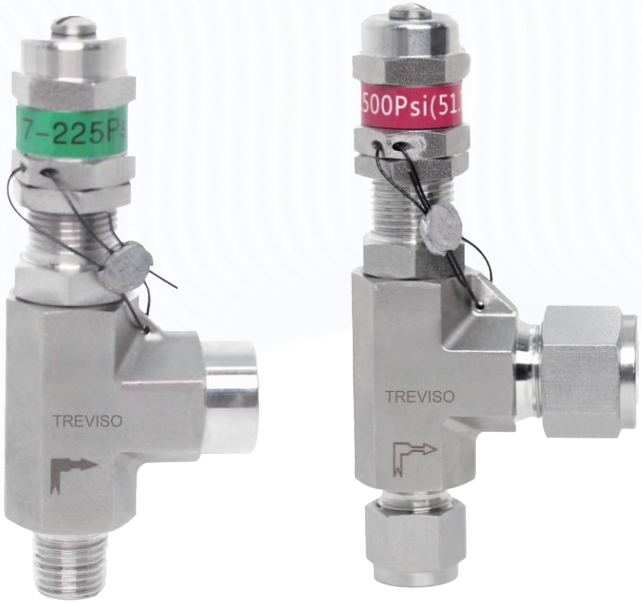
TREVISO

Proportional unloading valve product selection manual



CONTENT

01 Working principle of Proportional unloading valve

Basic Definition and Function

Proportional unloading valve is a key component that dynamically adjusts hydraulic systems by precisely controlling pressure or flow signals. Its core function is to adjust the unloading pressure or flow rate proportionally based on input signals, thereby optimizing system energy efficiency and protecting critical components

Compared with ordinary unloading valves, it has the following significant characteristics:

1. Proportional adjustment feature: The displacement of the valve core is linearly related to the pressure difference, which can accurately control the unloading flow rate and avoid the sudden impact of traditional on-off valves
2. Dynamic response capability: By optimizing the quality of the valve core and spring stiffness, millisecond level response is achieved, suitable for high-frequency pressure fluctuation scenarios
3. Energy saving and consumption reduction: In hydraulic systems, the output pressure of pumps is reduced through proportional unloading to lower energy consumption.

Core operating principle

The proportional unloading valve works based on the pressure displacement proportional control mechanism, and its process can be divided into the following key stages:

1. Pressure monitoring stage:

·The pressure sensor monitors the system pressure in real-time and feeds back the signal to the proportional solenoid or pilot valve core.

·Control the oil pressure to be applied to the piston through the control chamber, forming a pressure feedback loop

2. Signal conversion stage:

·The electrical signal drives the proportional electromagnet through the amplifier, and the electromagnetic force overcomes the pre tension force of the spring to push the valve core

·At this stage, there is electromagnetic inertia delay, with a typical response time of 10-30ms

3. Hydraulic response stage:

·When the system pressure exceeds the set threshold, the electromagnet pushes the valve core to move, gradually opening the unloading channel

·The displacement of the valve core changes the throttle area, causing a change in flow rate. Adjust the flow rate according to the fluid dynamics equation $Q=CdA\sqrt{(2\Delta P/\rho)}$

·At this stage, there is a hydraulic damping effect, with a response time of approximately 20-50ms

4. System regulation stage:

·The motion feedback of the executing component is fed back to the controller, forming a closed-loop regulation

·The PID control algorithm compensates for load changes by adjusting the electrical signal, with a typical adjustment period of 50-200ms.

02 Features and operation

spring

It can be adjusted to obtain the required set pressure.

locking screw

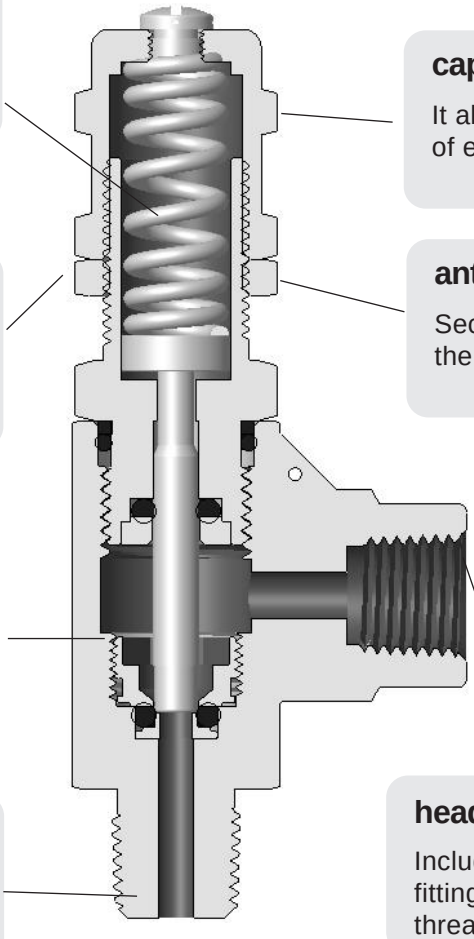
Maintain the position of the cap and ensure the set pressure adjustment.

square sealing element

Eliminate leakage around the valve stem during unloading mode.

o-ring

The elastomer can provide sealing against metals, ensuring reliable closure on the valve seat.



cap cover

It allows for easy adjustment of external set pressure.

anti loosening wire hole

Secure the cap to maintain the set pressure adjustment.

head joint

Includes gaugeable tube fittings and NPT or ISO pipe threads.

Features

High pressure valve

· Valves with specified set pressure can be provided at the factory
·Operating pressure up to 6000 psig (413 bar)
·Multiple springs, with selectable pressure range settings
·1/2 in. and 12 mm end connections - AT4221S series valve
·1/4 in. and 6 and 8 mm end connections - AT4221S series valves

low pressure valve

· Operating pressure up to 300 psig (20.6 bar)
The entire set pressure range uses a single spring
· Valves with specified set pressure can be provided at the factory
·1/4 in. and 6 and 8 mm end connections - AT4223S series valves
·1/2 in. and 12 mm end connections - AT4223S series valve

Application

AT series unloader valves are proportional unloader valves that gradually open as pressure increases. Therefore, they do not have capacity ratings for a given pressure rise (accumulation), and they are not tested according to ASME or any other standards.

Operation

When the system pressure reaches the set pressure, the AT series unloader valve opens; when the system pressure drops below the set pressure, it closes.

- High-pressure series - Select and install a spring with the required set pressure; attach the corresponding label to the cap.
- Low-pressure series - the spring has been installed.

03 Technical data

Pressure - Temperature Rating

series	AT4221S					AT4221S				AT4223S			
Maximum inlet pressure	6000 psig(413 bar); During unloading, it can reach up to 8000 psig (551 bar)					6000 psig(413 bar)				300 psig(20.6 bar)			
Maximum allowable outlet	1500 psig(103 bar)					2500 psig(172 bar)				225 psig(15.5 bar)			
set pressure	50-6000 psig(3.4-13 bar)					50-1500psig(3.4-103bar)				10-225psig(0.7-15.5bar)			
sealing material	carbon fluoride FKM	Nitrile rubber	neoprene	ethylene propylene	Perfluoro-carbon (FFKM)	carbon fluoride FKM	Nitrile rubber	neoprene	ethylene propylene	carbon fluoride FKM	Nitrile rubber	neoprene	ethylene propylene
temperature,°C(°F)	Maximum set pressure， psig(bar)												
-40(-40)	/	/	/	/		/	/	/	/	/	/	/	225 (15.5)
-34(-30)													
-23(-10)			6000 (413)										
-17(0)		6000 (413)											
-12(10)													
-4(25)	6000 (413)				2500 (172)	1500 (103)	1500 (103)	1500 (103)	1500 (103)	225 (15.5)	225 (15.5)	225 (15.5)	
-1(30)				6000 (413)									
4(40)					6000 (413)								
10(50)													
20(70)													
65(150)	5580 (384)	5580 (384)	5580 (384)	5580 (384)	3000 (207)								
93(200)	5160 (355)	5160 (355)	5160 (355)	5160 (355)	1500 (103)								
121(250)	4910 (338)	4910 (338)	4910 (338)	4910 (338)	/								
135(275)	/	/	4660 (321)	/			/	/	/	/			
148(300)													

- The dimensions are for reference only and may change at any time. The specific dimensions are subject to the actual order confirmation drawing.

Set pressure and resealing pressure

■ The set pressure refers to the upstream pressure when fluid flows out for the first time. At room temperature, after the initial unloading is completed, the set pressure of each valve can be repeated within a range of ± 5%.

■ At temperatures ranging from 60 to 80°F (15 to 26°C), the pressure should be maintained within ± 3.0 psig (0.20 bar) or ± 5% of the initial set pressure, whichever is higher

■ Below 60°F (15°C) and above 80°F (26°C), ± 6.0 psig (0.40 bar) or ± 20% of the initial set pressure, whichever is higher.

■ The resealing pressure is the upstream pressure when there is no fluid outflow, and it is always lower than the set pressure.

series	Test set pressure psig(bar)	As the minimum resealing pressure for setting the percentage of pressure,%
AT4223S	10-20(0.7-1.3)	50
	175-225(12.0-15.5)	91
AT4221S	100-200(6.8-13.7)	50
	850-1000(58.5-68.9)	84

Backpressure

High pressure valve (AT4221S series)

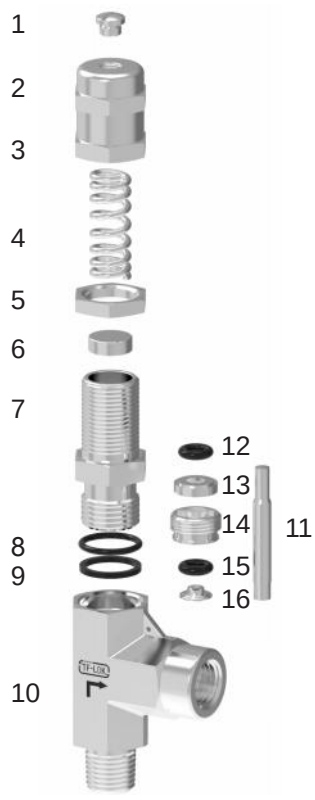
The design of these high-pressure valves minimizes the impact of system back pressure.

Low-pressure valves (AT4223S series)

The system back pressure will increase the set pressure of the valve. To compensate, multiply the back pressure by 0.8 and subtract the resulting value from the required set pressure.

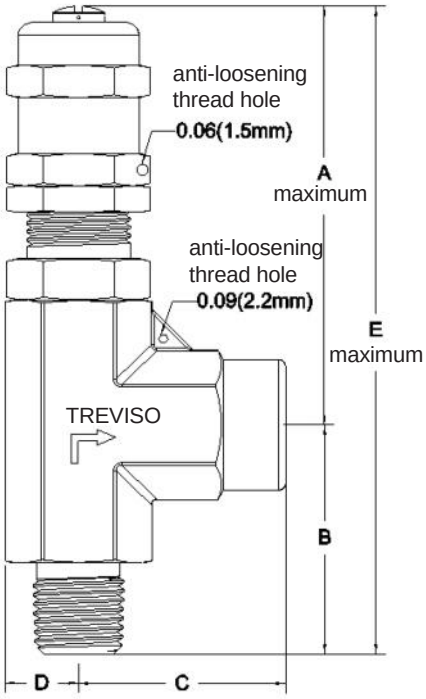
When the back pressure equals the atmospheric pressure, the obtained results should be used to preset the valve.

Structural material



component	Material grade/ASTM specification
1 plug head	316 SS/ASTM 276
2 cap	316 SS/A276
3 tag	polyester
4 spring	S17700 SS/AMS 5678
5 Lock nut	powder metal, 300 series SS/B783; 316 SS/A276
6 Spring bearing seat	powder metal, 300 series SS/B783; 316 SS/A276
7 valve cap	316 SS/A479
8 O-ring	carbon fluoride FKM
9 Sealing gasket	carbon fluoride FKM
10 valve body	316 SS/A182
11 Valve stem	316 SS/A479
12 O-ring	carbon fluoride FKM
13 protective rings	316 SS/A666;RAL4,/ 316 SS/A479
14 Valve seat retainer	316 SS/A479
15 O-ring	carbon fluoride FKM、EPDM
16 support pad	316 SS/A276
lubricant	Molybdenum disulfide-based dry film and lake agent; silicone-based

Size information



Low-pressure valve (AT4223S)

Termination		size, in(mm)					
Import/Export	size	A	B	C	D	E	H
AT4223S series: 0.19in. (4.8 mm) fully open port							
Pipe coupling adapter	1/4in.	2.70 (68.6)	1.44 (36.6)	1.60 (40.6)	0.43 (10.9)	4.14 (105)	4.09 (104)
	6mm						
	8mm						
External thread NPT /Tube fitting	1/4in.		1.19 (30.2)	1.60 (40.6)		3.89 (98.8)	
External thread NPT /Internal thread NPT	1/4in.		1.19 (30.2)	1.17 (29.7)		3.89 (98.8)	
External thread ISO /Internal thread ISO	1/4in.		1.19 (30.2)	1.17 (29.7)		3.89 (98.8)	
AT4223S series: 0.25in. (6.4 mm) fully open port							
Pipe coupling adapter	1/2in.	4.09 (104)	1.83 (46.5)	1.83 (46.5)	0.50 (12.7)	5.92 (150)	5.37 (136)
	12mm						
External thread NPT /Tube fitting	1/2in.		1.43 (36.3)	1.83 (46.5)		5.52 (140)	
External thread NPT /Internal thread NPT	1/2in.		1.43 (36.3)	1.43 (36.3)		5.52 (140)	

High-pressure valve (AT4221S)

Termination		size, in(mm)					
Import/Export	size		B	C	D	E	H
AT4221S series: 0.14 in. (3.6mm) fully open port							
Pipe coupling adapter	1/4in.	2.70 (68.6)	1.44 (36.6)	1.60 (40.6)	0.43 (10.9)	4.14 (105)	4.09 (104)
	6mm						
	8mm						
External thread NPT /Tube fitting	1/4in.		1.19 (30.2)	1.60 (40.6)		3.89 (98.8)	
External thread NPT /Internal thread NPT	1/4in.		1.19 (30.2)	1.17 (29.7)		3.89 (98.8)	
External thread NPT Internal thread RT	1/4in.		1.19 (30.2)	1.17 (29.7)		3.89 (98.8)	
AT4221S series: 0.25 in. (6.4 mm) fully open port							
Pipe coupling adapter	1/2in.	4.09 (104)	1.83 (46.5)	1.83 (46.5)	0.50 (12.7)	5.92 (150)	5.37 (136)
	12mm						
External thread NPT/	1/2in.		1.43 (36.3)	1.83 (46.5)		5.52 (140)	
External thread NPT Internal thread NPT	1/2in.		1.43 (36.3)	1.43 (36.3)		5.52 (140)	

- The dimensions are for reference only and may change at any time. The specific dimensions are subject to the actual order confirmation drawing.

www.trevisovalves.com

TREVISO

TREVISO TRANSMISSION MACHINERY S.R.L.

E-mail: sales@trevisovalves.com

Whatsapp：+86 13276507815

MILANO(MI) VIA DELL ANNUNCIATA 23/4 CAP 20121