

T 2520 EN

Type 2405 Pressure Reducing Valve

Self-operated Pressure Regulators



Application

Pressure reducing valve for set points from **2 mbar** to **10 bar** · Nominal size **DN 15** to **50** · Pressure rating **PN 16** to **40** · Suitable for gases at temperatures from **-20** to **+60 °C** (**0** to **+150 °C**)¹⁾

This regulator is used to control the pressure of flammable gases used as a source of energy, e.g. in boilers, driers, vaporizers, heat exchangers or industrial ovens. Alternatively, it can control the compressed air supply in process engineering applications.

An additional application of the regulator is the pressure control of inert gas used for inerting or blanketing reaction or storage tanks to protect the product in the tank from oxidation, explosion or escaping. To achieve an economical consumption of the inert gas, its pressure must be controlled to always remain slightly higher than atmospheric pressure while the tank is being filled or emptied.

Special features

- Low-maintenance regulator functioning as proportional or two-step controller
- Compact regulator design providing excellent control accuracy
- Internal set point springs with set point adjustment using a set point adjuster on the actuator
- Spring-loaded, single-seated valve balanced by a balancing diaphragm
- External connection of a control line
- Fulfills strict fugitive emission requirements
- Based on the fugitive emission requirements according to TA Luft (TA Luft compliant)³⁾
- Minimum leakage class IV

Version

Pressure reducing valve with proportional control action

Valve DN 15 to 50 · Flanged connections · Soft-seated plug · Body made of cast iron EN-GJL-250, spheroidal graphite iron EN-GJS-400-18-LT, cast steel 1.0619, cast stainless steel 1.4408 or forged stainless steel 1.4404

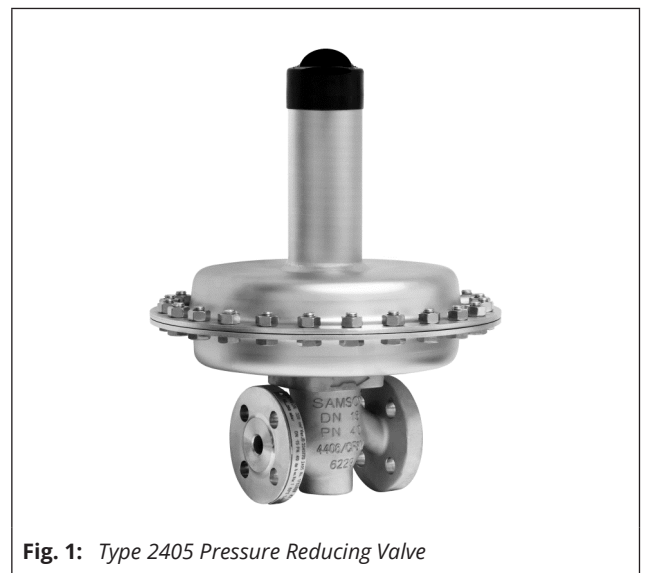


Fig. 1: Type 2405 Pressure Reducing Valve

Pressure reducing valve with two-step control mode for millibar set point ranges

Valve DN 32 to 50 · Flanged connections · Soft-seated plug · Body made of cast iron EN-GJL-250, spheroidal graphite iron EN-GJS-400-18-LT, cast steel 1.0619, cast stainless steel 1.4408 or forged stainless steel 1.4404

Special versions

- FDA version²⁾
- NACE version for sour gas applications
- Version with force limiter (for higher pressures across the operating diaphragm)
- Actuator with seal and leakage line connection

¹⁾ For unbalanced versions with FKM diaphragm and FKM soft seal

²⁾ This version is not suitable for direct contact with products manufactured in the food and pharmaceutical industries. It can only be used close to the product.

³⁾ Applies to actuator area 80 to 640 cm², actuator diaphragm made of EPDM or FKM and temperature range 0 to +150 °C

- Version with connected control line.
Pressure tapped directly at the valve body; optionally also with pressure gauge



Principle of operation

The medium flows through the regulator in the direction indicated by the arrow. The position of the plug (3) determines the cross-sectional area of flow between the plug and the seat (2).

– Pressure reducing valve with proportional control action (see Fig. 3)

In the pressureless state (control line not connected and no pressure applied) the valve is opened by the force of the set point springs (27). The spring force is adjustable at the set point adjuster (30).

The downstream pressure p_2 to be controlled is tapped downstream of the regulator and transmitted over an external control line to the control line connection (9) on the actuator housing (20) where it is converted into a positioning force by the diaphragm plate (18) with operating diaphragm (21). The diaphragm moves the plug over the plug stem (4) depending on the force of the set point springs.

When the force resulting from the downstream pressure p_2 rises above the spring force adjusted at the set point springs, the valve closes proportionally to the change in pressure.

In the version with pressure balancing, the forces produced by the upstream and downstream pressures acting on the plug are eliminated by the balancing diaphragm (8). The plug is fully balanced.

– Pressure reducing valve with two-step control mode (see Fig. 2)

The regulator (nominal sizes DN 32 to 50/NPS 1½ and NPS 2, K_{VS} 16, 20 and 32/ C_V 20 and 37 with set point ranges from 0.002 to 0.060 bar) operates as a two-step controller.

A differential pressure of at least 1.6 bar is required for troublefree operation.

In the idle state, the valve is closed when the pressure in the bottom actuator chamber is equal or higher than the set point. The set point is adjusted by tensioning the set point spring (27) at the set point adjuster (30).

The upstream pressure p_1 is routed through a hole in the plug stem to the chamber of the plug balancing unit above the balancing diaphragm (8).

The valve is pressure-balanced in this way.

The required closing force of the plug is generated by the compression spring (542) in the chamber.

If the downstream pressure p_2 being controlled drops below the lower switching point of the adjusted set point, the force created by the diaphragm (21) is lower than the force of the set point spring (27). This causes the diaphragm plate (18), which is fastened to the actuator stem (540), to be pushed down moving towards the

plug. This results in a force being exerted on the tappet, which is part of the assembly (535) of the internal bypass valve.

The pressure in the balancing chamber is relieved to the downstream side.

The balancing pressure drops until it reaches the level of the downstream pressure p_2 . As a result, the upstream pressure exerted on the plug is able to fully open the valve opposing the force of the compression spring (542).

If the downstream pressure p_2 starts to rise again and reaches the upper switching point of the adjusted set point, the diaphragm plate (18) and actuator stem (540) with it are lifted. The internal bypass valve closes and the upstream pressure p_1 starts to build up again in the chamber of the plug balancing unit above the balancing diaphragm (8). The pressure-balanced state of the valve is restored and the compression spring (542) causes the plug to close.

The two-step control mode is determined by a switching accuracy of ≤ 1.5 mbar between the upper and lower switching point.

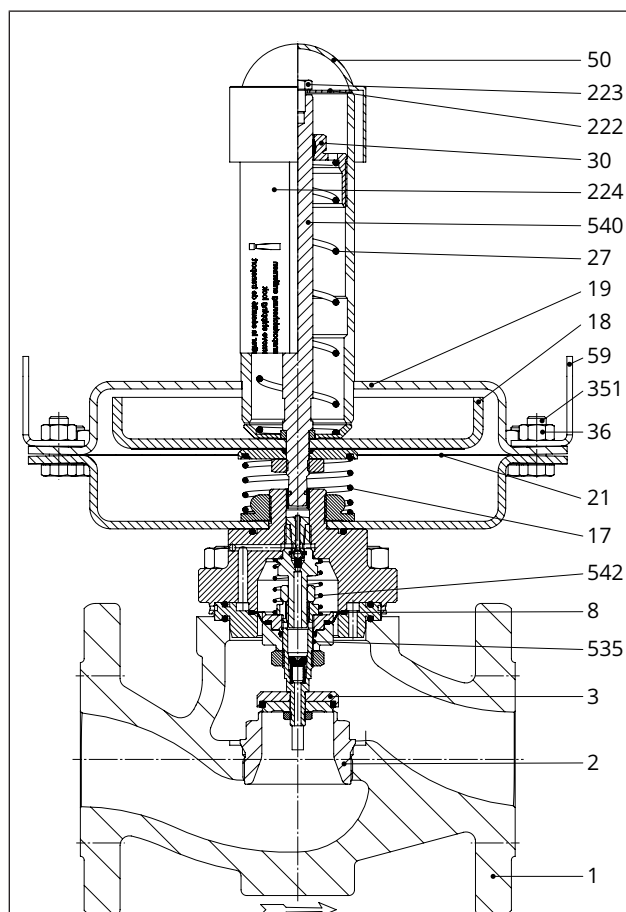


Fig. 2: Type 2405 Pressure Reducing Valve with pressure balancing · Nominal size DN 32 to 50 · Set points 0.005 to 0.060 bar · Flow-to-open (two-step control mode)

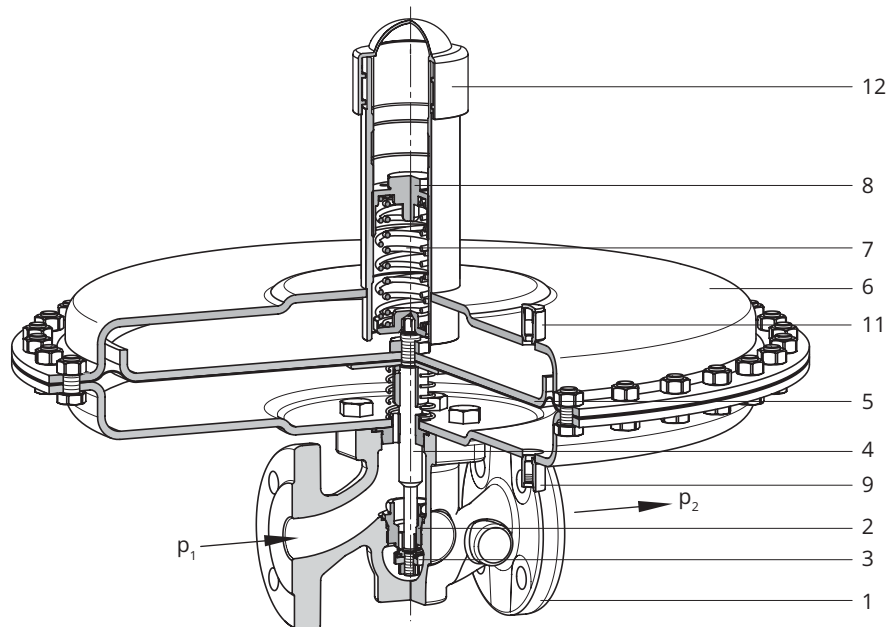


Fig. 3: Type 2405 Pressure Reducing Valve without pressure balancing · K_{VS} 1.6 to 4 · Flow-to-open

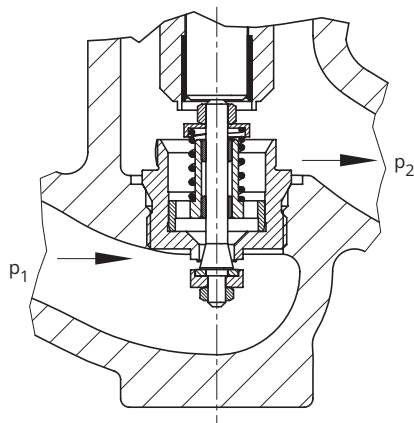


Fig. 4: Type 2405 Pressure Reducing Valve without pressure balancing · K_{VS} 0.016 to 1 · Flow-to-close

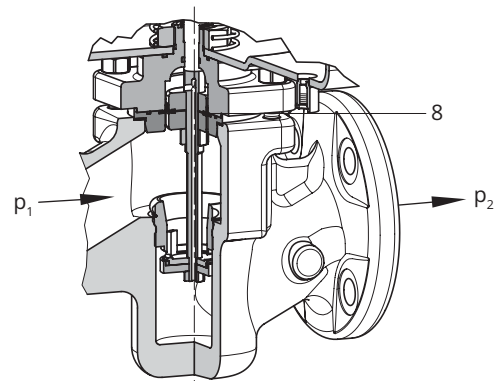


Fig. 5: Type 2405 Pressure Reducing Valve with pressure balancing · K_{VS} 6.3 to 32


- | | | |
|---|---|---|
| 1 Valve body | 21 Operating diaphragm | 540 Actuator stem |
| 2 Seat | 27 Set point spring | 542 Compression spring (closing spring of the plug) |
| 3 Plug | 30 Set point adjuster (A/F 27) | |
| 4 Plug stem (regulator with proportional control action only) | 36 Nut | |
| 8 Balancing diaphragm | 50 Cap | |
| 9 Control line connection, G ¼ fitting | 59 Lifting eyelet (on the right and left-hand side of the actuator) | |
| 11 Leakage line connection (special version), G ¼ fitting | 222 Shipping lock washer | |
| 17 Compensation spring | 223 Shipping lock screw (A/F 13) | |
| 18 Diaphragm plate | 224 Label | |
| 19 Top actuator case | 351 Screw | |
| 20 Bottom actuator case | 535 Plug assembly (regulator with two-step control mode only) | |

Table 1: Materials

Valve body	Cast iron EN-GJL-250 Spheroidal graphite iron EN-GJS-400-18-LT Cast steel 1.0619	Cast stainless steel 1.4408 Forged stainless steel 1.4404
Seat	1.4404	1.4404
Plug	1.4404	1.4404
Plug spring	1.4310 ¹⁾	
Plug stem	1.4404	
Seal	EPDM · FKM · NBR	
Balancing diaphragm	EPDM · FKM · NBR	
Actuator housing	1.0332	1.4301
Operating diaphragm	EPDM · FKM · NBR	

¹⁾ Only with K_{VS} 0.1 to 1

Table 2: Technical data · Pressure reducing valve with proportional control action

Nominal size		DN 15	DN 20	DN 25	DN 32	DN 40	DN 50
Pressure rating (valve)		PN 16 · PN 25 · PN 40					
K _{VS} coefficients	Standard	4.0	6.3	8.0	16 ⁵⁾	20 ⁵⁾	32 ⁵⁾
	Reduced K _{VS}	0.016 · 0.04 · 0.1 · 0.25 · 0.4 · 1.0 · 1.6 · 2.5	0.016 · 0.04 · 0.1 · 0.25 · 0.4 · 1.0 · 1.6 · 2.5 · 4.0	0.016 · 0.04 · 0.1 · 0.25 · 0.4 · 1.0 · 1.6 · 2.5 · 4.0 · 6.3	1.6 · 2.5 · 4.0 · 6.3 · 8.0	1.6 · 2.5 · 4.0 · 6.3 · 8.0 · 16	1.6 · 2.5 · 4.0 · 6.3 · 8.0 · 16 · 20
Max. permissible differential pressure		10 bar · 12 bar ¹⁾					
Max. permissible temperature range (medium temperature)		-20 to +60 °C (0 to +150 °C) ²⁾					
Leakage class according to IEC 60534-4		Soft-seated, minimum Class IV					
Conformity							
Set point ranges		2 to 15 mbar ⁵⁾ · 5 to 15 mbar · 10 to 30 mbar · 25 to 60 mbar · 50 to 200 mbar · 0.1 to 0.6 bar · 0.2 to 1 bar · 0.8 to 2.5 bar · 2 to 5 bar · 4.5 to 10 bar					
Max. perm. pressure at operating diaphragm	1200 cm ²	5 to 15 mbar			2 to 15 mbar ⁵⁾ · 10 to 30 mbar		
		0.5 bar					
	640 cm ²	10 to 30 mbar · 25 to 60 mbar			25 to 60 mbar		
		1 bar					
	320 cm ²	50 to 200 mbar · 0.1 to 0.6 bar					
		2 bar · 10 bar ³⁾					
	160 cm ²	0.2 to 1 bar					
		3 bar · 16 bar ³⁾					
	80 cm ²	0.8 to 2.5 bar					
5 bar · 16 bar ³⁾							
40 cm ²		2 to 5 bar					
		10 bar · 16 bar ³⁾					
Pressure balancing	K _{VS} = 0.016 to 4	Without balancing diaphragm					
	K _{VS} = 6.3 to 32	With balancing diaphragm					
Pressure tapping		External ⁴⁾					
Control line connection		G ¼					

¹⁾ Version with set points from 0.1 to 10 bar


²⁾ Unbalanced version with FKM diaphragm and FKM soft seal; not for FDA version

³⁾ Version with force limiter

⁴⁾ Special version with pressure tapping directly at the valve

⁵⁾ For the regulator version with two-step control mode only

Table 3: Technical data · Pressure reducing valve with two-step control mode

Nominal size		DN 32	DN 40	DN 50
Pressure rating (valve)		PN 16 · PN 25 · PN 40		
K _{vs} coefficients		16	20	32
Min. required differential pressure		1.6 bar		
Max. permissible differential pressure		10 bar		
Switching accuracy		≤1.5 mbar		
Max. permissible temperature range (medium temperature)		-20 to +60 °C		
Leakage class according to IEC 60534-4		Soft-seated, minimum Class IV		
Conformity				
Set point ranges		2 to 15 mbar · 10 to 30 mbar · 25 to 60 mbar		
Max. perm. pressure at operating diaphragm with a set point range	2 to 15 mbar	0.5 bar		
	10 to 30 mbar			
	25 to 60 mbar	1 bar		
Pressure balancing		With balancing diaphragm		
Pressure tapping		External		
Control line connection		G ¼		

Installation

The regulator is preferably to be installed in horizontal pipelines:

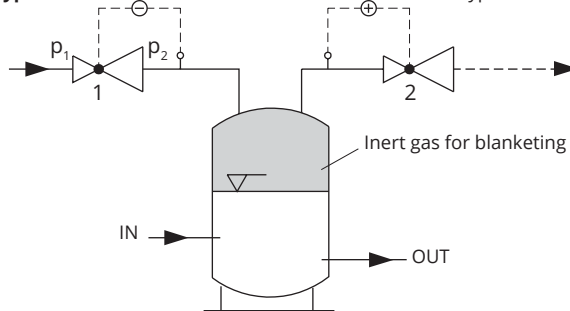
- Actuator housing on top, actuator facing upwards
- The direction of flow must match the direction indicated by the arrow on the body.
- In applications in which the blanketing gas can liquefy, condensate may form in the control line, causing damage to the regulator. To allow condensate to run back into the tank, install the control line with an approximate 10 % slope to the pressure tapping point at the tank.
- Distance between the pressure tapping point and regulator min. $6 \times \text{DN}$



In exceptional cases, the regulator can also be installed in vertical pipelines with the direction of flow from the top (see ► EB 2520 for more details).

Type 2405

Type 2406

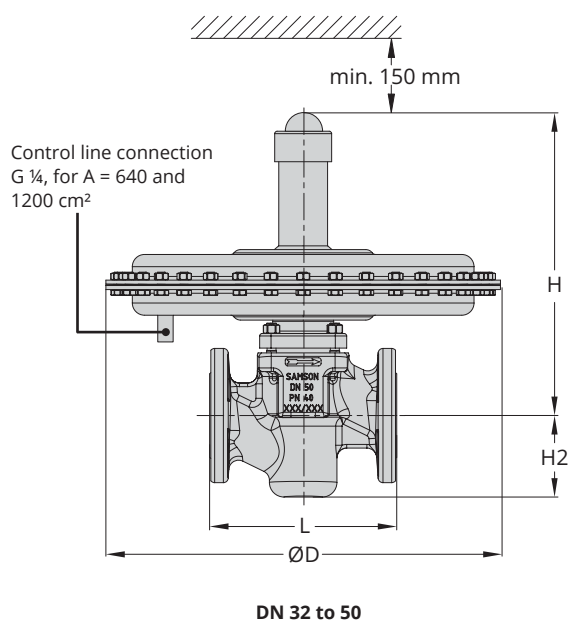
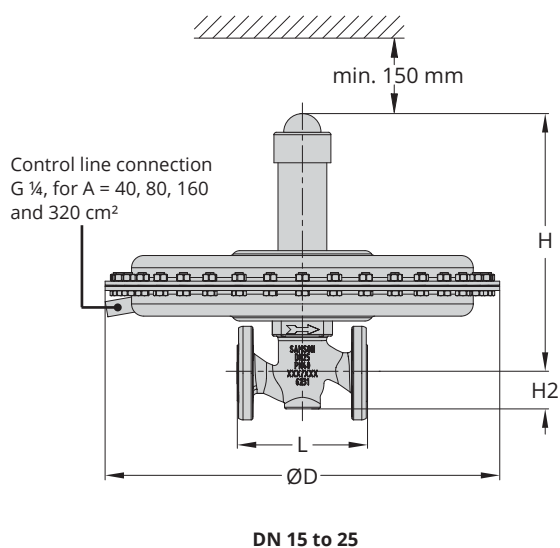


If the pressure p of the inert gas in the tank falls below the set point p_2 adjusted at the **Type 2405** Pressure Reducing Valve (1), it opens to allow more gas to enter the tank. The valve (1) closes again when the pressure p of the blanketing gas rises to the adjusted set point p_2 .

If the pressure is too high, the inert gas is vented off over the Type 2406 Excess Pressure Valve (2).

Fig. 6: Sample application, Type 2405 used for tank blanketing

Dimensions



The control line connection is turned by 90° in the drawing.
The connection is normally located opposite the side with the arrow indicating the direction of flow.

Fig. 7: Dimensions of Type 2405

Table 4: Dimensions in mm and weights in kg

Nominal size				DN 15	DN 20	DN 25	DN 32	DN 40	DN 50
Overall length L				130 mm	150 mm	160 mm	180 mm	200 mm	230 mm
Height H2		Forged steel		53 mm	–	70 mm	–	92 mm	98 mm
		Other materials		44 mm			72 mm		
Set point range	2 to 15 mbar ²⁾	Height H	Without balancing	–			–		
			With balancing	–			387 mm		
		Actuator		–			ØD = 485 mm, A = 1200 cm ²		
	5 to 15 mbar	Height H	Without balancing	325 mm			370 mm		
			With balancing	352 mm			387 ²⁾		
		Actuator		ØD = 485 mm, A = 1200 cm ²					
	10 to 30 mbar	Height H	Without balancing	318 mm			366 mm		
			With balancing	345 mm			387 ²⁾		
		Actuator		ØD = 380 mm, A = 640 cm ²			ØD = 485 mm, A = 1200 cm ²		
	25 to 60 mbar	Height H	Without balancing	318 mm			366 mm		
			With balancing	345 mm			380 ²⁾		
		Actuator		ØD = 285 mm, A = 320 cm ²			ØD = 380 mm, A = 640 cm ²		
	50 to 200 mbar	Height H	Without balancing	318 mm			366 mm		
			With balancing	345 mm			370 mm		
		Actuator		ØD = 285 mm, A = 320 cm ²					
	0.1 to 0.6 bar	Height H	Without balancing	318 mm			366 mm		
			With balancing	345 mm			370 mm		
		Actuator		ØD = 285 mm, A = 320 cm ²					
	0.2 to 1 bar	Height H	Without balancing	318 mm			366 mm		
			With balancing	345 mm			370 mm		
		Actuator		ØD = 225 mm, A = 160 cm ²					
	0.8 to 2.5 bar	Height H	Without balancing	330 mm			365 mm		
			With balancing	356 mm			369 mm		
		Actuator		ØD = 170 mm, A = 80 cm ²					
	2 to 5 bar	Height H	Without balancing	333 mm			368 mm		
			With balancing	359 mm			373 mm		
		Actuator		ØD = 170 mm, A = 40 cm ²					
	4.5 to 10 bar	Height H	Without balancing	437 mm			485 mm		
			With balancing	463 mm			489 mm		
		Actuator		ØD = 170 mm, A = 40 cm ²					
Weight ¹⁾ in kg (approx.)									
Set point range	2 to 15 mbar ²⁾			–			40 kg		
	5 to 15 mbar			28 kg			40 kg		
	10 to 30 mbar			18 kg			40 kg		
	25 to 60 mbar			14 kg			30 kg		
	50 to 200 mbar			14 kg			26 kg		
	0.1 to 0.6 bar			14 kg			26 kg		
	0.2 to 1 bar			10 kg			22 kg		
	0.8 to 2.5 bar			8 kg			20 kg		
	2 to 5 bar			8 kg			20 kg		
	4.5 to 10 bar			9 kg			21 kg		

¹⁾ Body made of cast steel 1.0619; +10 %

²⁾ For the regulator version with two-step control mode only

Ordering text**Type 2405 Pressure Reducing Valve**

Nominal size DN ..., set point range ... mbar (bar)

K_{VS} ..., body material ..., optionally, special version ...

Materials:

Plug seal ..., balancing diaphragm ..., operating diaphragm ...