DATA SHEET

T 2521 EN

Type 2405 Pressure Reducing Valve

Self-operated Pressure Regulators · ANSI version

CE

Application

Pressure reducing valve for set points from **0.075** to 150 psi/5 mbar to 10 bar · Nominal size NPS ½ to 2 [1]/DN 15 to 50 [1] · Pressure rating Class 125 to 300/PN 16 to 40 · Suitable for gases at temperatures from –5 to +140 °F/32 to 300 °F [2] (–20 to +60 °C/0 to +150 °C [2])

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.

Fig. 1: *Type 2405 Pressure Reducing Valve*

Special features

- Low-maintenance regulators functioning as proportional or two-step controllers
- Compact regulator design providing excellent control accuracy
- Internal set point springs with set point adjustment using a nut on the actuator
- Spring-loaded, single-seated valve balanced by a balancing diaphragm
- External connection of a control line
- Meets strict fugitive emission requirements
- Minimum leakage class IV

Version

Pressure reducing valve with proportional control action

Valves in NPS ½ to 2/DN 15 to 50 · Flanged connections · Soft-seated plug · Body made of cast iron, cast steel or cast stainless steel

Pressure reducing valve with two-step control mode

Valves in NPS 1½ and 2/DN 32 to 50 · Flanged connections · Soft-seated plug · Body made of cast iron, cast steel or cast stainless steel

Special versions

- Version with FDA-compliant materials for the food and pharmaceutical industries
- NACE version for sour gas applications
- Version with force limiter (for higher pressures across the operating diaphragm)
- Actuator with seal and leakage line connection
- Version with connected control line. Pressure tapped directly at the valve body; optionally also with pressure gauge

[1] NPS ½ and ¾ not in Class 125

[2] For unbalanced versions with FKM diaphragm and FKM soft seal

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Edition July 2024

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 0.005 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.

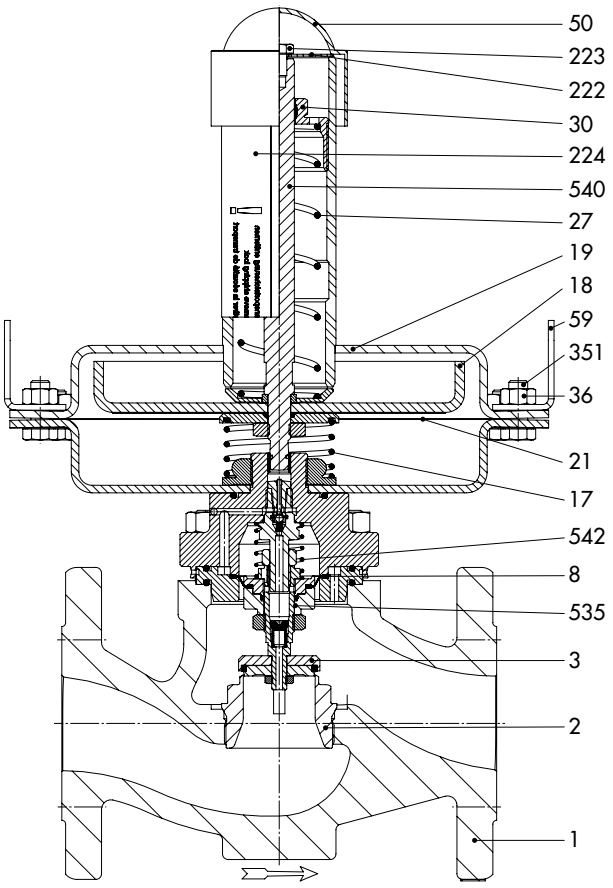


Fig. 2: *Type 2405 Pressure Reducing Valve with pressure balancing · Nominal size DN 32 to 50 · Set points 0.005 to 0.060 bar · Flow-to-open (two-step control mode)*

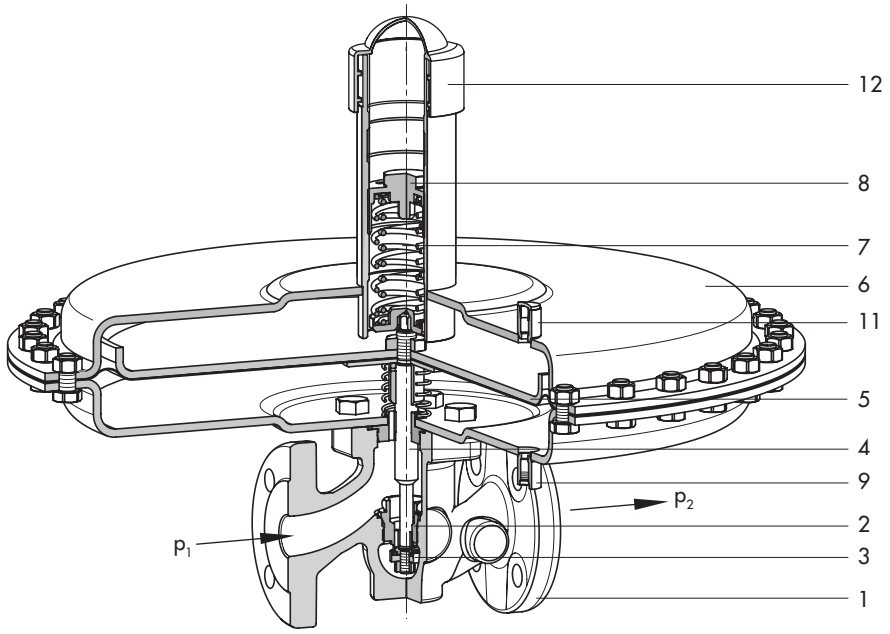


Fig. 3: *Type 2405 Pressure Reducing Valve without pressure balancing · K_{VS} 1.6 to 4 · Flow-to-open*

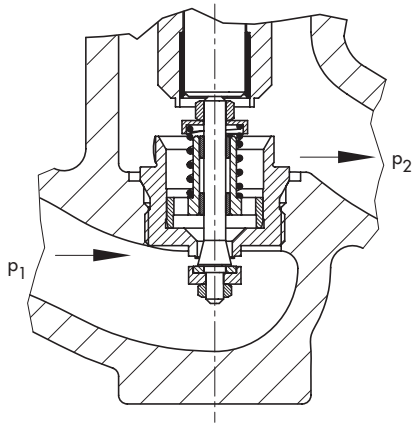


Fig. 4: *Type 2405 Pressure Reducing Valve without pressure balancing · K_{VS} 0.016 to 1 · Flow-to-close*

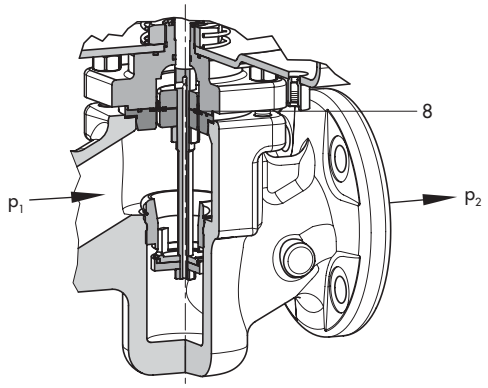


Fig. 5: *Type 2405 Pressure Reducing Valve with pressure balancing · K_{VS} 6.3 to 32*

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

Table 1: *Technical data*

Nominal size		**NPS ½** (DN 15)	**NPS ¾** (DN 20)	**NPS 1** (DN 25)	**NPS 1½** (DN 40)	**NPS 2** (DN 50)
Pressure rating (valve)		Class 125, Class 150, Class 300 · PN 16, PN 25, PN 40				
C_V coefficients	Standard	5	7.5	9.4	23	37
	Reduced C_V coefficients	0.02 · 0.05 0.12 · 0.3 · 0.5 1.2 · 2 · 3	0.02 · 0.05 0.12 · 0.3 · 0.5 1.2 · 2 · 3 · 5	0.02 · 0.05 · 0.12 0.3 · 0.5 · 1.2 2 · 3 · 5 · 7.5	2 · 3 5 · 7.5 9.4 · 20	2 · 3 · 5 7.5 · 9.4 20 · 23
K_{VS} coefficients	Standard	4	6.3	8	20	32
	Reduced K_{VS} coefficients	0.016 · 0.04 0.1 · 0.25 · 0.4 1 · 1.6 · 2.5	0.016 · 0.04 0.1 · 0.25 · 0.4 1 · 1.6 · 2.5 · 4	0.016 · 0.04 · 0.1 0.25 · 0.4 · 1 1.6 · 2.5 · 4 · 6.3	1.6 · 2.5 4 · 6.3 8 · 16	1.6 · 2.5 4 · 6.3 · 8 16 · 20
Max. permissible differential pressure		150 psi · 175 psi [1]/10 bar · 12 bar [1]				
Max. permissible temperature range (medium temperature)		–5 to +140 °F · 32 to 300 °F/–20 to +60 °C · 0 to 150 °C [2]				
Leakage class according to ANSI/FCI 70-2 or IEC 60534-4		Soft-seated, minimum Class IV				
Conformity		CE · UK CA · EAC				
Set point ranges		0.075 to 0.25 psi [5] · 0.15 to 0.42 psi [5] · 0.35 to 0.87 psi [5] · 0.75 to 3 psi 1.5 to 8 psi · 3 to 15 psi · 10 to 37.5 psi · 30 to 75 psi · 65 to 145 psi				
		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. permissible pressure at operating diaphragm	186 in² 1200 cm²	0.075 to 0.25 psi/ 5 to 15 mbar			0.075 to 0.25 psi 0.15 to 0.42 psi/ 5 to 15 mbar 10 to 30 mbar	
		7 psi/0.5 bar				
	100 in² 640 cm²	0.15 to 0.42 psi · 0.35 to 0.87 psi/ 10 to 30 mbar · 25 to 60 mbar			0.35 to 0.87 psi/ 25 to 60 mbar	
		14.5 psi/1 bar				
	50 in² 320 cm²	0.75 to 3 psi · 1.5 to 8 psi/50 to 200 mbar · 0.1 to 0.6 bar **30 psi · 145 psi [3]/2 bar · 10 bar [3]**				
	25 in² 160 cm²	3 to 15 psi/0.2 to 1 bar **45 psi · 240 psi [3]/3 bar · 16 bar [3]**				
	12.5 in² 80 cm²	10 to 37.5 psi/0.8 to 2.5 bar **75 psi · 240 psi [3]/5 bar · 16 bar [3]**				
	6 in² 40 cm²	30 to 75 psi/2 to 5 bar **145 psi · 240 psi [3]/10 bar · 16 bar [3]**				
		65 to 145 psi/4.5 to 10 bar **220 psi · 240 psi [3]/15 bar · 16 bar [3]**				
Pressure balancing	C_V = 0.02 to 5 · K_{VS} = 0.016 to 4	Without balancing diaphragm				
	C_V = 7.5 to 37 · K_{VS} = 6.3 to 32	With balancing diaphragm				
Pressure tapping		External [4]				
Control line connection		G ¼ (with ¼ NPT adapter)				

[1] Version with set points from 1.5 to 150 psi/0.1 to 10 bar
[2] For unbalanced versions with FKM diaphragm and FKM soft seal
[3] Version with force limiter
[4] Special version for set point ranges 10 to 37.5 psi/0.8 to 2.5 bar, 30 to 75 psi/2 to 5 bar and 65 to 150 psi/4.5 to 10 bar: pressure tapping directly at the valve body (see photo in Special versions on page 1)
[5] Version with two-step control mode only · The K_{VS} coefficients cannot be combined with the set points:
5 to 15 mbar · 10 to 30 mbar · 25 to 60 mbar

Table 2: *Materials · Material numbers according to ASTM and DIN EN*

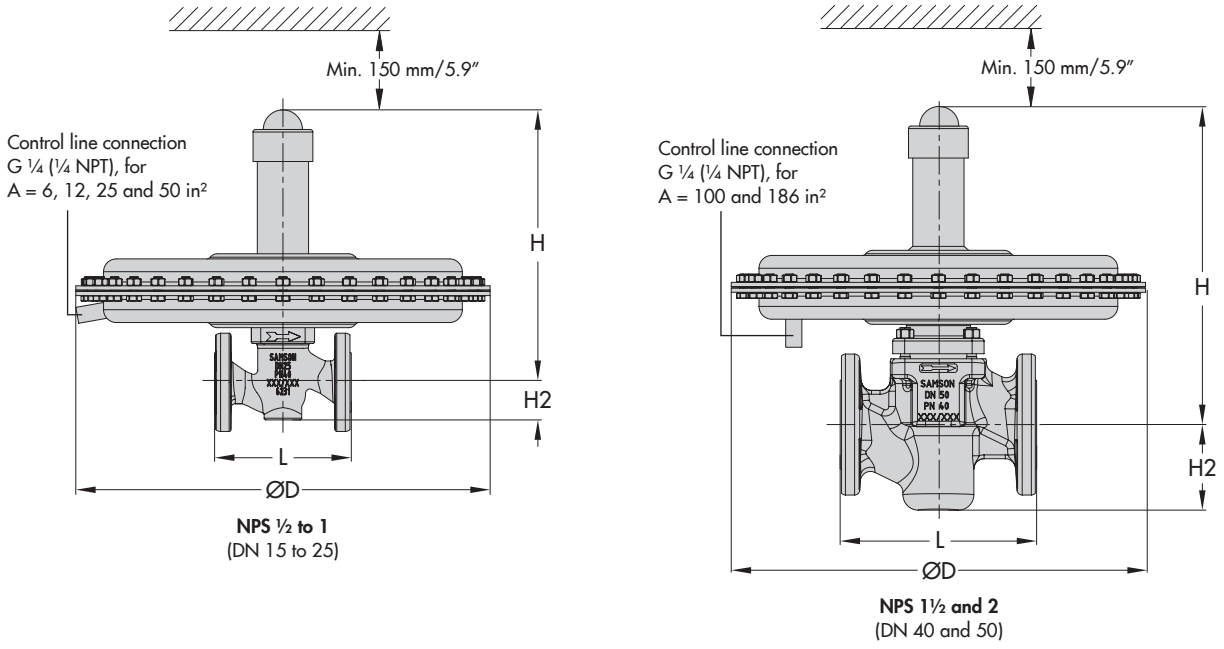
Valve body	**Cast iron A126B, cast steel A216 WCC**	**Cast stainless steel A351 CF8M**
Seat, plug and plug stem	316L	316L
Plug spring	1.4310 [1]	
Seal	EPDM · FKM · NBR	
Balancing diaphragm	EPDM · FKM · NBR	
Actuator housing	**1.0332**	**1.4301**
Operating diaphragm	EPDM · FKM · NBR	

[1] Only with C_V = 0.12 to 1.2/K_{VS} = 0.1 to 1

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

Nominal size		NPS 1½/DN 40	NPS 2/DN 50
Pressure rating (valve)		Class 125, Class 150, Class 300/PN 16, PN 25, PN 40	
C_V/K_{VS} coefficients		23/20	37/32
Min. required differential pressure		23.2 psi/1.6 bar	
Max. permissible differential pressure		150 psi/10 bar	
Switching accuracy		≤21.8 psi/≤1.5 mbar	
Max. permissible temperature range (medium temperature)		–5 to +140 °F/–20 to +60 °C	
Leakage class according to IEC 60534-4		Soft-seated, minimum Class IV	
Conformity		CE · UK CA · EAC	
Set point ranges		0.075 to 0.25 psi · 0.15 to 0.42 psi · 0.35 to 0.87 psi 5 to 15 mbar · 10 to 30 mbar · 25 to 60 mbar	
Max. perm. pressure at operating diaphragm with a set point range	0.075 to 0.25 psi/5 to 15 mbar	**7 psi/0.5 bar**	
	0.15 to 0.42 psi/10 to 30 mbar		
	0.35 to 0.87 psi/25 to 60 mbar	**14.5 psi/1 bar**	
Pressure balancing		With balancing diaphragm	
Pressure tapping		External	
Control line connection		G ¼ (with ¼ NPT adapter)	

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.
An adapter G ¼ to ¼-18 NPT (order no. 0230-3417) must be ordered separately.

Fig. 6: *Dimensions of Type 2405*

Table 4: *Dimensions in inch/mm · Weights in lb/kg*

Nominal size				NPS ½ (DN 15)	NPS ¾ (DN 20)	NPS 1 (DN 25)	NPS 1½ (DN 40)	NPS 2 (DN 50)
Length L		Class 125	inch	–	–	7.3	8.8	10
			mm	–	–	184	222	254
		Class 150	inch	7.3	7.3	7.3	8.8	10
			mm	184	184	184	222	254
		Class 300	inch	7.5	7.6	7.8	9.3	10.5
			mm	191	194	197	235	267
Height H2	Cast steel		inch	1.8			2.8	
			mm	44			72	
	Forged steel		inch	2.1	–	2.8	3.7	3.9
			mm	53	–	70	92	98
Set point range	0.075 to 0.25 psi (5 to 15 mbar)	Height H	Without balancing	12.8″/325 mm			14.6″/370 mm	
			With balancing	13.9″/352 mm			–	
		Actuator		ØD = 19.1″/485 mm, A = 186 in²/1200 cm²				
	0.15 to 0.42 psi (10 to 30 mbar)	Height H	Without balancing	12.6″/318 mm			14.4″/366 mm	
			With balancing	13.8″/345 mm			–	
		Actuator		ØD = 15″/380 mm, A = 100 in²/640 cm²			ØD = 19.1″/485 mm, A = 186 in²/1200 cm²	
	0.35 to 0.87 psi (25 to 60 mbar)	Height H	Without balancing	12.6″/318 mm			14.4″/366 mm	
			With balancing	13.8″/345 mm			–	
		Actuator		ØD = 11.2″/285 mm, A = 50 in²/320 cm²			ØD = 15″/380 mm, A = 100 in²/640 cm²	
	0.75 to 3 psi (50 to 200 mbar)	Height H	Without balancing	12.6″/318 mm			14.4″/366 mm	
			With balancing	13.8″/345 mm			14.6″/370 mm	
		Actuator		ØD = 11.2″/285 mm, A = 50 in²/320 cm²				
	1.5 to 8 psi (0.1 to 0.6 bar)	Height H	Without balancing	12.6″/318 mm			14.4″/366 mm	
			With balancing	13.8″/345 mm			14.6″/370 mm	
		Actuator		ØD = 11.2″/285 mm, A = 50 in²/320 cm²				
	3 to 15 psi (0.2 to 1 bar)	Height H	Without balancing	12.6″/318 mm			14.4″/366 mm	
			With balancing	13.8″/345 mm			14.6″/370 mm	
		Actuator		ØD = 8.9″/225 mm, A = 25 in²/160 cm²				
	10 to 35 psi (0.8 to 2.5 bar)	Height H	Without balancing	13″/330 mm			14.4″/365 mm	
			With balancing	14″/356 mm			14.6″/369 mm	
		Actuator		ØD = 6.7″/170 mm, A = 12 in²/80 cm²				
	30 to 75 psi (2 to 5 bar)	Height H	Without balancing	13.2″/333 mm			14.5″/368 mm	
			With balancing	14.2″/359 mm			14.7″/373 mm	
		Actuator		ØD = 6.7″/170 mm, A = 6 in²/40 cm²				
	65 to 150 psi (4.5 to 10 bar)	Height H	Without balancing	17.2″/437 mm			19.1″/485 mm	
			With balancing	18.3″/463 mm			19.3″/489 mm	
		Actuator		ØD = 6.7″/170 mm, A = 6 in²/40 cm²				
Weight [1] in lb and kg (approx.)								
Set point range	0.075 to 0.25 psi (5 to 15 mbar)			61.7 lb/28 kg			88.2 lb/40 kg	
	0.15 to 0.42 psi (10 to 30 mbar)			39.7 lb/18 kg			88.2 lb/40 kg	
	0.35 to 0.87 psi (25 to 60 mbar)			30.9 lb/14 kg			66.1 lb/30 kg	
	0.75 to 3 psi (50 to 200 mbar)			30.9 lb/14 kg			57.3 lb/26 kg	
	1.5 to 8 psi (0.1 to 0.6 bar)			30.9 lb/14 kg			57.3 lb/26 kg	
	3 to 15 psi (0.2 to 1 bar)			22 lb/10 kg			48.5 lb/22 kg	
	10 to 35 psi (0.8 to 2.5 bar)			17.6 lb/8 kg			44.1 lb/20kg	
	30 to 75 psi (2 to 5 bar)			17.6 lb/8 kg			44.1 lb/20kg	
	65 to 150 psi (4.5 to 10 bar)			19.8 lb/9 kg			46.3 lb/21 kg	

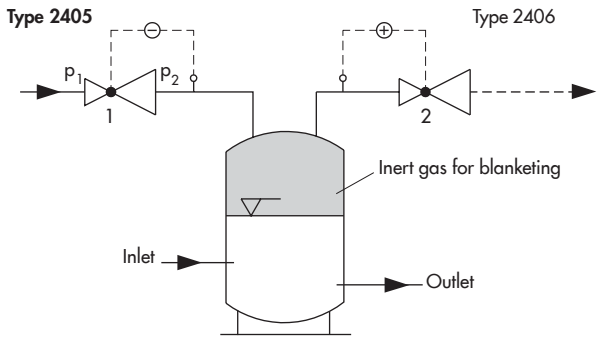
[1] Body made of A216 WCC and A351 CF8M: +10 %

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 x NPS (6 x 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).



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. 7: *Sample application, Type 2405 used for tank blanketing*

Ordering text

Type 2405 Pressure Reducing Valve

Nominal size NPS (DN) ..., set point range ... psi (mbar/bar), C_V (K_{VS}) coefficient ..., body material ..., optionally, special version ...

Materials:
Plug seal ..., balancing diaphragm ..., operating diaphragm ...