Self-operated Pressure Regulators
for special applications

Type 2357-31 Pressure Build-up Regulator
with safety function and integrated excess pressure valve

Application

Pressure regulators for **cryogenic gases** and liquids as well as other liquids, gases and vapors · Operating pressures up to **50 bar** · Set point ranges from **1** to **40 bar** · Temperatures from **–196** to **+200 °C** · Oxygen clean according to international standards and guidelines

Industrial gases (such as argon, nitrogen and oxygen) are stored in a liquefied condition in thermally insulated tanks at extremely low temperatures and at a constant pressure, even when the tapped amount fluctuates. Pipes transport the medium to the consumer. The extreme operating conditions (pressures up to 50 bar and temperatures down to –196 °C) require the use of special valves.

The Type 2357-31 Pressure Regulator is especially designed for the conditions in cryogenic service.

Special features

- Low-maintenance proportional regulators requiring no auxiliary energy
- Wide set point range and convenient set point adjustment
- Rugged design and low overall height
- Cleaned and packed for oxygen service

Versions

The pressure regulator consists of a valve body with three ports (marked A, B and C), internal operating diaphragm and set point adjuster.

Pressure build-up regulator with safety functionDirection of flow from port A to port B (closing)

The pressure at port B is transmitted to the operating diaphragm. When the downstream pressure rises, the pressure build-up plug closes the valve.

Safety function: the tubular plug in the pressure build-up regulator operates like a safety valve and relieves the pressure chamber at port A when the pressure exceeds the set point by 5 bar. The difference in pressure at the balancing bellows between the inside pressure at port C and outside pressure at port A creates a positioning force. This force opens the plug to equalize the pressures and the pressure chamber upstream of port A is relieved of pressure.

Excess pressure valve
Direction of flow from port B to port C (opening)

When no pressure is applied, the passage from port B to C is closed. The tubular plug does not open until the pressure becomes 0.5 bar higher than the set point (pressure build-up).

Port C can be additionally equipped with a non-return unit.

Type 2357-31 with non-return unit · Connection with soldering nipple and ball-type bushing (ports A and B)

Fig. 1: *Type 2357-31 Pressure Build-up Regulator*

Accessories

Ports A and B: soldering nipple with ball-type bushing (for 28 mm pipe diameter)

Port C: soldering nipple with ball-type bushing (for 18 mm pipe diameter, without non-return unit)

Non-return unit: soldering nipple with ball-type bushing (for 28 mm pipe diameter) to mount on the non-return unit.

Further accessories in Data Sheet ▶ T 2570 EN.

Principle of operation

Depending on the direction of flow, the regulator functions as a **pressure build-up regulator with safety function** (A → B) or as an **excess pressure valve** (B → C). The position of the pressure build-up plug (2.1) determines the flow rate across the area released between the plug and seat.

The pressure regulator is designed to keep the pressure constant to an adjusted set point, especially in cryogenic plants.

The regulators consists of a valve with three ports (A, B, C), spring-loaded operating diaphragm (3) with set point adjuster (6) and pressure build-up plug (2).

Pressure build-up regulator

Direction of flow from port A to port B. The pressure at port B is transmitted to the operating diaphragm (3). The positioning force produced moves the pressure build-up plug (2.1) depending on the spring force adjustable at the set point adjuster (10). The valve closes as soon as the pressure downstream of the valve has assumed the adjusted set point.

Pressure build-up regulator with safety function

The regulator additionally functions as a safety valve for the pressure chamber upstream of port A. When the pressure exceeds the set point by approx. 5 bar, the positioning force overcomes the force of the closing spring (16), causing the pressure build-up plug to open and the pressure to be relieved to ports B and C.

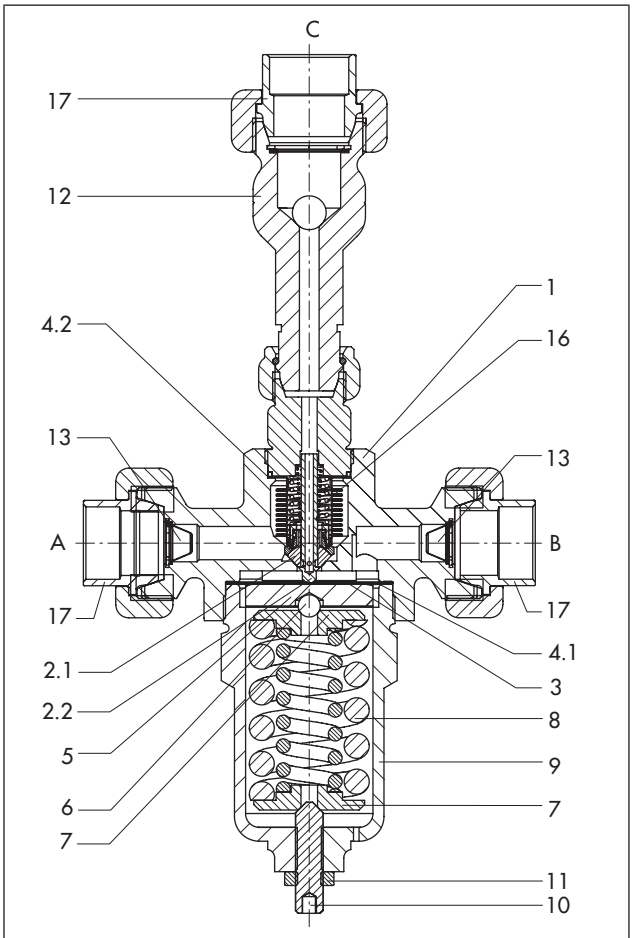
Excess pressure valve

Direction of flow from port B to port C. The plug seals off the operating diaphragm (3) when there is no pressure drop across port B and C.

The pressure at port B is acts on the operating diaphragm (3). The positioning force produced by this pressure opposes the adjustable spring force of the set point spring(s) (8) and opens the tubular plug (2.2) when the pressure rises above the set point by approx. 0.5 bar. The pressures are equalized and the medium escapes through the inside of the plug over port C.

The regulator can be optionally equipped with a non-return unit (12). It prevents the medium from flowing back to port C and allows maintenance work to be performed on the regulator without having to empty the tank first.

To connect the regulator to the pipelines containing the process medium, soldering nipples with ball-type bushings (17) are available as accessories. Filters (13) are also optionally available.



1	Valve body	8	Set point springs
2.1	Pressure build-up plug	9	Bottom section of body (spring housing)
2.2	Tubular plug	10	Set point adjuster (hex socket, SW 5)
3	Operating diaphragm	11	Lock nut (SW 17)
4.1	Seal (bottom section of the body)	12	Non-return unit (accessories)
4.2	Seal (top section of body)	13	Filter
5	Diaphragm plate	16	Closing spring
6	Ball	17	Soldering nipple with ball-type bushing (accessories)
7	Spring plate		

Fig. 2: *Functional drawing of Type 2357-31 Pressure Build-up Regulator*

Installation

Install the regulator with its main axis in the vertical position. The bottom body section (9) must point down, port C must face upward.

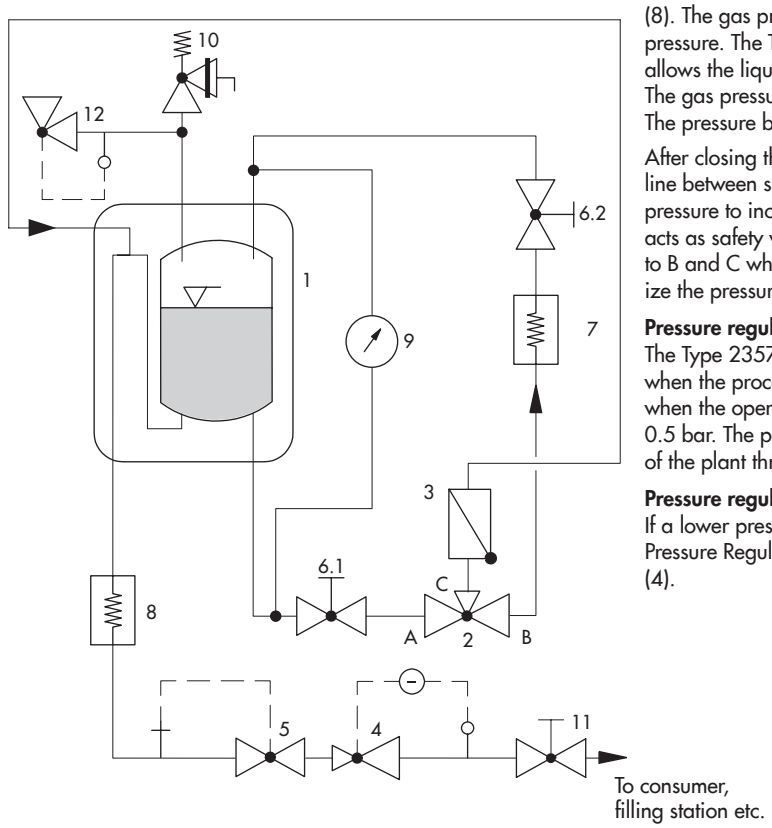
The direction of flow determines the regulator's function:

- **Build-up pressure regulator** with safety function: direction of flow from port A to port B
- **Excess pressure valve** Direction of flow from port B to port C

EC type examination

An EC type examination according to the Pressure Equipment Directive 97/23/EC, Module B has been performed on the regulators.

Typical application (schematic drawing)



Pressure regulator functioning as a pressure build-up regulator with safety function
When tapping the liquefied cryogenic gas, the gas pressure in the insulated tank causes the medium to be transferred to the vaporizer (8). The gas pressure in the tank drops below the adjusted operating pressure. The Type 2357-31 Build-up Pressure Regulator (2) opens and allows the liquefied gas to flow into the pressure build-up vaporizer (7). The gas pressure increases and reaches the operating pressure again. The pressure build-up regulator (2) closes.

After closing the shut-off valve (6.1), the liquid remaining in the pipeline between shut-off valve and regulator (2) vaporizes, causing the pressure to increase. The plug of the pressure build-up regulator (2) acts as safety valve by opening the valve (upstream pressure at port A) to B and C when the set point is exceeded by approx. 5 bar to equalize the pressures.

Pressure regulator functioning as an excess pressure valve
The Type 2357-31 Regulator (2) functions as an excess pressure valve when the process medium flows from port B to C. The valve opens when the operating pressure exceeds the adjusted set point by approx. 0.5 bar. The process medium is drained back to the consumer pipeline of the plant through port C.

Pressure regulator functioning as a pressure reducing valve
If a lower pressure is required in the draw-off pipe, the Type 2357-1 Pressure Regulator can be used to function as a pressure reducing valve (4).

1 Cryogenic tank
2 Type 2357-31 Pressure Build-up Regulator
3 Non-return unit
4 Type 2357-1/-6 Pressure Reducing Valve
5 Type 2040 Temperature Monitor
6.1 Shut-off valve
6.2 Shut-off valve
7 Pressure build-up vaporizer
8 Final vaporizer
9 Media 5/Media 6 Level Meter
10 Safety valve
11 Shut-off valve
12 Pressure protection by Type 2357-2 with special accessories

Fig. 3: *Series 2357 Pressure Build-up Regulator with safety function for cryogenic service*

Table 1: *Technical data · All pressures in bar (gauge)*

Type 2357-31		**Process medium in the liquid state**
Nominal pressure		PN 50
K_{VS} coefficient		
Pressure build-up		0.8
Pressure reduction		0.2
Set point range		1 to 8 bar · 5 to 25 bar · 8 to 40 bar
Permissible operating pressure		50 bar
Fail-safe action		5 bar above the set point
Excess pressure function	Heat leak	Approx. 0.5 bar above the set point
	Filling the tank	Approx. 5 bar above the set point
Temperature range		–196 to +200 °C
Weight, approx.		3.5 kg
Connections	A, B	M40 x 2
	C	M26 x 1.5 male thread
	Non-return unit	M26 x 1.5/M40 x 2

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

Type 2357-31	
Body	CW617N (brass)
Spring housing	CC754S-GM (brass)
Bellows	1.4571
Plug	Brass · PTFE soft seal
Set point springs	Stainless steel 1.4310
Body gasket	PTFE

Flow capacity of the regulator dependent on the liquid column in the cryogenic tank

The value table and the mass flow diagram show the flow capacity for the media nitrogen (N_2), oxygen (O_2), argon (Ar), carbon dioxide (CO_2) and natural gas (LNG).

The specifications apply to the **Type 2357-31** Pressure Build-up Regulator installed in the liquid phase of the pressure build-up control loop; as shown in Fig. 3 (typical application).

The maximum flow capacity [kg/h] of the regulator arises from the liquid level of the medium in the tank and can be determined from the graph.

The data in the graph are based on theoretical calculations which do not take factors, such as pressure losses in the pipeline, into account. Therefore, the real flow capacity may deviate from the calculated value.

Table 3: *Mass flow dependent on the liquid column in the cryogenic tank*

Filling level [m]	Mass flow rate [kg/h]				
	N_2	O_2	Ar	CO_2	LNG
1	248	351	427	359	130
3	379	537	653	550	199
5	475	673	819	689	249
7	555	785	956	805	291
9	624	884	1076	906	328
11	687	973	1184	996	361
14	771	1093	1329	1119	405
17	848	1201	1460	1230	445
20	918	1300	1580	1331	482

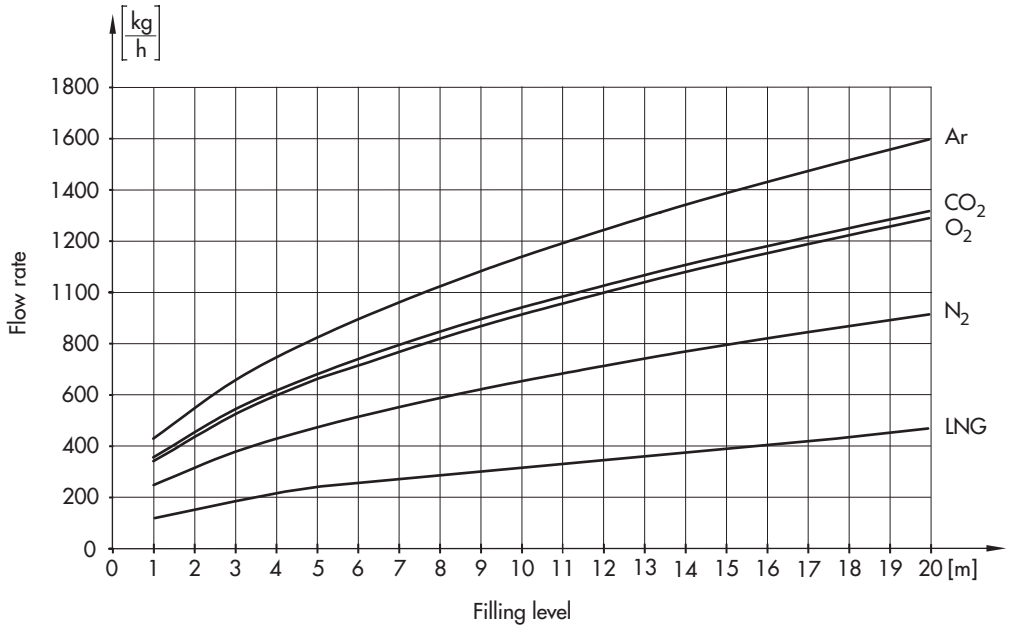
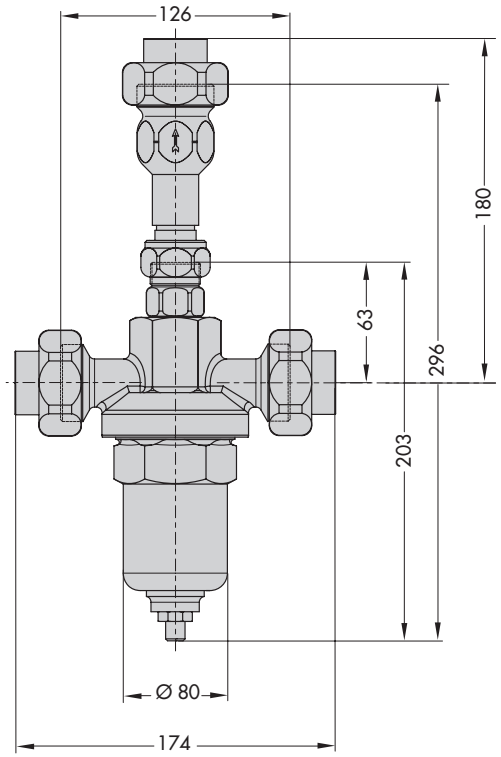


Fig. 4: *Mass flow dependent on the liquid column in the cryogenic tank*

Dimensions



Type 2357-31 · Version with soldering nipple (accessories) and non-return unit (accessories)

All dimensions in mm

Fig. 5: *Dimensional drawing*

Ordering text

Type 2357-31 Pressure Build-up Regulator
Set point range ... bar
Optionally, accessories ...
Optionally, special version ...

Specifications subject to change without notice

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