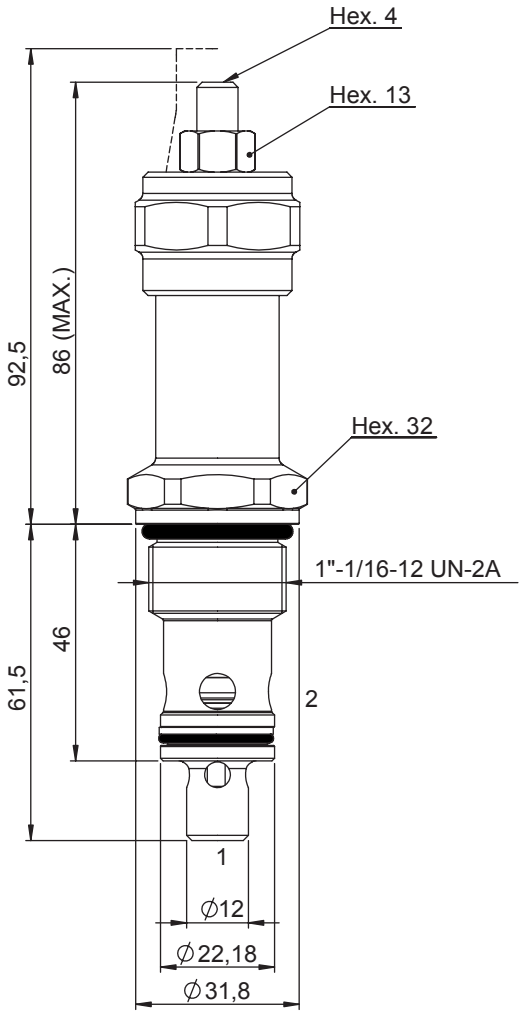
0 0 2 3 4 ☐ 0 0 0 0

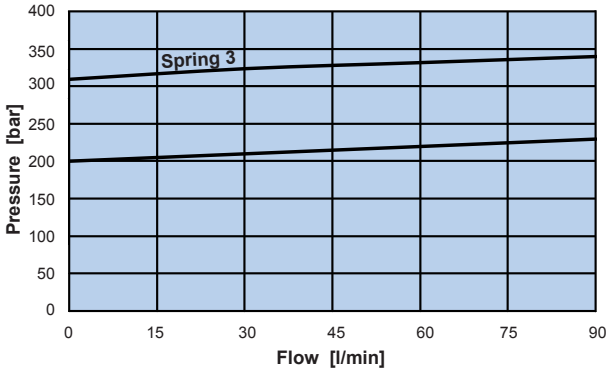
SPRINGS	1	2	3
Setting range min.-max. [bar]	40 - 140	120 - 250	220 - 410
Pressure Increase [bar/by turn]	23	31	53
Standard setting 4 l/min [bar]	50	150	250

DIRECT ACTING RELIEF VALVE

- Flow . . . . . **90 l/min**
- Max working pressure . . . . . **350 bar**
- Seals . . . . . **NBR e PTFE**
- Cavity **C240000**
- Cartridge thightening torque . . . . . **90 Nm**
- Weight. . . . . **0,35 Kg**
- Tamper proof cap. . . . . **cod. 9021020250**







10

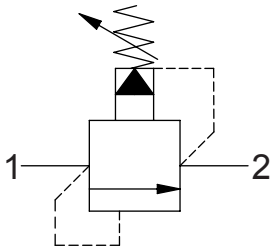
Ordering code

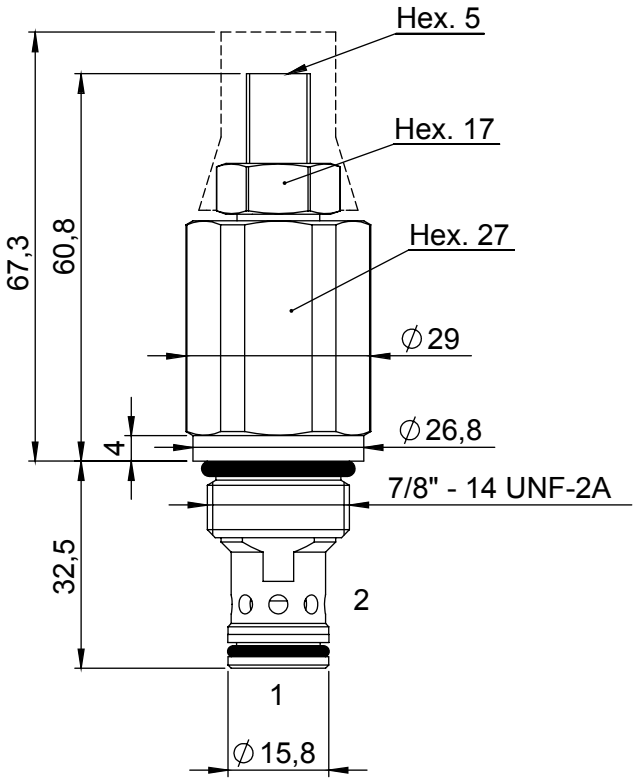
0 0 2 4 0 ☐ 0 0 0 0

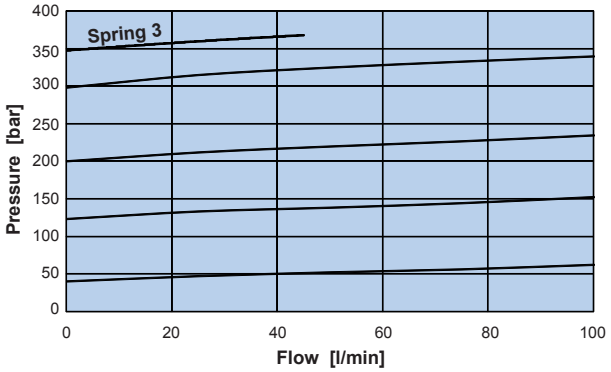
SPRINGS	2	3
Setting range min.-max. [bar]	60 - 250	200 - 350
Pressure Increase [bar/by turn]	22	56
Standard setting 4 l/min [bar]	100	200

PILOT OPERATED RELIEF VALVE

- Flow . . . . . **100 l/min**
- Max working pressure. . . . . **350 bar**
- Seals . . . . . **NBR e PTFE**
- Cavity . . . . . **C 230000**
- Cartridge thightening torque. . . . . **40 Nm**
- Weight . . . . . **0,25 Kg**
- Tamper proof cap. . . . . **cod. 4029250280**







11

Ordering code

0 0 3 3 0 □ 0 □ 0 0

SPRINGS	3
Setting range min.-max. [bar]	20 - 350
Pressure Increase [bar/by turn]	136
Standard setting 4 l/min [bar]	100

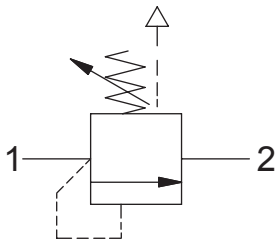
0 — **Hex socket screw**

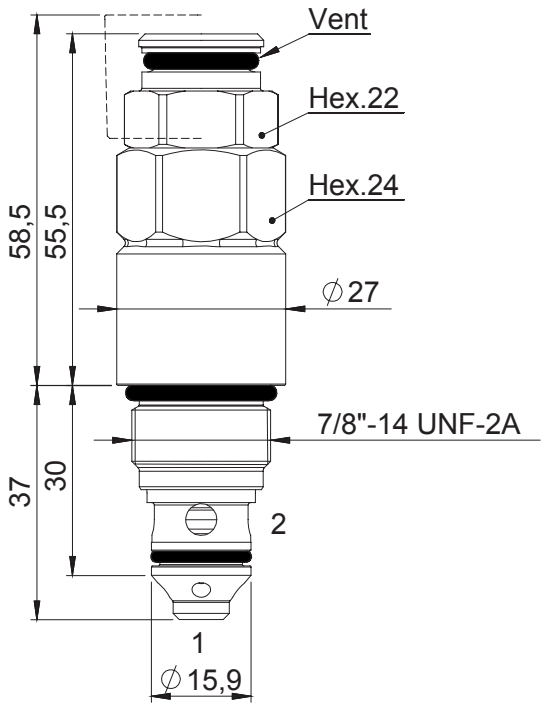
2 — **Handknob**

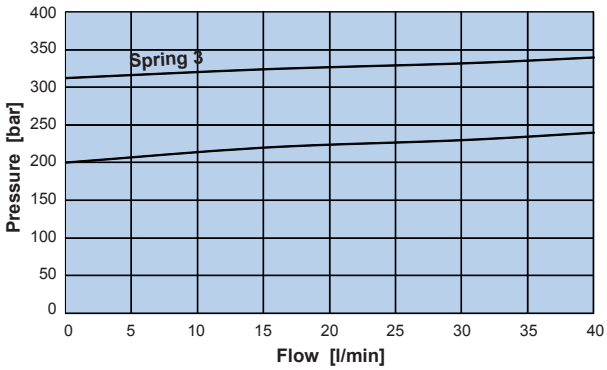
Adjustments

DIRECT ACTING COMPENSATED RELIEF VALVE

- Flow . . . . . **40 l/min**
- Max working pressure . . . . . **410 bar**
- Seals . . . . . **NBR e PTFE**
- Cavity **C230000**
- Cartridge thightening torque . . . . . **40 Nm**
- Weight. . . . . **0,23 Kg**
- Tamper proof cap. . . . . **cod. 9021030190**







Note:
Hardned body cartridge, suggested for heavy duty applications (HD) and for lifting equipment.

For lifting equipments, cleanliness class ISO 4406 17/14 (NAS 1653 class 8) or better is recommended.

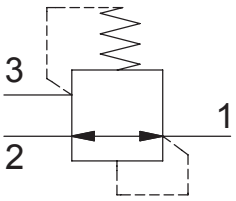
Ordering code

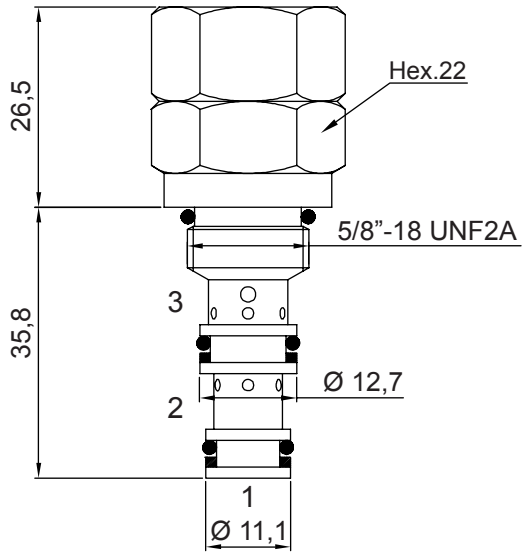
0 0 2 3 5 ☐ 0 0 0 0

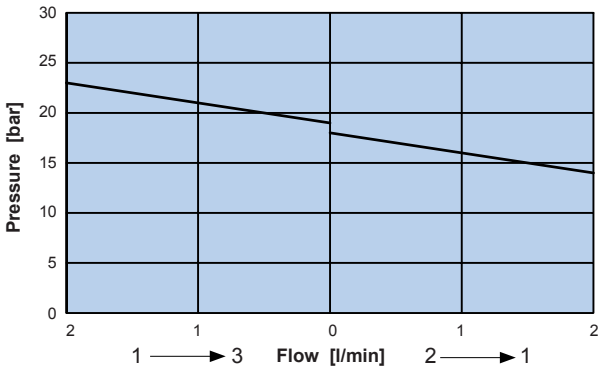
SPRINGS	2	3
Setting range min.-max. [bar]	120 - 250	220 - 410
Pressure Increase [bar/by turn]	31	53
Standard setting 4 l/min [bar]	150	250

FIX SETTING DIRECT ACTING PRESSURE REDUCING VALVE

- Flow . . . . . **2 l/min**
- Max working pressure in 2 . . . . . **350 bar**
- Max working pressure in 1 . . . . . **18 bar**
- Max working pressure in 3 . . . . . **1 bar**
- Seals . . . . . **NBR e PTFE**
- Cavity . . . . . **C 310000**
- Cartridge thightening torque. . . . . **15 Nm**
- Weight . . . . . **0,10 Kg**







13

Note:
- Fix setting valve
- In case of different setting from standard, contact NEM customer service.

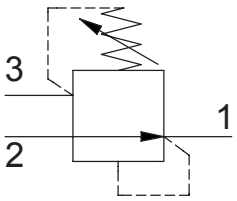
Ordering code

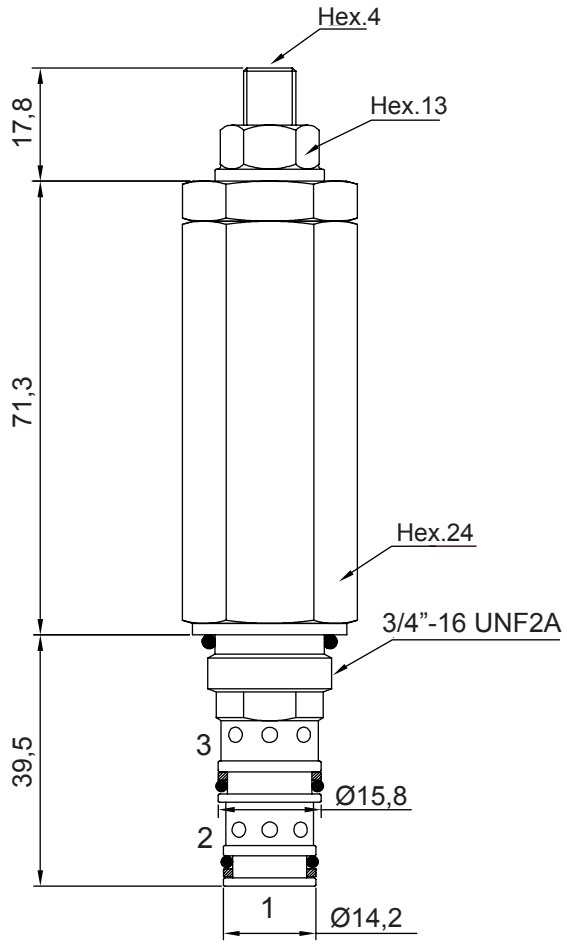
0 1 2 1 2 ☐ 0 3 0 0

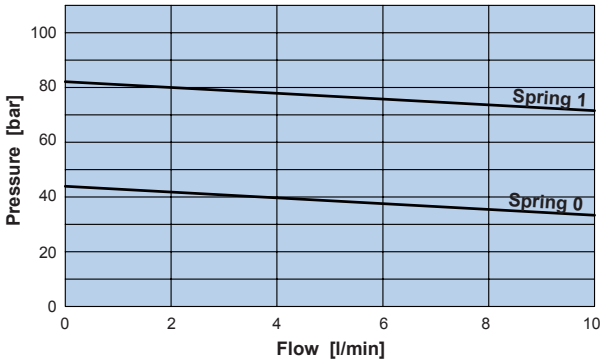
MOLLE	0
Standard setting [bar]	18

DIRECT ACTING PRESSURE REDUCING VALVE

- Flow . . . . . **10 l/min**
- Max working pressure in 2 . . . . . **350 bar**
- Max working pressure in 1 . . . . . **100 bar**
- Max working pressure in 3 . . . . . **1 bar**
- Seals . . . . . **NBR e PTFE**
- Cavity . . . . . **C 320000**
- Cartridge thightening torque. . . . . **30 Nm**
- Weight . . . . . **0,25 Kg**







14

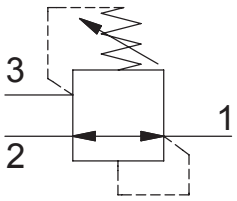
Ordering code

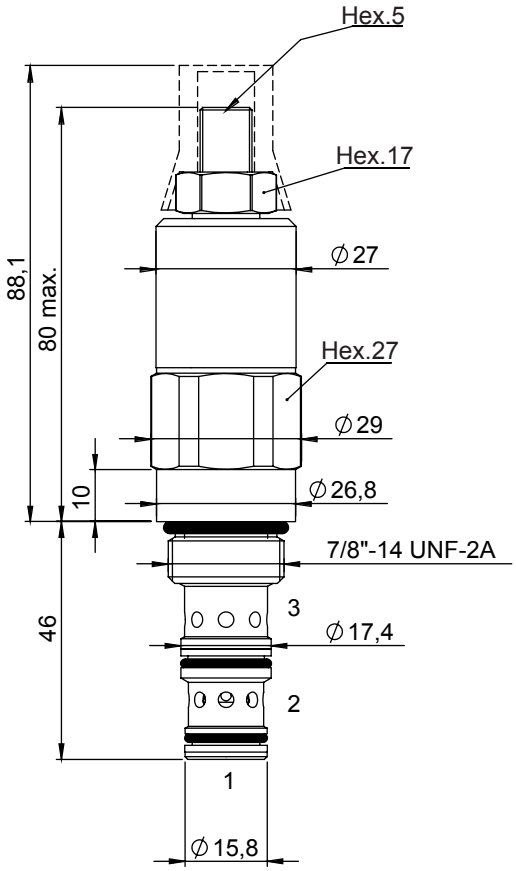
0 1 2 2 1 ☐ 0 0 0 0

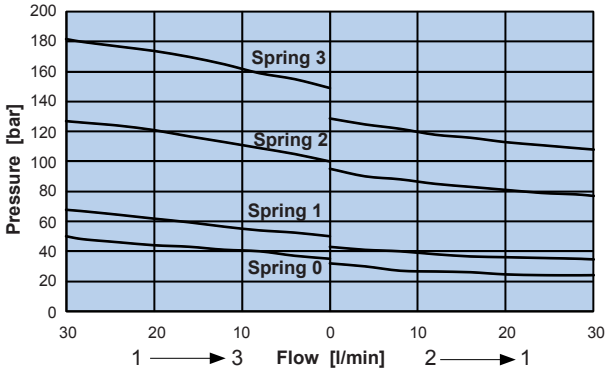
SPRINGS	0	1
Setting range [bar]	5 - 50	20 - 100
Pressure Increase [bar/turn]	7	17
Standard setting [bar]	25	50

DIRECT ACTING PRESSURE REDUCING VALVE

- Flow . . . . . **30 l/min**
- Max working pressure in 2 . . . . . **350 bar**
- Max working pressure in 1 . . . . . **150 bar**
- Max working pressure in 3 . . . . . **1 bar**
- Seals . . . . . **NBR**
- Cavity . . . . . **C 330000**
- Cartridge thightening torque. . . . . **40 Nm**
- Weight . . . . . **0,31 Kg**
- Leakage with 350 bar in 2: . . . . . **70 cc/min**
- Tamper proof cap. . . . . **cod. 4029250280**







15

Ordering code

0 1 2 3 2 □ 0 □ 0 0

SPRINGS	0	1	2	3
Setting range [bar]	5 - 30	15 - 55	20 - 103	30 - 150
Pressure Increase [bar/turn]	5	8	20	30
Standard setting [bar]	25	50	100	140

0 — **Hex socket screw**

2 — **Handknob**

Adjustments

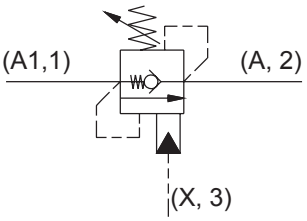
HYDRAULIC CARTRIDGES VALVES

COUNTERBALANCE VALVES

16

INTRODUCTION

Counterbalance valves are hydraulic valves designed specifically to hold and control negative or gravitational loads. They are meant to serve all those applications that involve the control of suspended loads, such as mechanical joints, lifting applications, extensible movable bridge, winches, etc…
Counterbalance valves main functionalities are lowering velocity control and stationary load holding.
Counterbalance valves hydraulic symbol is similar to an integrated micro-circuit, in which 3 characteristic components can be identified:



- A uni-directional valve, which allow a free feeding to the hydraulic actuator and lock load in the required position.
- A pressure relief valve, which, thanks to its specific configuration, holds the loads acting on hydraulic actuators (for instance, cylinders or motors) and limits max pressurization, allowing also stress control, where needed.
- A pilot piston, which opens the pressure relief valve, thanks to connection to hydraulic energy source.

17

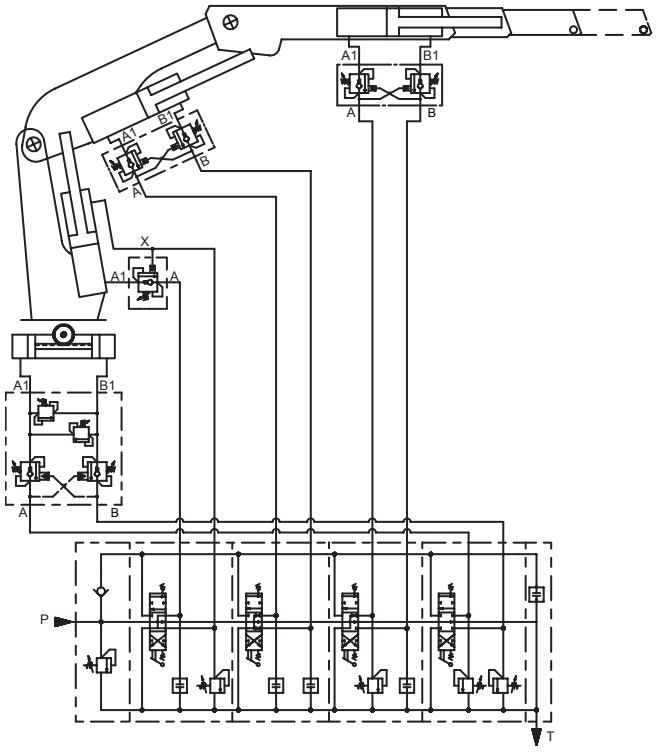


Fig.2 Example of counterbalance valve application

Generally, counterbalance valves are installed directly on cylinders or hydraulic actuators (ex. Port A1-1).

That guarantees load control and holding even in case of rupture or external leakage of the hoses connecting valve and setting device (directional control valve). Picture nr. 2 shows an example of truck crane hydraulic scheme, which is a typical application for counterbalance valves.

WORKING PRINCIPLE

Thanks to the uni-directional valves, oil flow regulated by the directional control valve comes inside the cylinder facing minimum resistance.
When directional spools are in neutral position, sealing devices are in rest position, locking connection between hydraulic actuator and directional control valve. Thanks to mechanical sealing obtained through grinded sealing point, it's possible to avoid leakage through the spools of uni-directional valve. Counterbalance valves, in fact, are able to close with very small leakage (<10 drops/min). Since there are no dents nor saturation effects (possible even in case of clean oil), a perfect sealing will take place in a few minutes.
Pump Connection to pilot line (X-3)– consequence of directional spool change-over– determines the progressive opening of the counterbalance valves, up to the balance satisfying the flows continuity equation. That guarantees the absence of cavitations and also the control of dragged loads lowering velocity.

SETTING

Counterbalance valves setting corresponds to the opening pressure of pressure relief section. This pressure determines the max load which counterbalance valve is able to hold.
Usually the setting pressure value must be at least 1.3 times the max load induced pressure to hold. That tolerance allows induced loads safe holding.

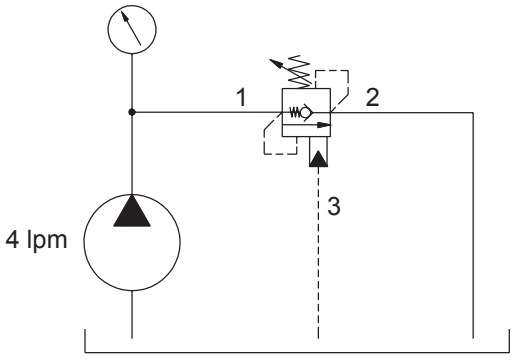


Fig.3

Standard setting pressure (Pt) of counterbalance valves corresponds to pressure on port (1), while the valve is crossed by a 4l/min flow (picture 3).

es. Pt: 350 bar @ 4 l/min

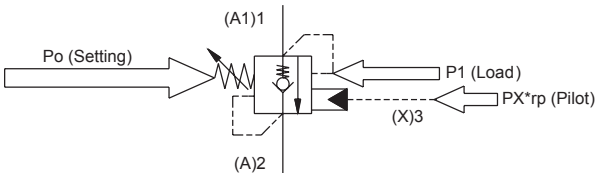
In particular cases, and generally upon customers' request, the pressure can be set considering the initial opening value, corresponding almost to 20 ml/min. flow.

es. Pt: 350 bar @ 20 ml/min

PILOT RATIO

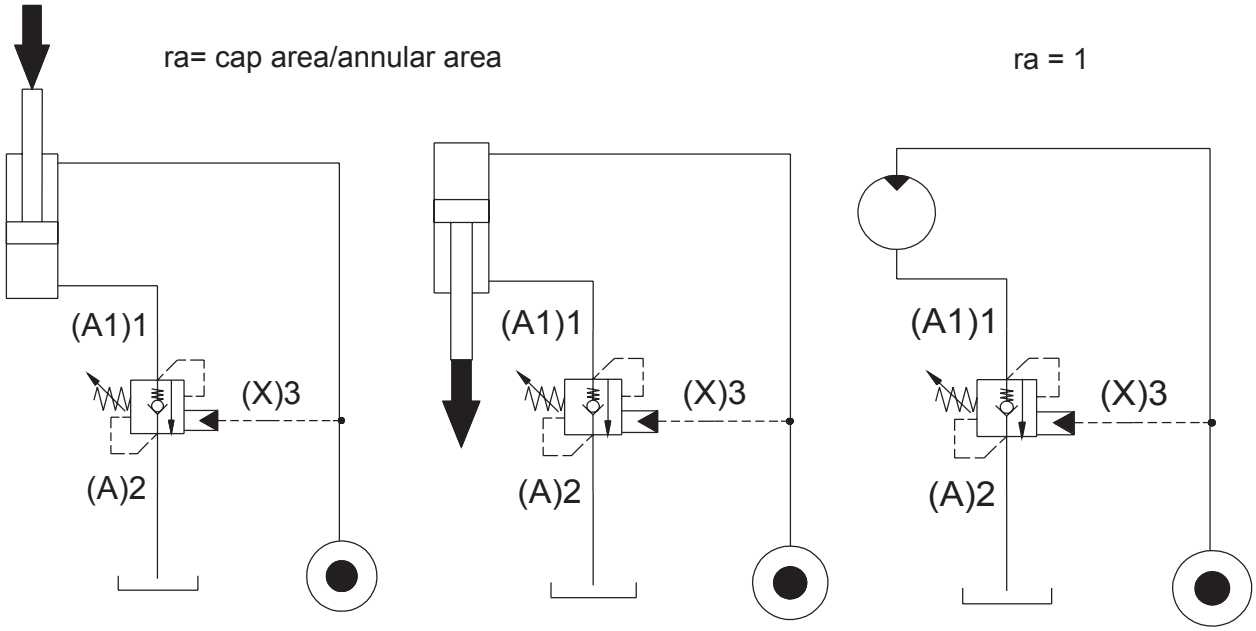
As mentioned before, counterbalance valves are characterized by a pilot area on which pressure coming from the actuator's feeding line acts. Such pressure, together with the pressure due to the load, moves pilot piston, progressively contrasting the force generated by the setting spring.
Hence the combined action of the two pressures is connected to the ratio between the pushing areas on which they act. This ratio is known as "Pilot Ratio" (pr), and it is the basic parameter for any counterbalance valve.
Pilot Ratio (pr) is defined as the geometrical ratio between the area on which the load acts (port 1) and the pilot area (port 3). Thanks to this parameter, it is possible to calculate the values of pilot pressures first opening (Px):

Px = (Pt – P1) / rp



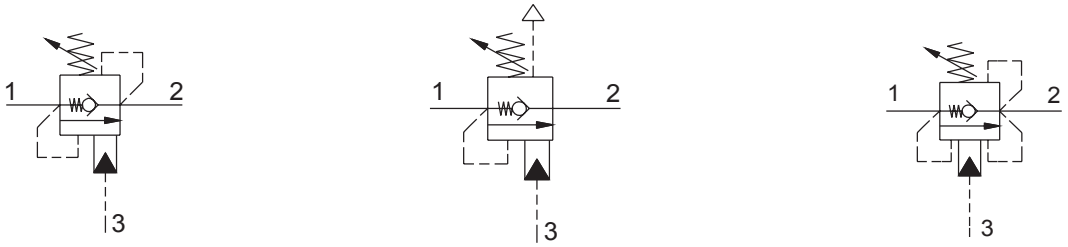
According the Pilot Ratio, counterbalance valves can be divided in 2 types:
High Pilot Ratio (>6:1): suitable for those applications where the loads are constant (for instance, hydraulic motors) and very stable, where low pilot pressures are demanded in favour of speed and energy savings.
Low Pilot Ratio (<5:1): suitable for those applications where loads can vary (for instance, trucks cranes) and for those mechanical structures are not stable, where more control and more stability are needed, an higher pilot pressure is required.
When counterbalance valves are installed on hydraulic actuators, to determine the correct value of pilot pressure it is necessary to introduce in the calculation the ratio between the areas of the actuator itself.

Px = (Pt – P1) / (rp+ra)
ra: ratio between the areas of the hydraulic actuator



COMPENSATION

Because of coupling counterbalance valves with directional control valves, considering the type of spool to use is needed. When the counterbalance valves are in charge of the pressure relief function, it's essential to make a distinction between "closed-centre" spool applications and "open-centre" spool application.
Generally, when "closed-centre" spools are installed, it's necessary to use compensated counterbalance valves: since these valves are insensitive to back-pressure on return line (A-2), their pressure setting won't change.

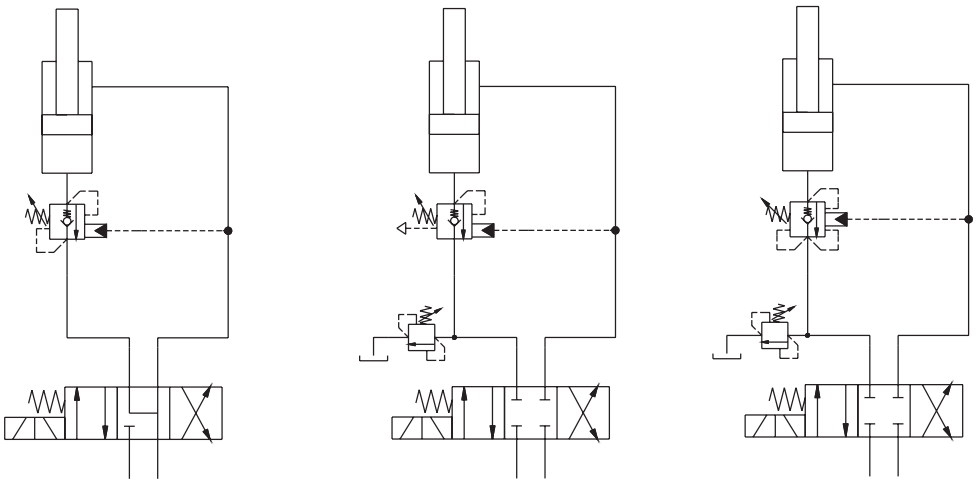


Two examples of compensated valves application are regenerative circuits and circuits in which draining of eventual pressure peaks must be relieved in series by the anti-shock valves installed inside the directional control valve.
In case of "open-centre" directional spool application, not-compensated valves are compulsory, in which the spring is connected to the return line (A-2).

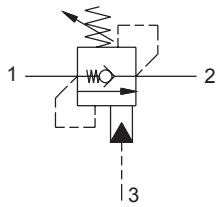
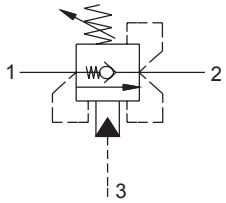
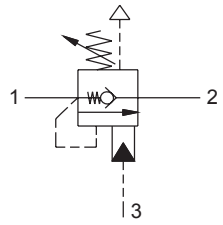
In **Not-Compensated (N)** type valves, back-pressure affects both pressure setting and pilot pressure
In these valves, the return line is directly connected to the spring. Valves in which adjustable spring is connected to return line are not compensated ones.
Main use: open-centre spool application.

In **Fully-Compensated (C)** type valves, back-pressure does not affect neither pressure setting nor pilot pressure. Belong to this type the valves in which the adjustable spring is separated from return line (A-2) and is connected to a draining line or is air-vented.
In these valves, back-pressure (A-2) is balanced, so it won't find any area to carry out its force, so that both setting and pilot pressures are independent from pressure on return line (A).
Main use: closed-centre spool applications, regenerative circuits.

In **Partially-Compensated (S)** valves, only pressure setting is independent from back-pressure, while pilot pressure is affected by back-pressures, which sometimes can be helpful in stabilizing the circuit.
To this kind of valves belong all the valves in which only the area subject to the load (A1-1) is balanced.
Main use: closed-centre spool applications.

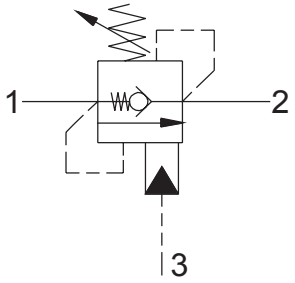


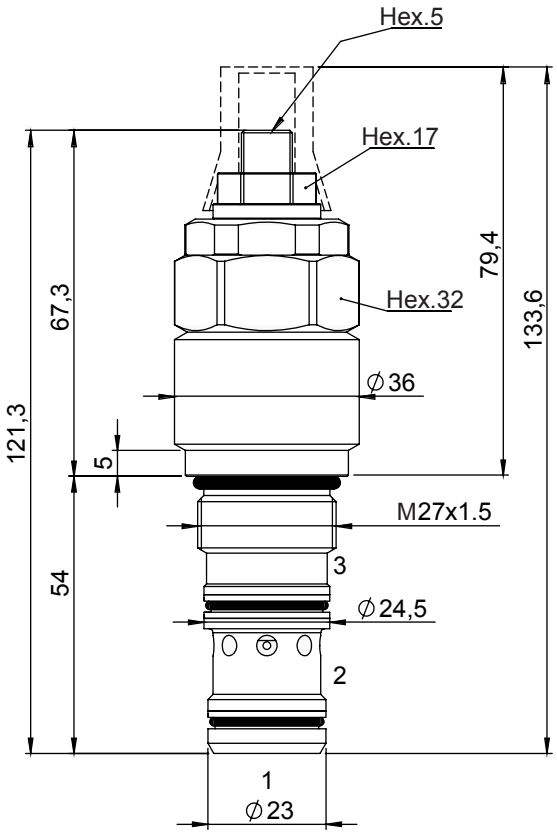
COUNTERBALANCE VALVES

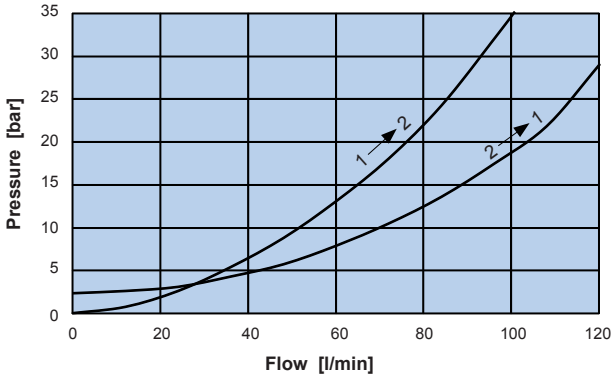
NOT COMPENSATED		Flow l/min	Pmax bar	SIZE	CAVITY	PAGE
	CT-6440	100	410	M27x1.5	M340000	2.01.001
	CT-6140	100	410	SAE-12	C341000	2.01.002
PARTIALLY COMPENSATED						
	CT-6442	100	410	M27x1.5	M340000	2.01.003
	CT-6142	100	410	SAE-12	C341000	2.01.004
FULLY COMPENSATED						
	CT-6141	100	410	SAE-12	C341000	2.01.005
	CT-6441	100	410	M27x1,5	M340000	2.01.006

NOT COMPENSATED COUNTERBALANCE VALVE

- Flow. . . . . .**100 l/min**
- Max working pressure. . . . . **410 bar**
- Cavity . . . . . **M 340000**
- Compensation. . . . . **Not compensated**
- Cartridge thightening torque. . . . . .**60 Nm**
- Weight. . . . . **0,7 Kg**
- Tamper proof cap . . . . . .**cod. 4029250280**







Note:
-Setting: 1,3 times the maximum load induced pressure.
-The back pressure (2) can affect the relief function (for circuits with back pressure use CT-6441 o CT-6442).

Ordering code

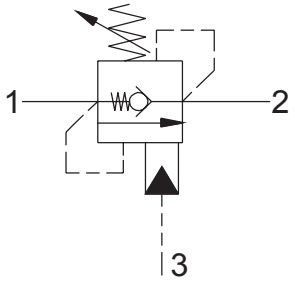
0 6 4 4 0 ☐ ☐ 0 0 0

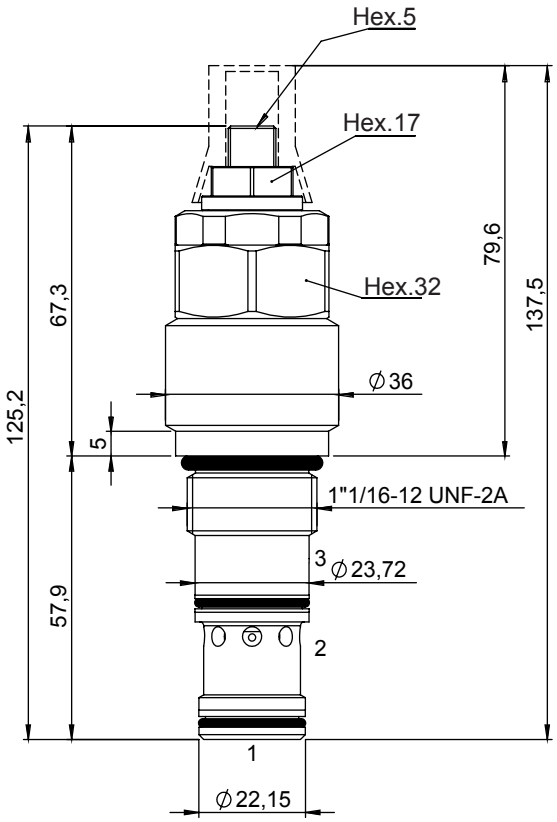
PILOT RATIO	
5	**5:1**

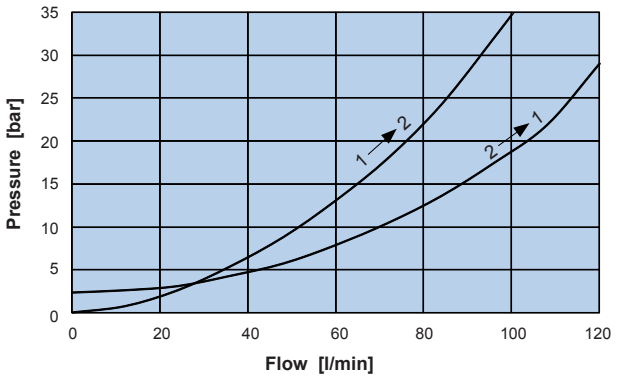
SPRINGS	4
Setting range [bar]	230 - 410
Pressure Increase [bar/turn]	34
Standard setting 4 l/min [bar]	350

NOT COMPENSATED COUNTERBALANCE VALVE

- Flow. . . . . .**100 l/min**
- Max working pressure. . . . . **410 bar**
- Cavity . . . . . **M 340000**
- Compensation. . . . . **Not compensated**
- Cartridge thightening torque. . . . . .**60 Nm**
- Weight. . . . . **0,7 Kg**
- Tamper proof cap . . . . . .**cod. 4029250280**







23

Note:
-Setting: 1,3 times the maximum load induced pressure.
-The back pressure (2) can affect the relief function (for circuits with back pressure use CT-6142).

Ordering code

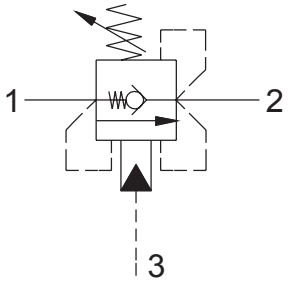
0 6 1 4 0 ☐ ☐ 0 0 0

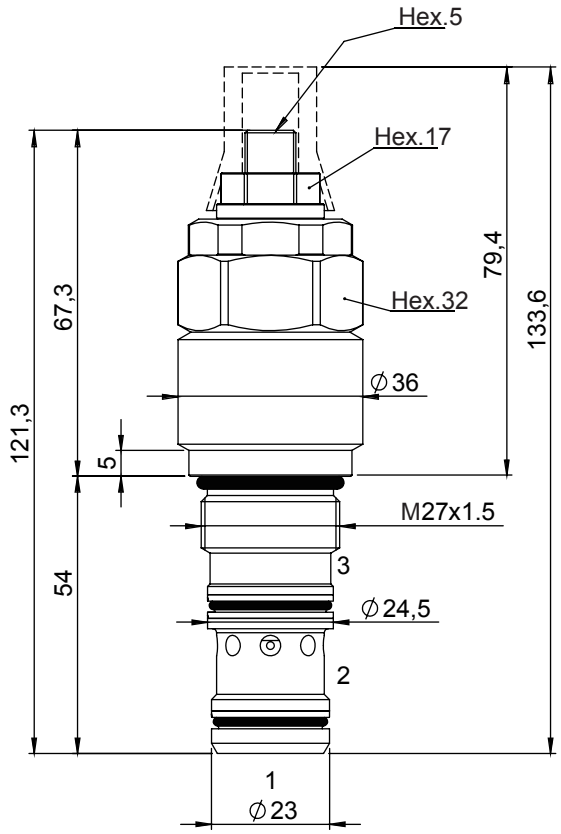
PILOT RATIO	
5	**5:1**

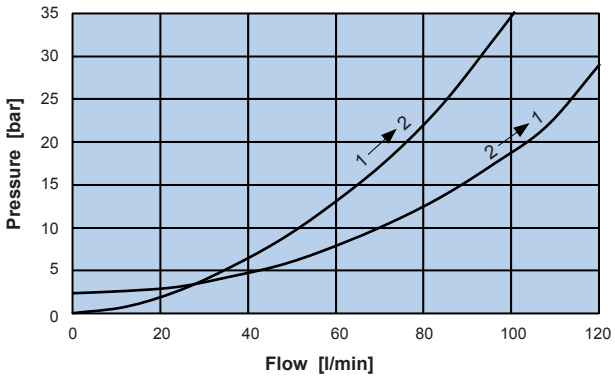
SPRINGS	4
Setting range [bar]	230 - 410
Pressure Increase [bar/turn]	34
Standard setting 4 l/min [bar]	350

PARTIALLY COMPENSATED COUNTERBALANCE VALVE

- Flow. . . . . .100 l/min
- Max working pressure. . . . . 410 bar
- Cavity . . . . . M 340000
- Compensation. . . . . Partially compensated
- Cartridge thightening torque. . . . . .60 Nm
- Weight. . . . . 0,7 Kg
- Tamper proof cap . . . . . .cod. 4029250280







Note:
-Setting: 1,3 times the maximum load induced pressure.

Ordering code

0 6 4 4 2 ☐ ☐ 0 0 0

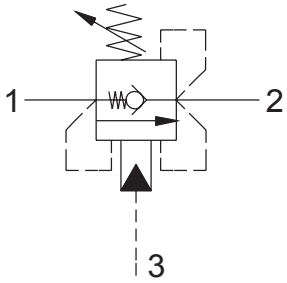
PILOT RATIO	
5	5:1

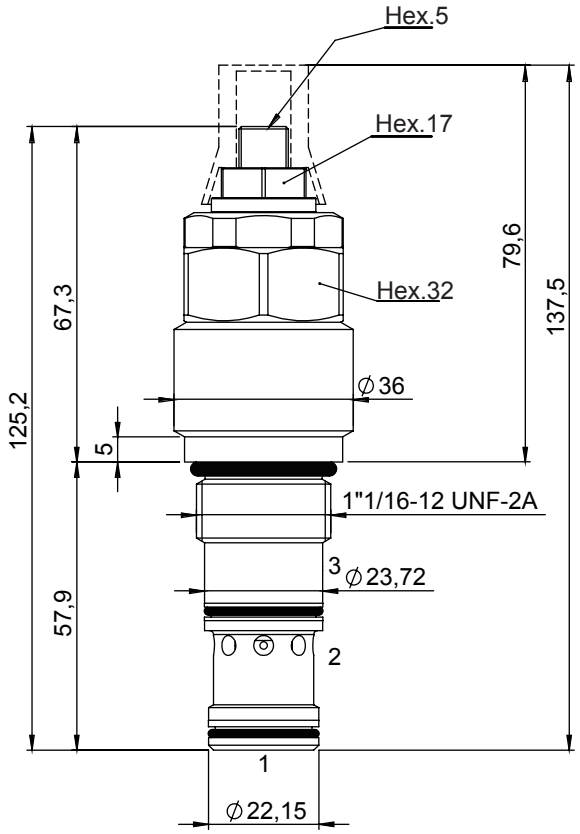
SPRINGS	4
Setting range [bar]	230 - 410
Pressure Increase [bar/turn]	34
Standard setting 4 l/min [bar]	350

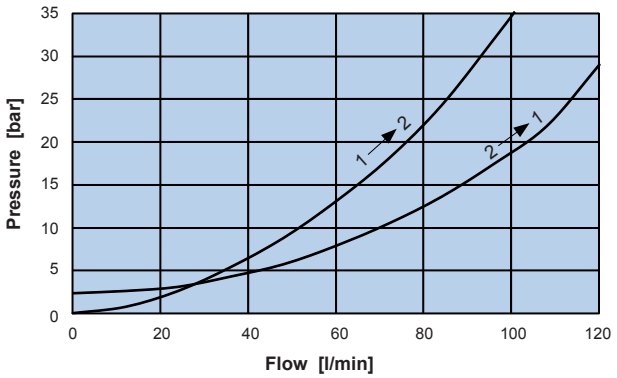
CT-6142
Cartridge SAE 12

PARTIALLY COMPENSATED COUNTERBALANCE VALVE

- Flow. . . . . .**100 l/min**
- Max working pressure. . . . . **410 bar**
- Cavity . . . . . **C 341000**
- Compensation. . . . . **Partially compensated**
- Cartridge thightening torque. . . . . .**60 Nm**
- Weight. . . . . **0,7 Kg**
- Tamper proof cap . . . . . .**cod. 4029250280**







25

Note:
-Setting: 1,3 times the maximum load induced pressure.

Ordering code

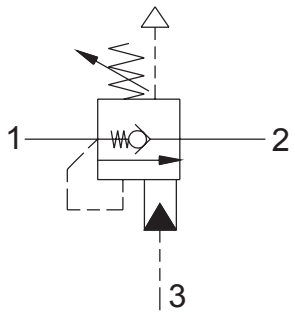
0 6 1 4 2 ☐ ☐ 0 0 0

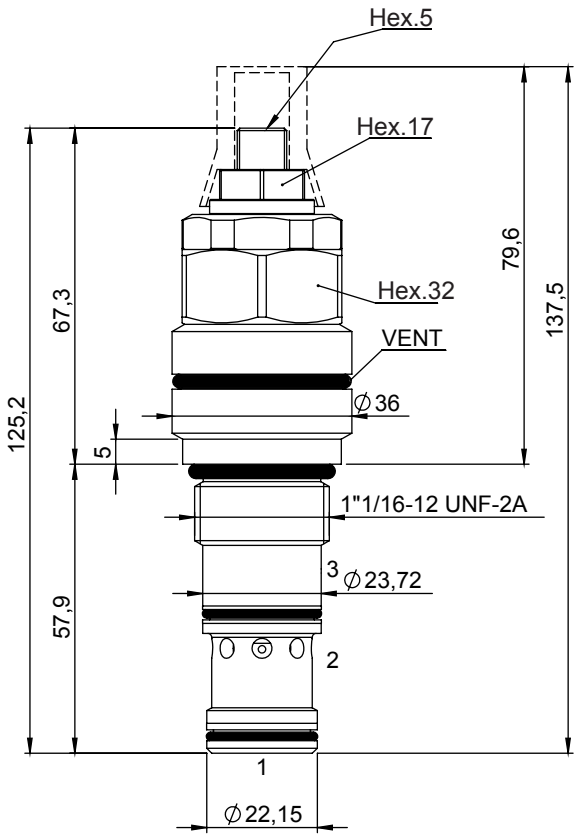
PILOT RATIO	
5	**5:1**

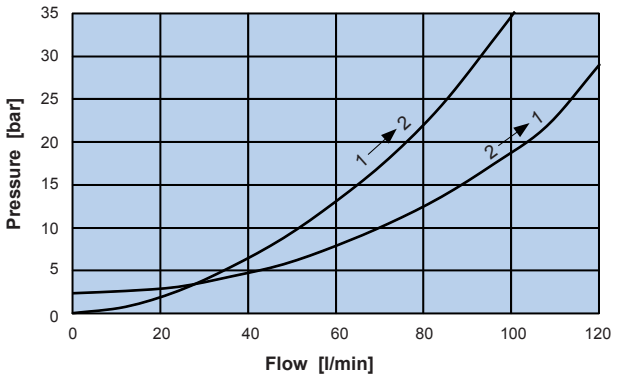
SPRINGS	**4**
Setting range [bar]	230 - 410
Pressure Increase [bar/turn]	34
Standard setting 4 l/min [bar]	350

FULLY COMPENSATED COUNTERBALANCE VALVE

- Flow. . . . . .**100 l/min**
- Max working pressure. . . . . **410 bar**
- Cavity . . . . . **C 341000**
- Compensation. . . . . .**Fully compensated**
- Cartridge thightening torque. . . . . .**60 Nm**
- Weight. . . . . **0,7 Kg**
- Tamper proof cap . . . . . .**cod. 4029250280**







Note:
-Setting: 1,3 times the maximum load induced pressure.

Ordering code

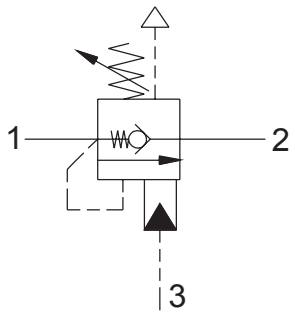
0 6 1 4 1 ☐ ☐ 0 0 0

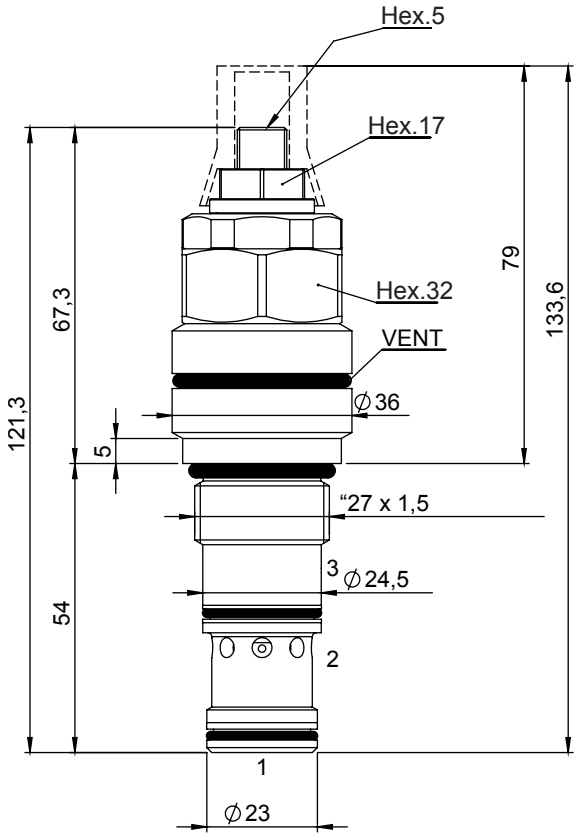
PILOT RATIO	
5	**5:1**

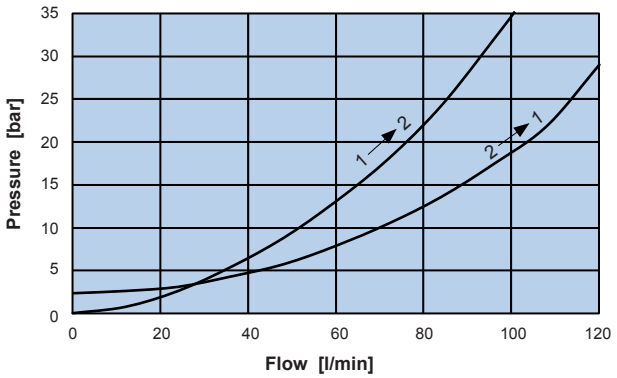
SPRINGS	**4**
Setting range [bar]	230 - 410
Pressure Increase [bar/turn]	34
Standard setting 4 l/min [bar]	350

FULLY COMPENSATED COUNTERBALANCE VALVE

- Flow. . . . . .**100 l/min**
- Max working pressure. . . . . **410 bar**
- Cavity . . . . . **M 340000**
- Compensation. . . . . **Fully compensated**
- Cartridge thightening torque. . . . . .**60 Nm**
- Weight. . . . . **0,7 Kg**
- Tamper proof cap . . . . . .**cod. 4029250280**







27

Note:
-Setting: 1,3 times the maximum load induced pressure.

Ordering code

0 6 4 4 1 ☐ ☐ 0 0 0

PILOT RATIO	
5	**5:1**

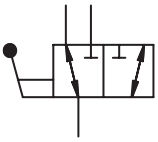
SPRINGS	**4**
Setting range [bar]	230 - 410
Pressure Increase [bar/turn]	34
Standard setting 4 l/min [bar]	350

HYDRAULIC CARTRIDGES VALVES

DIRECTIONAL CONTROL VALVES

28

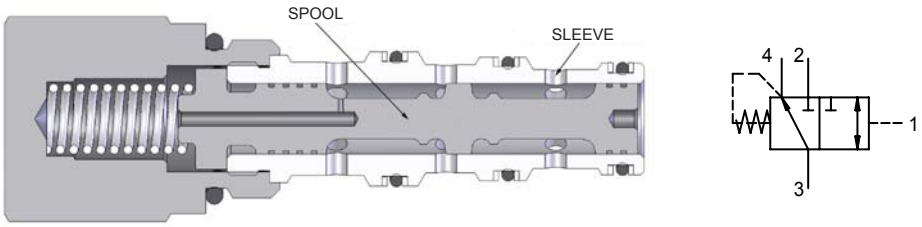
INTRODUCTION



SPOOL TYPE DIRECTIONAL VALVE

Spool type cartridge directional valves are valves which allow to direct or to drive in-coming oil flow through different hydraulic circuit lines. Depending on their actuator type they can be commutated by an external pilot pressure or by a manual override.

The construction is based on matching a drilled cylindrical sleeve with a mobile spool. The spool commutation allows the opening and/or closing of the radial holes made on the cylindrical sleeve.



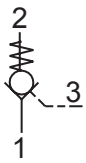
29

Example of uni-directional valve- spool type

These kind of valves are characterized by a radial clearance between the mobile spool and the cylindrical sleeve that determines an internal leakage of a few cc/min. This is why it's use is not advised for gravitational loads holding without the installation of specific valves like: check valves or counterbalance valves.

UNI-DIRECTIONAL VALVES

Unidirectional valves are 2-way valves which allow oil flow only in single direction, with low pressure drops. Flow in the opposite direction is prevented by sealing devices like conical poppets or balls, kept in a closed position by a spring.
The function which prevents oil from crossing the valve in the opposite direction is characterized by an optimal hydraulic sealing (<0,25 cc/min), and by the fact that pressure inside the cartridge acts together with the spring, keeping the sealing device in a closed position.
The passage through uni-directional valve is called "free flow", and it's subject to closing spring strength, whose setting brings about initial opening pressure.



PILOT OPERATED CHECK VALVES

Pilot operated check valves, also known as lock valves, are uni-directional valves in which the opening of the a normally-closed passage can take place thanks to the pilot pressure.
The sealing device's opening through pilot pressure is of an on/off type (from fully closed to fully opened), so that check valves are used to lock hydraulic cylinders.
It's use is not advised at all for the applications intended to lower gravitational loads, on which modulation and/or control of lowering speed is required. This type of applications requires counterbalance valves.

The ratio between the sealing device's area and pilot area determines the valve pilot ratio (rp), which is the essential parameter for calculating the opening pilot pressure. Normally, given a generic load induced pressure (Pp), the pilot pressure (Ppil) required for opening the valve is calculated dividing the load induced pressure (Pp) by pilot ratio (rp):

$$Ppil = Pp / rp$$

When check valves are used on hydraulic actuators (i.e. Cylinders), due to area ratio (ra) of the actuator itself, the effects of inner pressure must also be considered.

$$Ppil = Pp / (rp - ra)$$

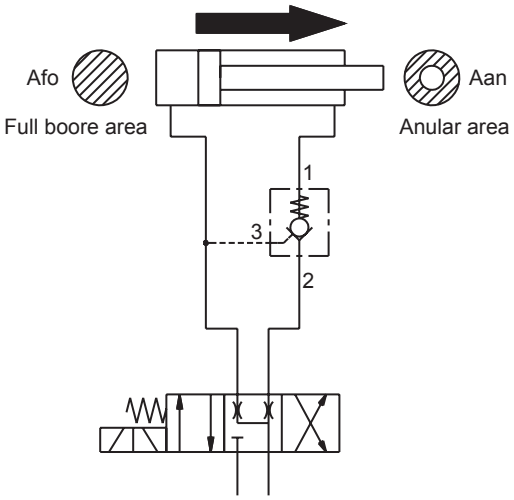
On the hydraulic cylinders, the areas ratio "Ra" is calculated with reference to the type of movements.

Cylinders out (Extension)	Cylinders in
ra = Afo / Aan (>1)	ra = Aan / Afo (<1)

It's very important to remember that, in case of double acting cylinders, pilot ratio must be always higher than areas ratio:

rp > ra

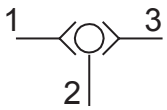
If this rule is not respected, then it is not possible to pilot the check valve during the cylinder extension.



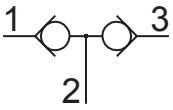
SELECTOR VALVES

Selector valves are designed for pilot circuits or for circuits intended to transfer load sensing (LS) signals inside integrated circuits or directional control valves.
According to their hydraulic schematic, there are 2 types of selector valves:

Bidirectional Selector Valves: These valves compare 2 pressure signals, and allow a bi-directional flow of the highest.

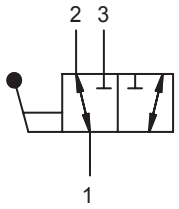
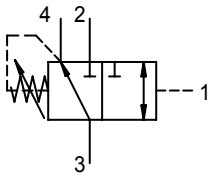
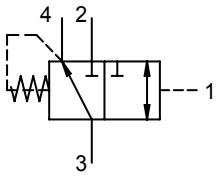


Uni-Directional Selector Valves: These valves compare 2 pressure signals, and allow a uni-directional flow of the highest.



DIRECTIONAL CONTROL VALVES

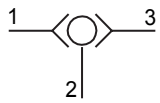
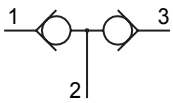
SPOOL DIRECTIONAL VALVES

		Flow l/min	Pmax bar	SIZE	CAVITY	PAGE
	CT-493	30	350	SAE-10	C330000	3.01.001
	CT-48341-1 TV	50	350	SAE-10	C430000	3.01.002
	CT-4834-1 TF	50	350	SAE-10	C430000	3.01.003

CHECK VALVES

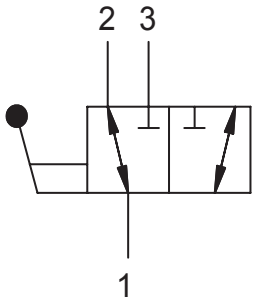
	CT-703	80	350	SAE-10	C230000	3.01.004
	CT-705	200	350	SAE-20	C250000	3.01.005
	CT-713	40	350	Special 7/8”-14	C230001	3.01.006

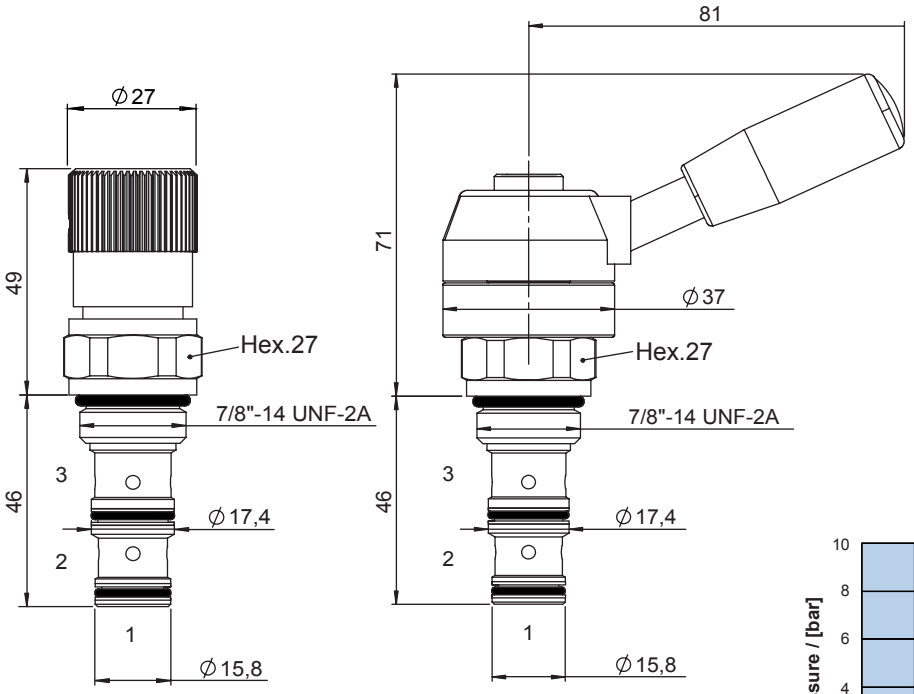
SELECTOR VALVES

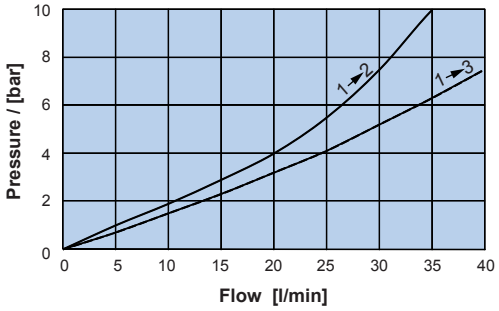
	CT-074	10	350	G-1/8	S000004	3.01.007
	CT-074	2	350	G-1/8	S000005	3.01.008

3 WAYS 2 POSITION ROTARY SPOOL DIRECTIONAL VALVE

- Max Flow. . . . . .**30 l/min**
- Max Pressure. . . . . .**350 bar**
- Cavity . . . . . **C 330000**
- Seals . . . . . .**NBR**
- Cartridge thightening torque. . . . . .**40 Nm**
- Weight . . . . . .**0,2 Kg**







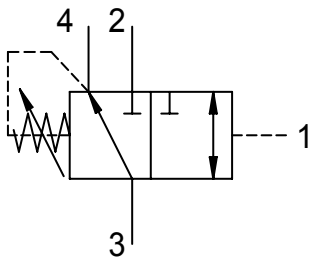
Ordering code

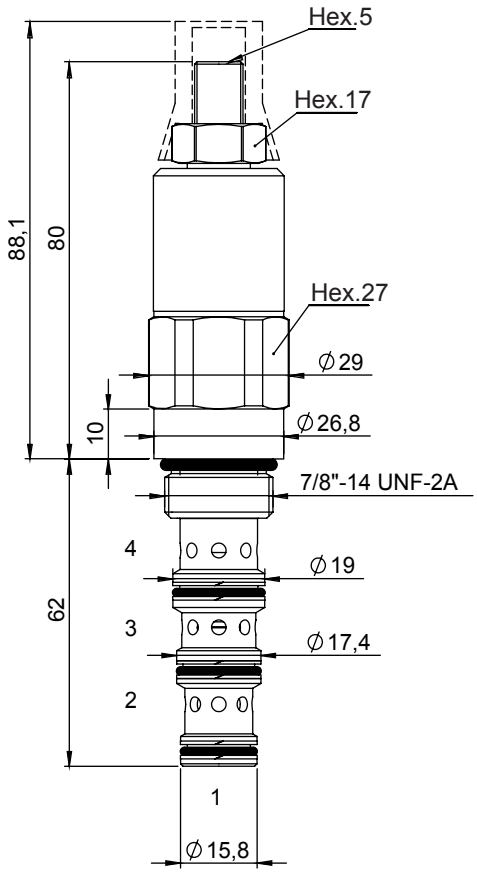
0 4 9 3 2 0 0 ☐ 0 0

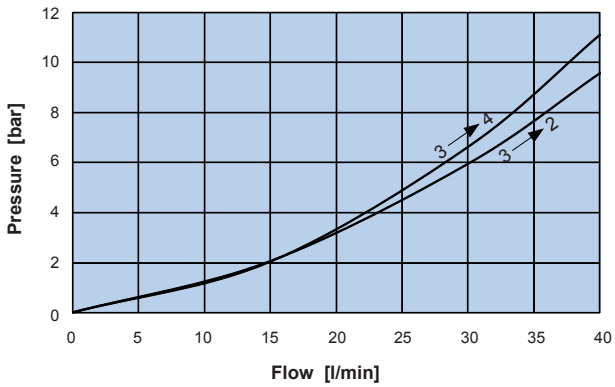
3	7
Hand lever	Handknob

ADJUSTABLE SETTING DIRECTIONAL VALVE

- Max Flow. . . . . .**50 l/min**
- Max Pressure. . . . . .**350 bar**
- Cavity . . . . . **C 430000**
- Cartridge thightening torque. . . . . .**40 Nm**
- Weight . . . . . .**0,35 Kg**







Ordering code

0 4 8 3 4 1 ☐ ☐ 0 0

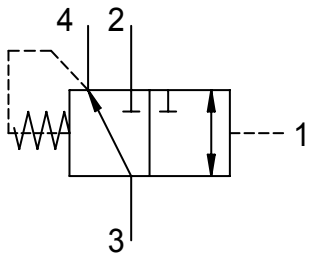
SPRINGS	1	2	3
Setting	2 - 10 bar	5 - 10 bar	10 - 60 bar
Standard setting	5	8	20
Bar/turn	1,9	3	10,3

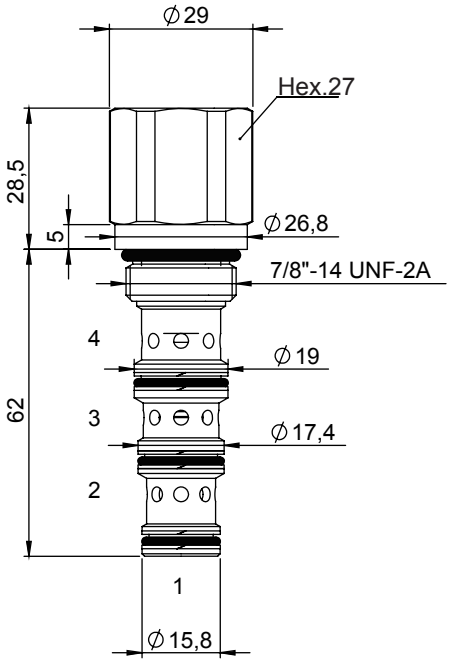
0	1	2
Screw	Tamper proof	Handknob

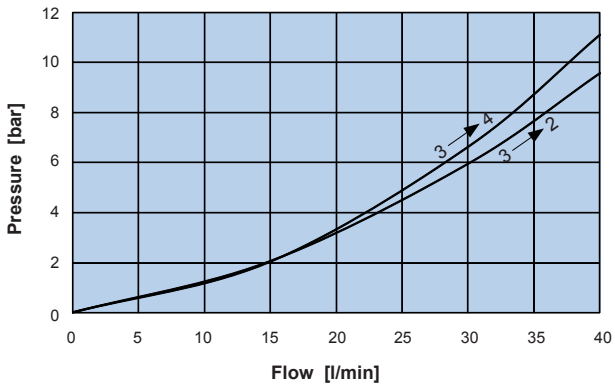
Adjustments

FIX SETTING DIRECTIONAL VALVE

- Max Flow. . . . . .**50 l/min**
- Max Pressure. . . . . .**350 bar**
- Cavity . . . . . **C 430000**
- Cartridge thightening torque. . . . . .**40 Nm**
- Weight . . . . . .**0,2 Kg**







35

Ordering code

0 4 8 3 4 1 □ □ 0 0

SPRINGS	1
Setting	6

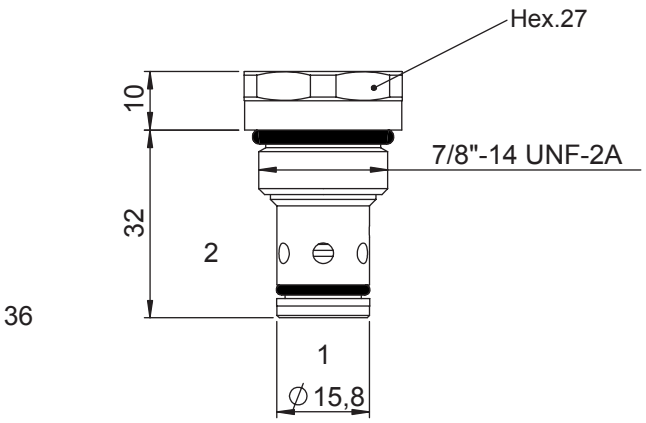
3

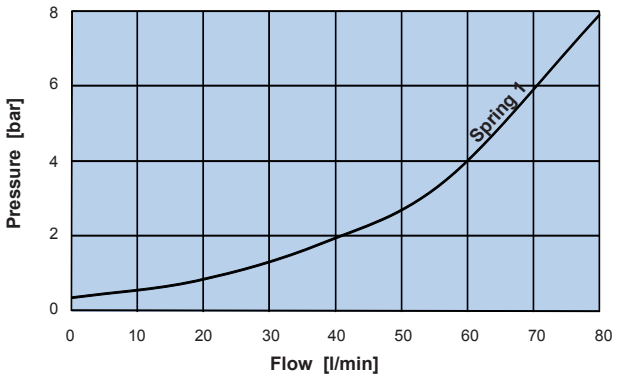
Fix setting

Adjustments

CHECK VALVE

- Max Flow. . . . . .80 l/min
- Max Pressure. . . . . .350 bar
- Cavity . . . . . C 230000
- Leakage. . . . . .0,25 cc/min
- Seals . . . . . .NBR
- Cartridge thightening torque. . . . . .40 Nm
- Weight . . . . . .0,1 Kg





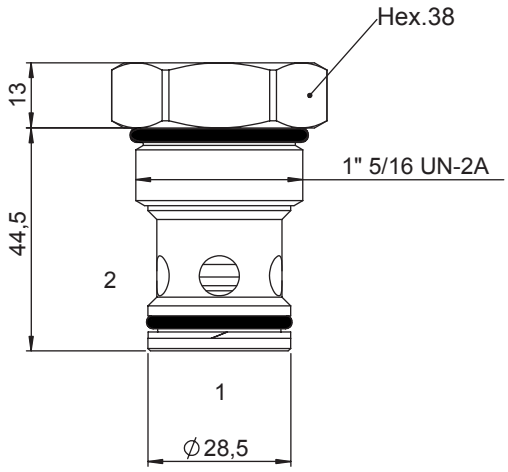
Ordering code

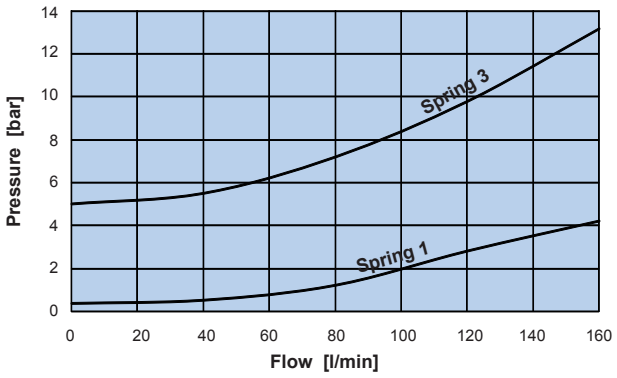
0 7 0 3 1 0 □ 0 0 0

SPRINGS	1	2	3
Cracking pressure [bar]	0,35	2,5	5

CHECK VALVE

- Max Flow. . . . . .150 l/min
- Max Pressure. . . . . .350 bar
- Cavity . . . . . C 250000
- Leakage. . . . . .0,25 cc/min
- Seals . . . . . .NBR
- Cartridge thightening torque. . . . . .65 Nm
- Weight . . . . . .0,3 Kg





37

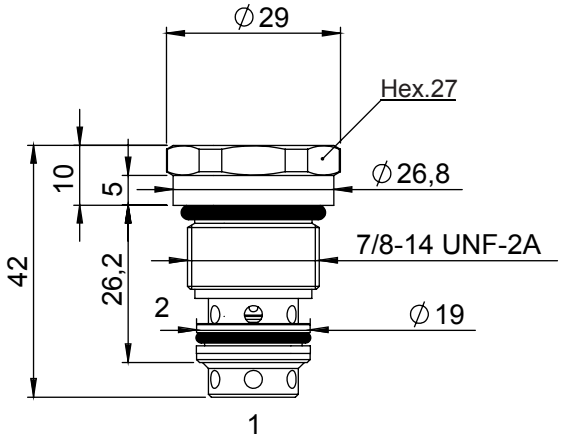
Ordering code

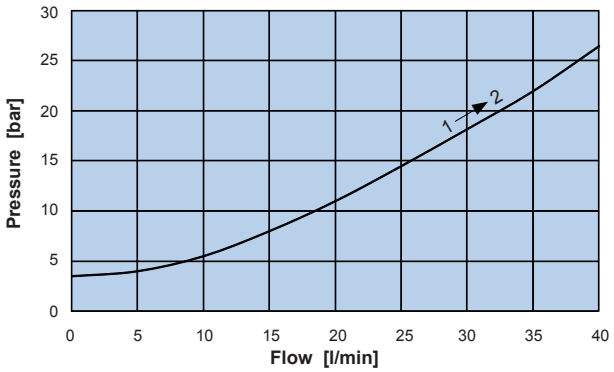
0 7 0 5 1 0 ☐ 0 0 0

SPRINGS	1	2	3
Cracking pressure [bar]	0,35	2,5	5

CHECK VALVE

- Max Flow. . . . . .40 l/min
- Max Pressure. . . . . .350 bar
- Cavity . . . . . .C 230001
- Leakage. . . . . .0,25 cc/min
- Seals . . . . . .NBR
- Cartridge thightening torque. . . . . .40 Nm
- Weight . . . . . .0,1 Kg





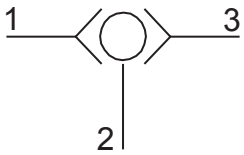
Ordering code

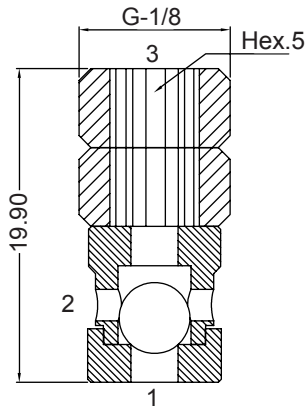
0 7 1 3 1 0 ☐ 0 0 0

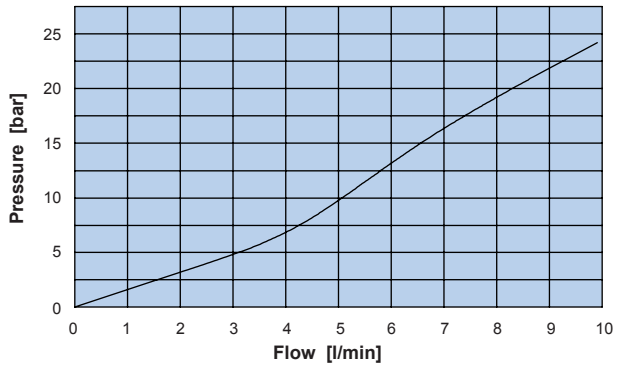
SPRINGS	2	3
Cracking pressure [bar]	2	5

INSERT SHUTTLE VALVE

- Max Flow. . . . . .**10 l/min**
- Max Pressure. . . . . .**350 bar**
- Cavity **S000004**
- Cartridge thightening torque. . . . . **12-15 Nm**
- Weight . . . . . .**0,010 Kg**







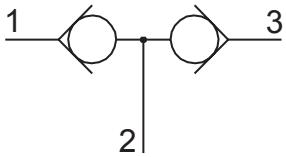
39

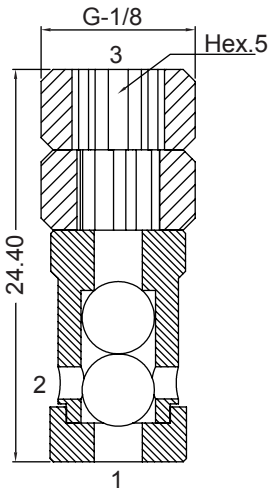
Ordering code

0 7 4 2 1 0 0 0 0 0

UNIDIRECTIONAL INSERT SHUTTLE VALVE

- Max Flow. . . . . .**2 l/min**
- Max Pressure. . . . . .**350 bar**
- Cavity . . . . . .**S 000005**
- Cartridge thightening torque. . . . . **12-15 Nm**
- Weight . . . . . .**0,010 Kg**





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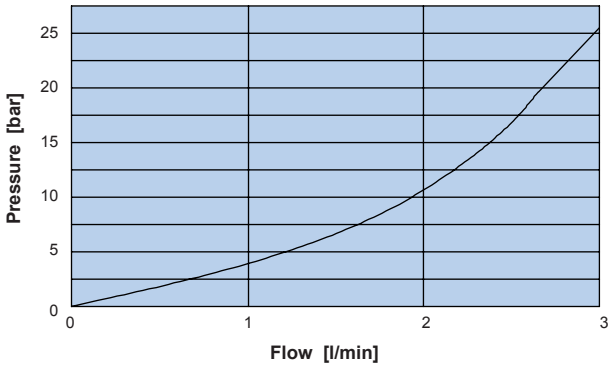


Ordering code

0 7 4 2 2 0 0 0 0

HYDRAULIC CARTRIDGES VALVES

FLOW CONTROL VALVES

INTRODUCTION

BIDIRECTIONAL FLOW RESTRICTORS

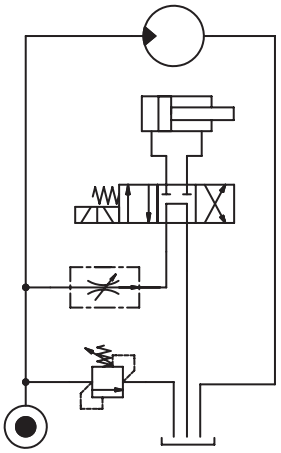
Thanks to this type of valves, it's possible to regulate flow passage inside an hydraulic circuit. The flow restriction brings about a non-compensated load loss which depends on the loads themselves.
These valves allow to obtain compensated flow regulators, when coupled with pressure compensators.

UNIDIRECTIONAL FLOW RESTRICTORS

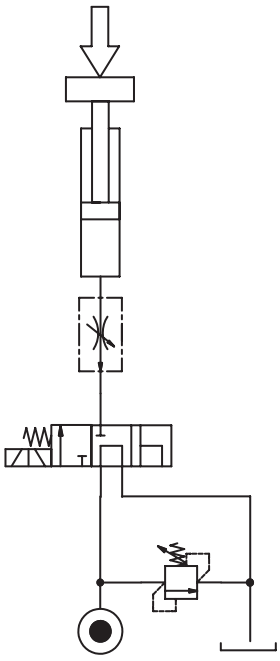
These valves regulate flow passage only in one direction, keeping the flow passage free in the opposite direction. Flow restriction brings about a non-compensated load loss which depends on the loads themselves.
These valves act as compensated flow regulators, when coupled with pressure compensators.

2-WAY COMPENSATED FLOW REGULATORS

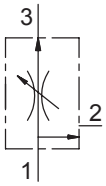
These valves regulate oil flow inside an hydraulic line, independently from the feeding pressure.
They are composed by an adjusting device for flow setting and a pressure compensator connected to it in series which keeps a constant pressure drop across the adjusting device flow area.
2-way compensated flow regulators are usually installed in parallel to the main line:
1) to reduce feeding on secondary circuits, which work at lower pressures compared to the main feeding line pressure;
2) to reduce inertial/dragged maximum speed.
In the first case, it's important to provide draining of oil in excess in comparison with set flow, installing a pressure relief valve.



Derivation connection



Series connection



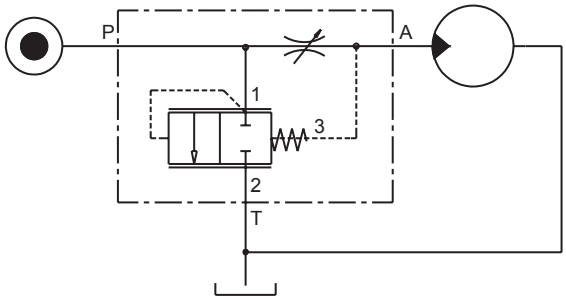
3-WAY COMPENSATED FLOW REGULATORS

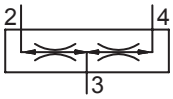
These valves regulate oil flow inside an hydraulic line, draining excess flow through a third line which makes the regulated flow independent from the working pressure.

There are different types of 3-way regulators:

Cartridge type: this type is very compact and enable a constant regulated flow, independently from pressure on both lines. The excess flow line can be pressurized even at higher values than the regulated line. Regulated flow has priority over any line connected to the excess port.

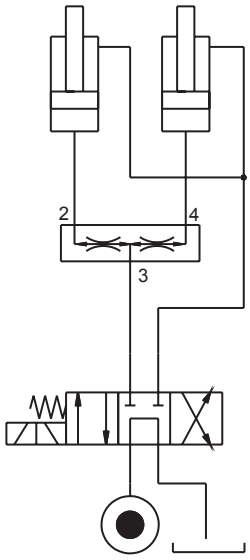
Integrated circuit type: these valves are flow regulators designed using cartridges installed in a manifold. Their main characteristic is that they're able to manage higher flows than the cartridge type.
Main components are: (1) flow control device; (2) 2-way normally closed compensator.
For an optimal functionality, pressure on third line (T) must be lower than pressure on regulated line (A).



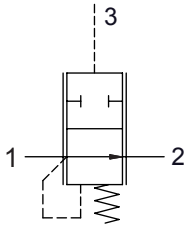


FLOW DIVIDERS/COMBINERS

These valves enable the division of the inlet oil flow(3) in equal parts or with a predetermined ratio on ports (2) e (4), so that flow onto the actuators is pressure compensated.
This function is guaranteed also in the opposite direction, where the flows from the hydraulic actuators are reunified in port (3).

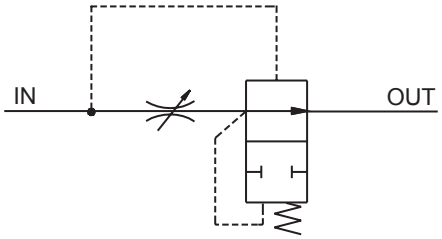


Flow divider/combiner hydraulic scheme

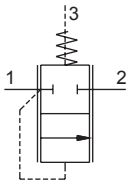


2-WAY N/O PRESSURE COMPENSATORS

2-way N/O pressure compensators are cartridges designed for 3-way cavities, which allow to obtain 2-way compensated flow regulator, since they are series connected to a flow restrictor or to a 2/2 proportional valve.

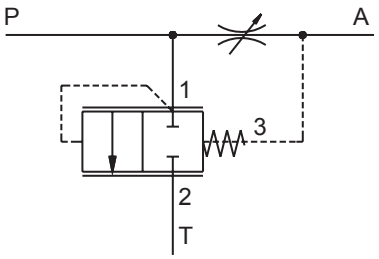


Example of 2 way compensated flow regulator

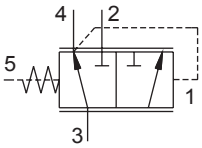


2-WAY N/C PRESSURE COMPENSATORS

2-way N/C pressure compensators are cartridges designed for 3-way cavities, which act as a 3-way compensated flow regulator, since they are connected in parallel to a flow restrictor or to a 2/2 proportional valve.
For an optimal functionality, pressure on port (2-T) must be lower than pressure on regulated line (3-A).

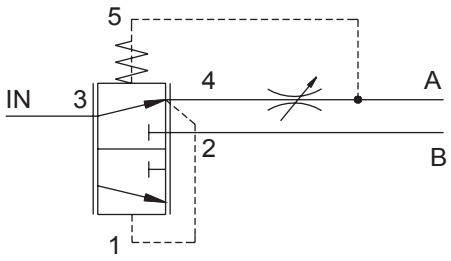


Example of 3 way compensated flow regulator

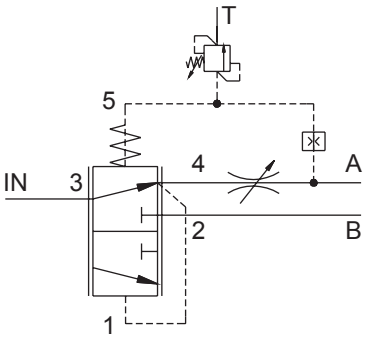


3-WAY POST- REGULATED PRESSURE COMPENSATORS

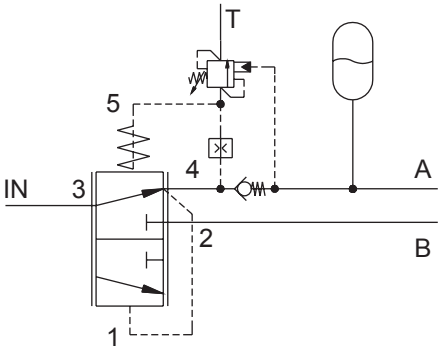
3-way post-regulated pressure compensators are cartridges designed for 4-way cavities.
If connected to a flow restrictor or to 2/2 proportional valve, they act as a 3-way compensated flow regulator, which enables a constant regulated flow independently from the pressure on ports (4) and (2).
As its main characteristic, this type of compensator is able to feel the pressures to be balanced on line (4-A), i.e. it's able to work on regulated line pressure.
So that it's possible to regulate pressure or even to intercept regulated flow, by adding the necessary components.
Feeding circuits for accumulators (braking systems) are interesting applications of these type of compensators.



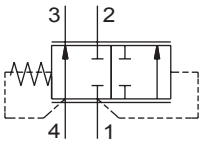
Post-regulated flow regulator



Flow and pressure-limited regulator

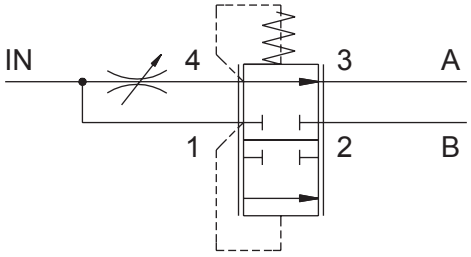


Feeding circuit for accumulators piloted dump valve equipped



4-WAY PRESSURE COMPENSATORS

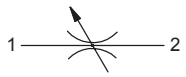
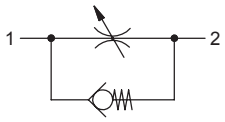
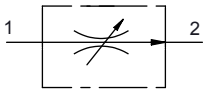
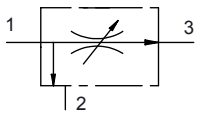
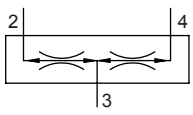
4-way pressure compensators are cartridges designed for 4-way cavities.
Connected to a flow restrictor or to a 2/2 proportional valve, they act as a 3-way compensated flow regulator which is able to keep a constant regulated flow independently from pressure on ports (2) and (3).
As its main characteristic, this type of compensator is able to feel pressures to be balanced on line (4-IN), i.e.
It is able to work on pressure picked up-stream the compensator. Only flow regulations can be done with this type of compensator.



Pre-regulated flow regulator

FLOW CONTROL VALVES

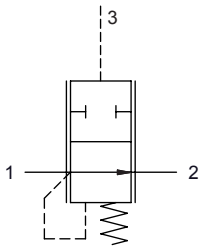
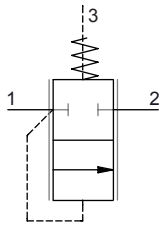
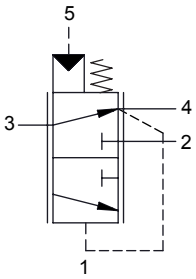
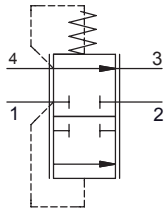
FLOW CONTROL VALVES

2 WAYS FLOW CONTROL VALVES		Flow l/min	Pmax bar	SIZE	CAVITY	PAGE
	CT-302	30	350	SAE-8	C220000	4.01.001
	CT-372	30	350	SAE-8	C220000	4.01.002
	CT-313	30	30	SAE-10	C230000	4.01.003
	CT-314	50	50	SAE-12	C240000	4.01.004
3 WAYS FLOW CONTROL VALVES						
	CT-323	50	30	SAE-10	C330000	4.01.005
	CT-324	90	50	SAE-12	C340000	4.01.006
FLOW DIVIDER AND CONBINER VALVES						
 ***Flow divider and conbiner valve**	CT-823	50	350	SAE-10	C430000	4.01.007

47

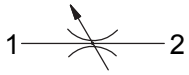
FLOW CONTROL VALVES

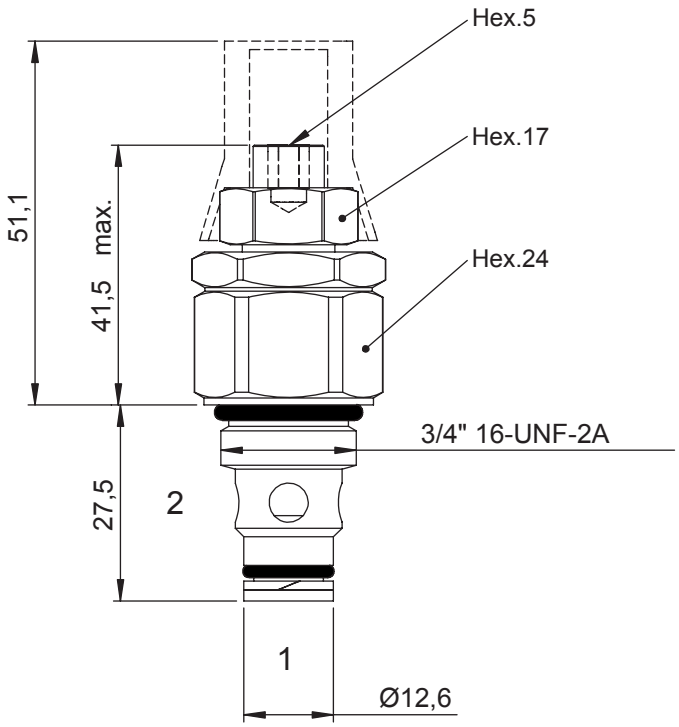
LOGIC ELEMENTS

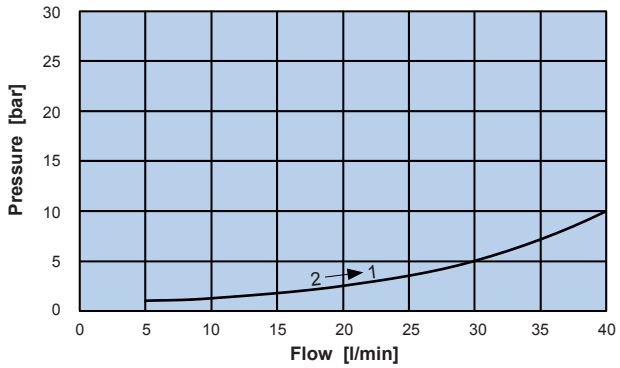
		Flow l/min	Pmax bar	SIZE	CAVITY	PAGE
	CT-214	60	350	SAE-12	C341000	4.01.008
	CT-203	70	350	SAE-10	C331000	4.01.009
	CT-204	150	350	SAE-12	C341000	4.01.010
	CT-205	200	350	SAE-16	C351000	4.01.011
	CT-243	60	350	SAE-10	C430000	4.01.012
	CT-253	50	350	SAE-10	C533000	4.01.013

BIDIRECTIONAL FLOW CONTROL VALVE

- Max Flow. . . . . **30 l/min**
- Max working pressure . . . . . **350 bar**
- Seals . . . . . **NBR**
- Cavity **C220000**
- Cartridge thightening torque. . . . . **30 Nm**
- Weight. . . . . **0,15 Kg**
- Tamper proof cap: **cod.4029250280**
- Adjustment range. . . . . **5 turns**



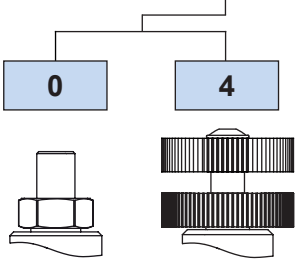




Fully open adjustment pressure drop

Ordering code

0 3 0 2 0 0 0 ☐ 0 1

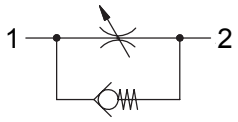


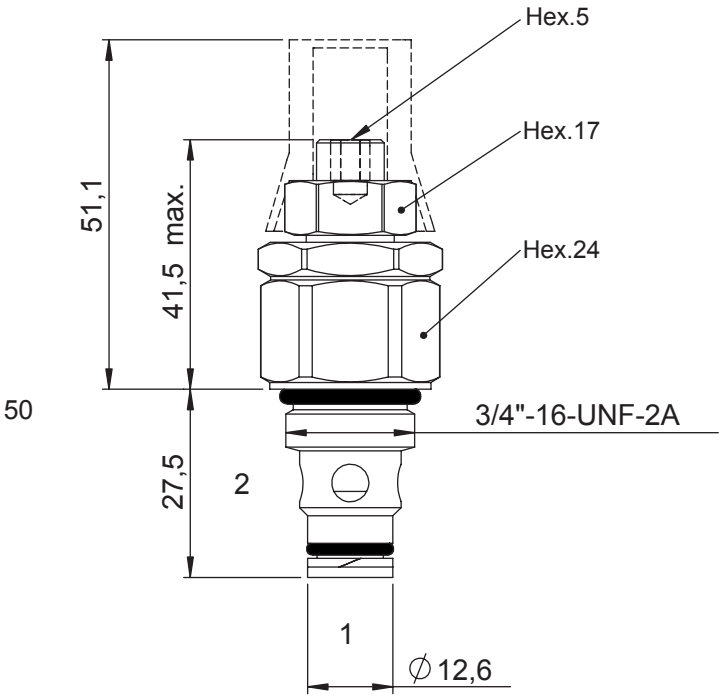
Screw **Handknob**

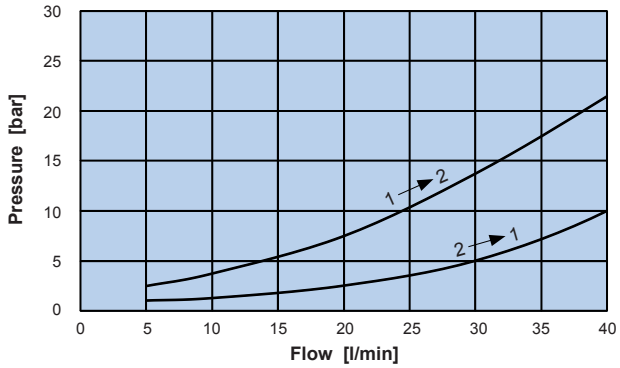
Adjustments

UNIDIRECTIONAL FLOW CONTROL VALVE

- Max Flow. . . . . **30 l/min**
- Max working pressure . . . . . **350 bar**
- Seals . . . . . **NBR**
- Cavity **C220000**
- Cartridge thightening torque. . . . . **30 Nm**
- Weight. . . . . **0,15 Kg**
- Tamper proof cap: **cod.4029250280**
- Adjustment range. . . . . **5 turns**







Ordering code

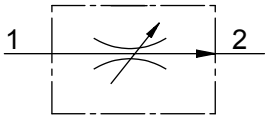
0 3 7 2 0 0 0 ☐ 0 1

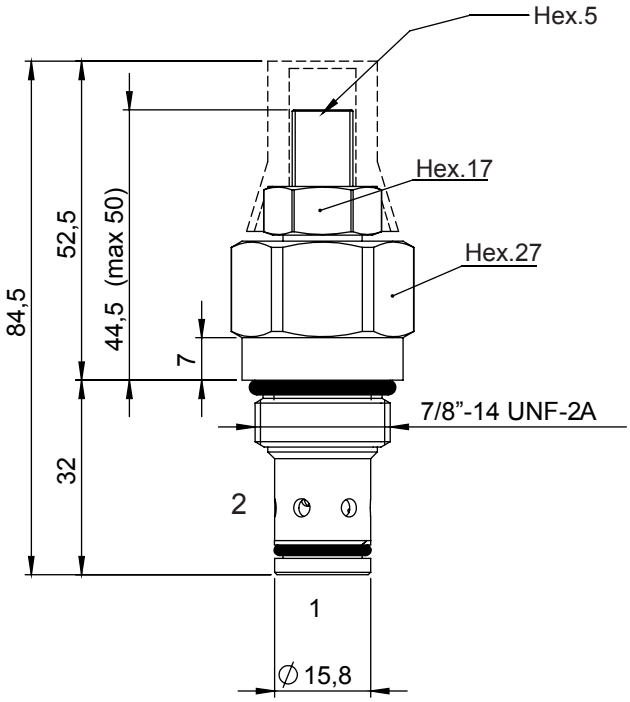
0	4
Screw	Handknob

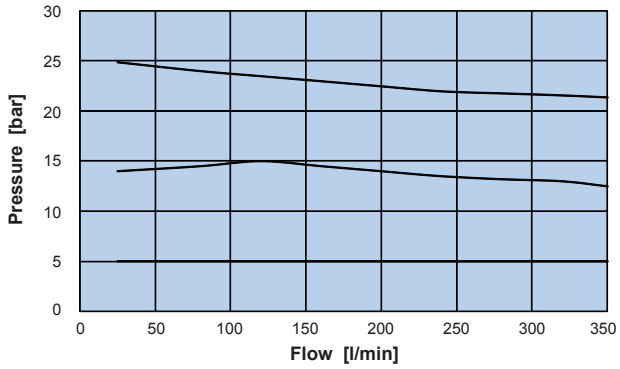
Adjustments

2 WAYS COMPENSATED FLOW CONTROL VALVE

- Max Flow. . . . . **30 l/min**
- Max working pressure . . . . . **350 bar**
- Cavity **C230000**
- Cartridge thightening torque. . . . . **40 Nm**
- Weight. . . . . **0,2 Kg**
- Tamper proof cap: **cod.4029250280**







51

Ordering code

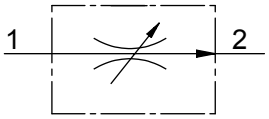
0 3 1 3 0 0 0 ☐ 0 0

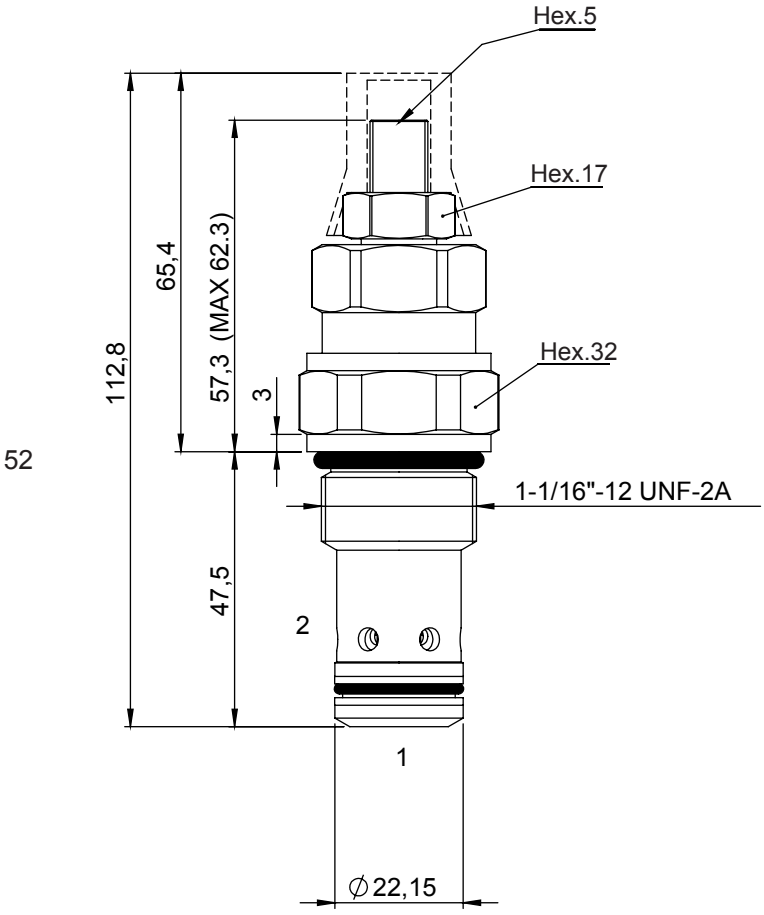
0	2
Screw	Handknob

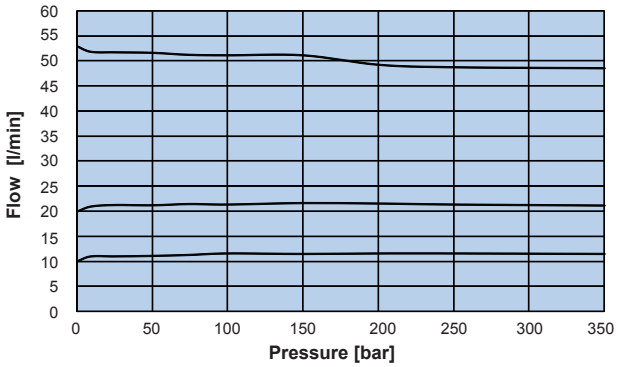
Adjustments

2 WAYS COMPENSATED FLOW CONTROL VALVE

- Max Flow. . . . . .**50 l/min**
- Max working pressure . . . . . .**350 bar**
- Cavity **C240000**
- Cartridge thightening torque. . . . . .**50 Nm**
- Weight. . . . . **0,31 Kg**
- Tamper proof cap: **cod.4029250280**







Ordering code

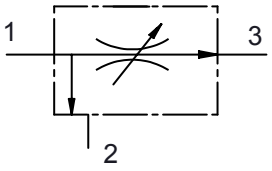
0 3 1 4 0 0 0 ☐ 0 1

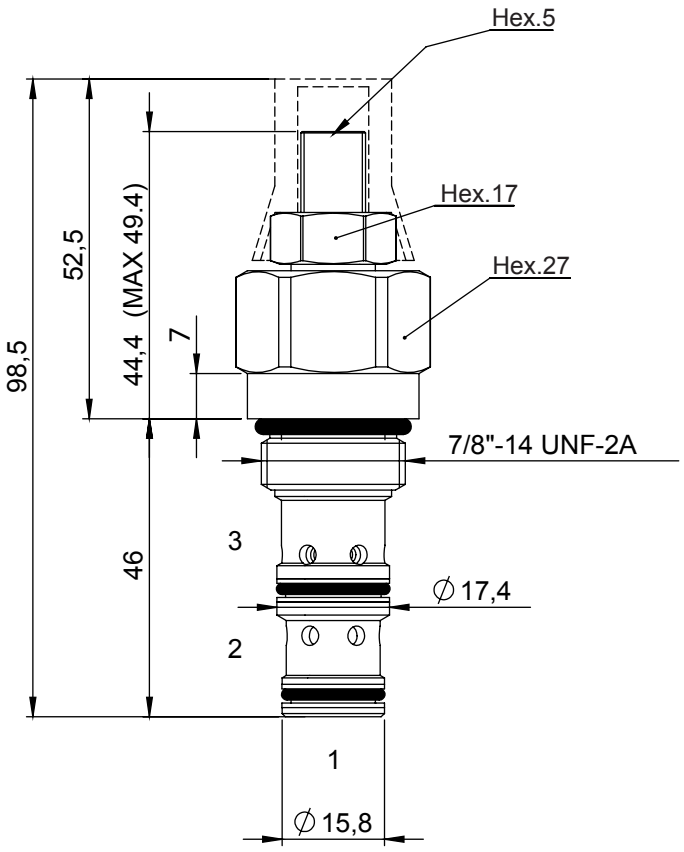
0	4
Screw	Handknob

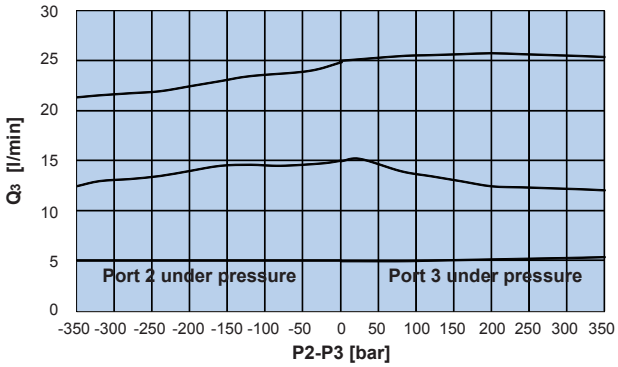
Adjustments

3 WAYS COMPENSATED FLOW CONTROL VALVE

- Max Flow in (1). . . . . **50 l/min**
- Max Regulated Flow (3) . .. . **30 l/min**
- Max working pressure . . . . . **350 bar**
- Cavity **C330000**
- Cartridge thightening torque. . . . . **40 Nm**
- Weight. . . . . **0,31 Kg**
- Tamper proof cap: **cod.4029250280**



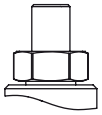
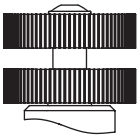




53

Ordering code

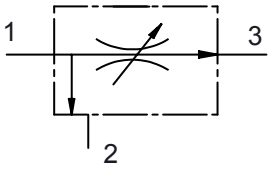
0 3 2 3 0 0 0 ☐ 0 0

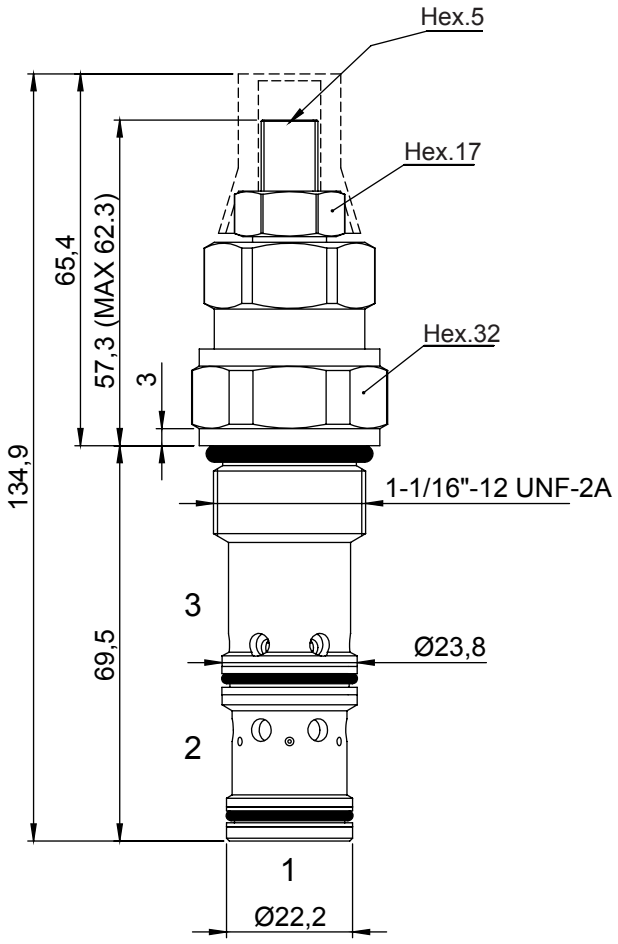
0	4
	
Screw	Handknob

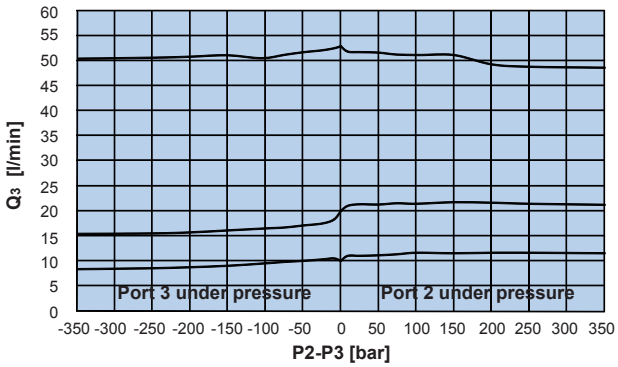
Adjustments

3 WAYS COMPENSATED FLOW CONTROL VALVE

- Max Flow in (1). . . . . **90 l/min**
- Max Regulated Flow (3). . . . . **50 l/min**
- Max working pressure . . . . . **350 bar**
- Cavity **C340000**
- Cartridge thightening torque. . . . . **50 Nm**
- Weight. . . . . **0,4 Kg**
- Tamper proof cap: **cod.4029250280**

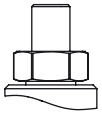
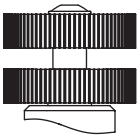






Ordering code

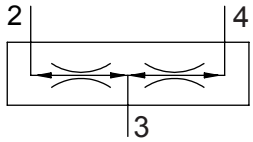
0 3 2 4 0 0 0 ☐ 0 0

0	5
	
Screw	Handknob

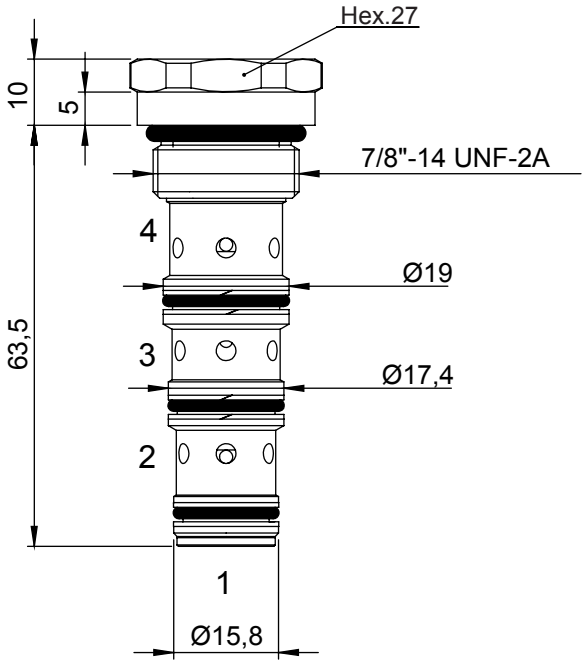
Adjustments

FLOW DIVIDER AND COMBINER VALVE

- Flow. . . . . .**40 l/min**
- Max working pressure. . . . . .**350 bar**
- Rapporto di divisione. . . . . .**50% ÷ 50%**
- Cavity **C430000**
- Tollerance. . . . . .**< +/-5%**
- Seals . . . . . .**NBR**
- Cartridge thightening torque. . . . . .**40 Nm**
- Weight. . . . . .**0,15 Kg**



Note:
- PATENDED FLOW DIVIDER AND COMBINER VALVE



55

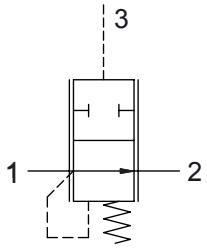
Ordering code

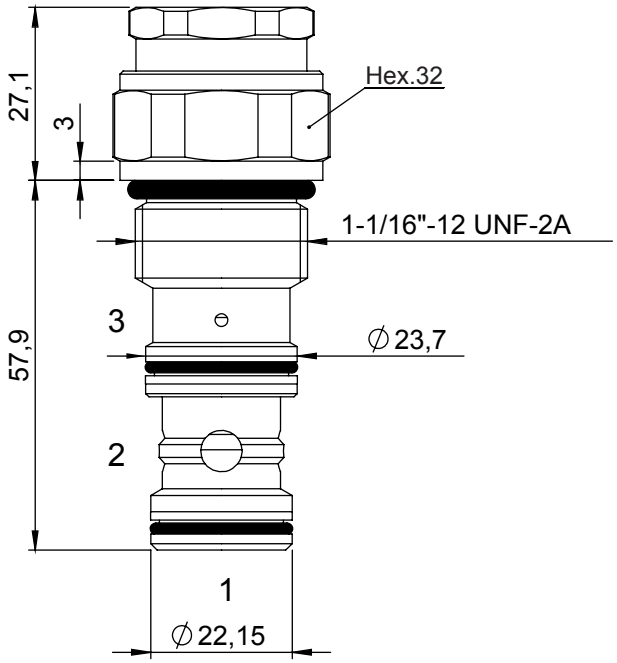
0 8 2 3 0 ☐ 0 0 0 0

SETTING RANGE	0	1	2	3
Qmin ÷ Qmax l/min	20 ÷ 40	2 ÷ 6	5 ÷ 12	12 ÷ 30

2 WAYS NO SPOOL LOGIC ELEMENT

- Max Flow . . . . . **60 l/min**
- Max working pressure . . . . . **350 bar**
- Seals . . . . . **NBR**
- Cavity . . . . . **C 341000**
- Cartridge thightening torque. . . . . **50 Nm**
- Weight. . . . . **0,3 Kg**





56

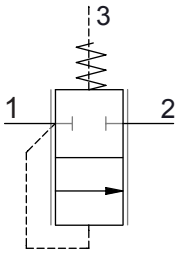
Ordering code

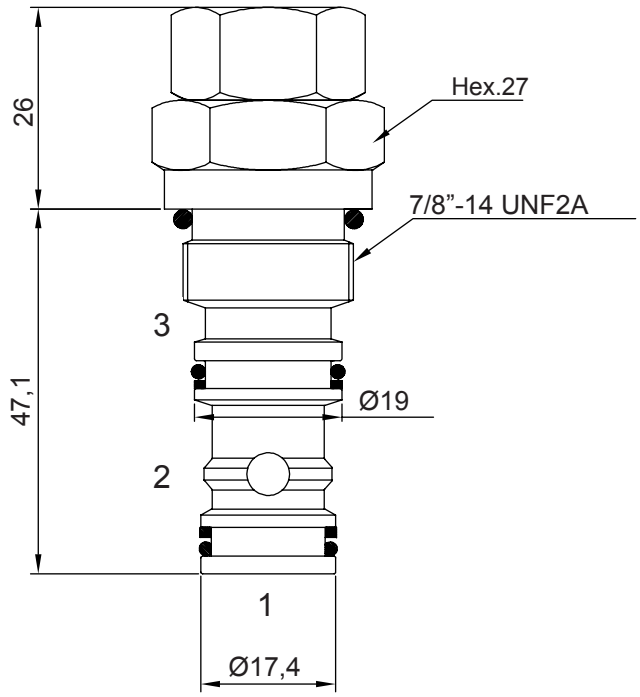
0 2 1 4 0 0 2 ☐ 0 0

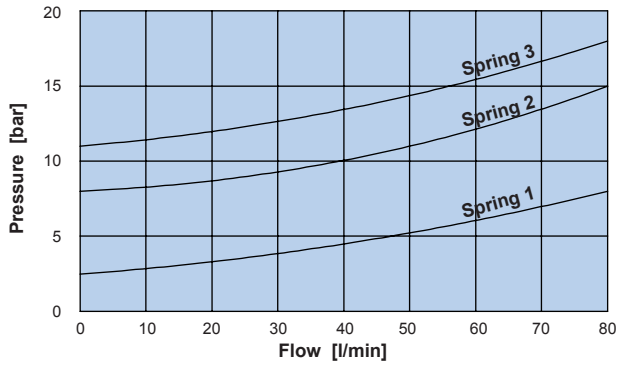
SPRINGS	4
Cracking pressure [bar]	5

2 WAYS NC PRESSURE COMPENSATOR

- Max Flow . . . . . **70 l/min**
- Max working pressure . . . . . **350 bar**
- Seals . . . . . **NBR e PTFE**
- Cavity **C331000**
- Cartridge thightening torque . . . . . **40 Nm**
- Weight . . . . . **0,17 Kg**







57

Ordering code

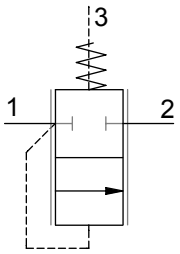
0 2 0 3 0 0 ☐ ☐ 0 0

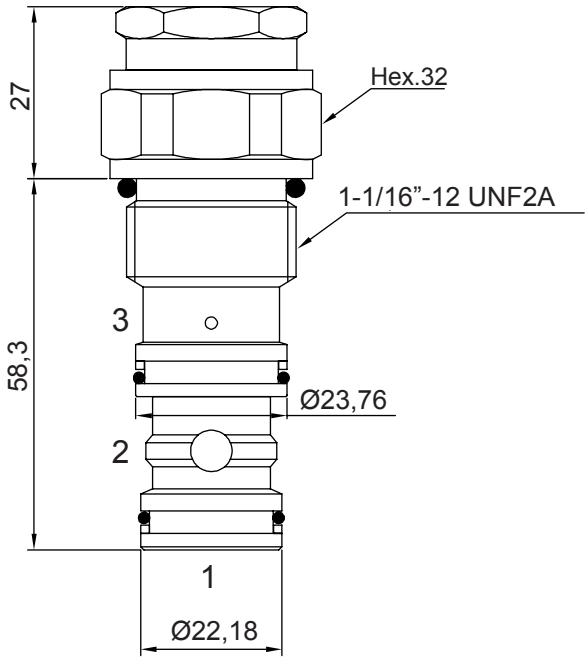
MAX FLOW	1	2
Q [l/min]	40 l/min	70 l/min

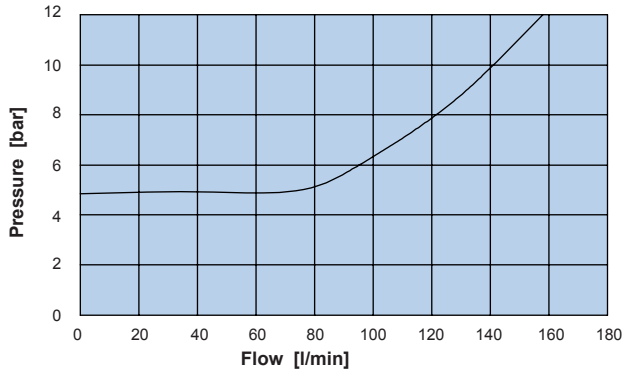
SPRINGS	1	2	3
Cracking pressure [bar]	2,5	7,5	11

2 WAYS NC PRESSURE COMPENSATOR

- Max Flow . . . . . **150 l/min**
- Max working pressure. . . . . **350 bar**
- Seals . . . . . **NBR e PTFE**
- Cavity **C341000**
- Cartridge thightening torque . . . . . **50 Nm**
- Weight . . . . . **0,26 Kg**







58

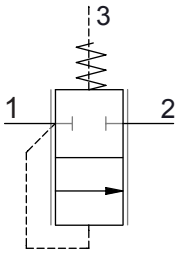
Ordering code

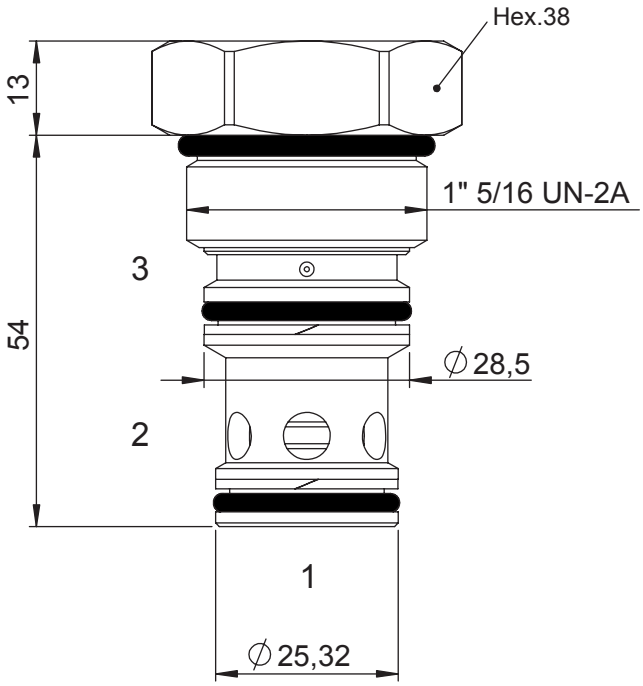
0 2 0 4 0 0 2 ☐ 0 0

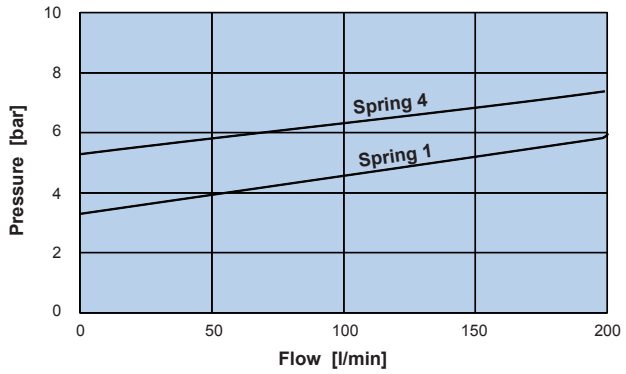
SPRINGS	4
Cracking pressure [bar]	5

2 WAYS NC PRESSURE COMPENSATOR

- Max Flow . . . . . **200 l/min**
- Max working pressure . . . . . **350 bar**
- Seals . . . . . **NBR**
- Cavity **C351000**
- Cartridge thightening torque . . . . . **65 Nm**
- Weight . . . . . **0,3 Kg**







59

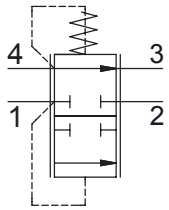
Ordering code

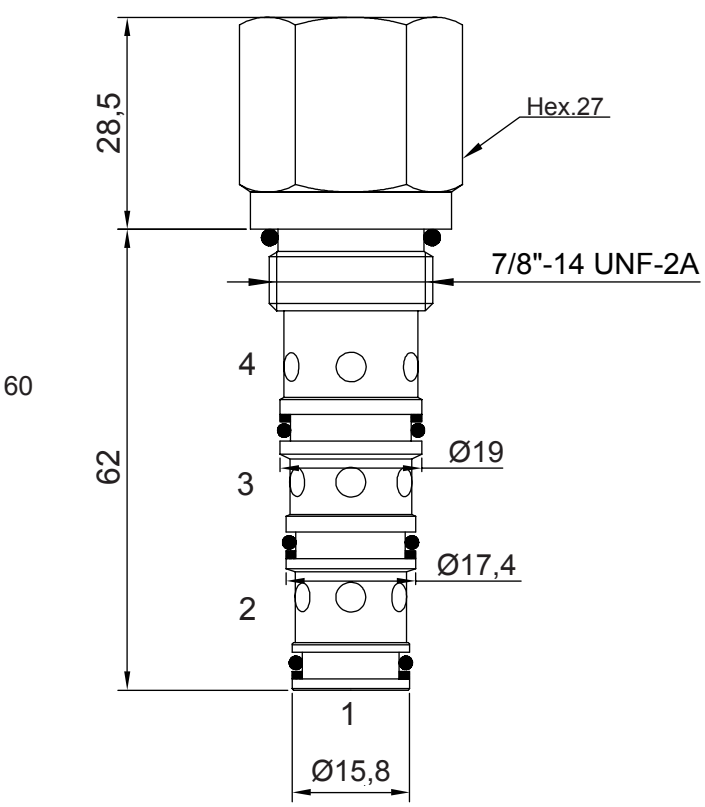
0 2 0 5 0 0 2 ☐ 0 0

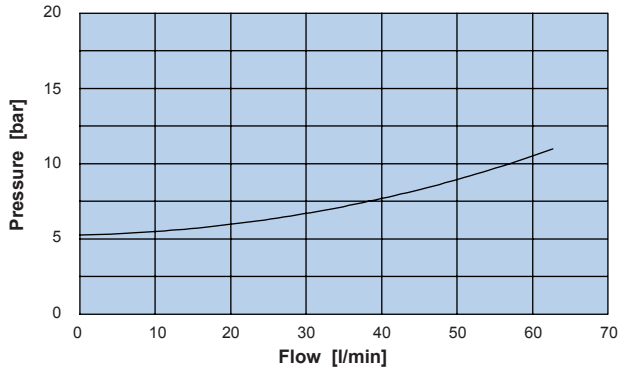
SPRINGS	1	4
Cracking pressure [bar]	2,8	4,8

4 WAYS PRESSURE COMPENSATOR

- Flow . . . . . **60 l/min**
- Max working pressure. . . . . **350 bar**
- Leakage . . . . . **100 cc/min**
- Seals . . . . . **NBR e PTFE**
- Cavity **C430000**
- Cartridge thightening torque . . . . . **40 Nm**
- Weight . . . . . **0,21 Kg**







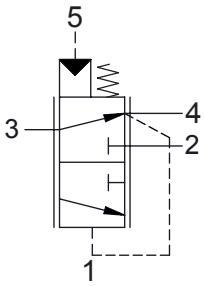
Ordering code

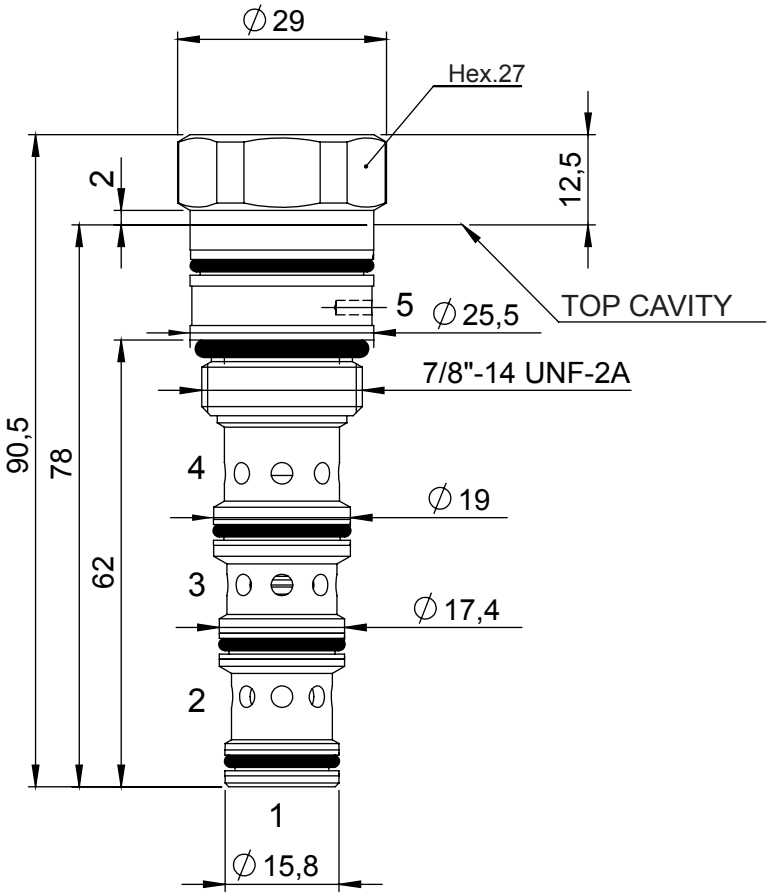
0 2 4 3 0 0 2 ☐ 0 0

SPRINGS	4
Cracking pressure [bar]	5

3 WAYS POST COMPENSATED PRESSURE COMPENSATOR

- Flow . . . . . **50 l/min**
- Max working pressure . . . . . **350 bar**
- Seals . . . . . **NBR**
- Cavity **C533000**
- Cartridge thightening torque . . . . . **40 Nm**
- Weight . . . . . **0,2 Kg**





61

Ordering code

0 2 5 3 0 0 2 ☐ 0 0

SPRINGS	4
Cracking pressure [bar]	5