6.2.5 Screwed fastenings

Shall be according to EN 13611:2007, 6.2.5.

6.2.6 Jointing

Shall be according to EN 13611:2007, 6.2.6.

6.2.7 Moving parts

Shall be according to EN 13611:2007, 6.2.7.

6.2.8 Sealing caps

Shall be according to EN 13611:2007, 6.2.8.

6.2.9 Dismantling and reassembly

Shall be according to EN 13611:2007, 6.2.9.

6.2.101 Adjustments

The adjustments (e.g. outlet pressure, offset and gas/air-ratio) shall be readily accessible to authorised persons, but there shall be provision for sealing after adjustment. Means shall be provided to discourage interference by unauthorised persons. If it is stated in the installation and operating instructions that a pressure regulator can be put out of action, appropriate means shall be provided to put the pressure regulator out of action.

6.2.102 Resistance to pressure

Parts of the pressure regulator that are subjected to inlet pressure under normal operating conditions, or could be subjected to inlet pressure in the event of a failure, shall resist a pressure equal to the withstand pressure.

6.2.103 Blockage of canals and orifices

Blockage of auxiliary canals and orifices shall not lead to an unsafe situation otherwise they shall be protected against blockage by suitable means.

6.2.104 Signal tube connections

Requirements on connections for gas pressure, air pressure or furnace pressure signal tubes shall be stated in the installation and operating instructions.

6.3 Materials

6.3.1 General material requirements

Shall be according to EN 13611:2007, 6.3.1.

6.3.2 Housing

Shall be according to EN 13611:2007, 6.3.2 with the following modification:

The withstand pressure shall be used instead of maximum inlet pressure, if applicable.

6.3.3 Test for leakage of housing after removal of non-metallic parts

Shall be according to EN 13611:2007, 6.3.3 with the following addition and modification:

Addition:

Any breather holes shall be blocked.

Modification:

The withstand pressure shall be used instead of maximum inlet pressure, if applicable. The test shall be performed in accordance with 7.3.2.

6.3.4 Zinc alloys

Shall be according to EN 13611:2007, 6.3.4.

6.3.5 Springs providing closing and/or sealing force

EN 13611:2007, 6.3.5 is not applicable.

6.3.6 Resistance to corrosion and surface protection

Shall be according to EN 13611:2007, 6.3.6.

6.3.7 Impregnation

Shall be according to EN 13611:2007, 6.3.7.

6.3.8 Seals for glands for moving parts

Shall be according to EN 13611:2007, 6.3.8.

6.4 Gas connections

6.4.1 Making connections

Shall be according to EN 13611:2007, 6.4.1.

6.4.2 Connection sizes

Shall be according to EN 13611:2007, 6.4.2.

6.4.3 Threads

Shall be according to EN 13611:2007, 6.4.3.

6.4.4 Union joints

Shall be according to EN 13611:2007, 6.4.4.

6.4.5 Flanges

Shall be according to EN 13611:2007, 6.4.5.

6.4.6 Compression fittings

Shall be according to EN 13611:2007, 6.4.6.

6.4.7 Nipples for pressure test

Shall be according to EN 13611:2007, 6.4.7.

6.4.8 Strainers

Shall be according to EN 13611:2007, 6.4.8 with the following addition:

Strainers fitted to controls of DN 25 and above shall be accessible for cleaning or replacement without the need to remove the control body by dismantling threaded or welded pipe work.

6.5 Electronic parts of the control

EN 13611:2007, 6.5 is not applicable.

6.6 Protection against internal faults for the purpose of functional safety

EN 13611:2007, 6.6 is not applicable.

7 Performance

7.1 General

Shall be according to EN 13611:2007, 7.1.

7.2 Leak tightness

Shall be according to EN 13611:2007, 7.2 with the following addition:

For signal chamber(s) without combustion gas signal carrying compartment(s), when tested according to 7.3.101, the leakage rate from the signal chamber(s) shall not exceed the leakage rate at the maximum signal pressure stated in the installation and operating instructions before and after the tests specified in 7.102.7.

7.3 Test for leak tightness

7.3.1 General

Shall be according to EN 13611:2007, 7.3.1 with the following modification:

If stated in the installation and operating instructions that the regulator shall be used in combination with a safety shut-off device upstream of the regulator the following alternative external leakage test can be used:

For external leakage carry out the test with 1,5 times the withstand pressure at inlet and outlet, and with a pressure of 1,5 times the difference between withstand pressure and maximum outlet pressure on the atmospheric side of the working diaphragm (including the safety diaphragm, if any).

The test results shall meet the requirements of 7.2.

7.3.2 External leak-tightness

Shall be according to EN 13611:2007, 7.3.2 with the following addition:

If applicable the additional test conditions of 7.3.1 shall be taken into account.

7.3.3 Internal leak-tightness

EN 13611:2007, 7.3.3 is not applicable.

7.3.101 External leak-tightness for signal carrying compartment(s)

With any bleed port incorporated in the signal tube(s) or signal chamber(s) plugged, pressurize and test the compartment(s) according to 7.2 and measure the leakage rate.

The test results shall meet the requirements of 7.2.

7.4 Torsion and bending

Shall be according to EN 13611:2007, 7.4.

7.5 Torsion and bending tests

Shall be according to EN 13611:2007, 7.5.

7.6 Rated flow rate

Shall be according to EN 13611:2007, 7.6.

7.7 Test for rated flow

7.7.1 Apparatus

Shall be according to EN 13611:2007, 7.7.1.

7.7.2 Test procedure

Shall be according to EN 13611:2007, 7.7.2 with the following addition:

If rated flow rate for pressure regulators as stated in the installation and operating instructions is specified for the control member in the fully open position, the test shall be performed with the control member in that position.

7.7.3 Conversion of air flow rate

Shall be according to EN 13611:2007, 7.7.3.

7.8 Durability

Shall be according to EN 13611:2007, 7.8.

7.9 Performance tests for electronic controls

EN 13611:2007, 7.9 is not applicable.

7.10 Long-term performance for electronic controls

EN 13611:2007, 7.10 is not applicable.

7.101 Pressure regulator performance

7.101.1 General

When carrying out performance tests at any particular setting, the minimum inlet pressure used shall be at least 200 Pa (2 mbar) in excess of the set outlet pressure.

If the inlet pressure range includes two corresponding values for the minimum and maximum pressure, as given in Table 1, then the inlet setting pressure shall be the respective nominal pressure according to that table. Otherwise, the inlet setting pressure and the inlet pressure range shall be stated in the installation and operating instructions.

The outlet pressure variation from the outlet setting pressure p_{2s} shall not exceed that given in Table 2 or ±100 Pa (±1 mbar), whichever is the greater.

Table 1 — Gas pressure at inlet to the pressure regulator

Type of gas	Nominal pressure kPa (mbar)	Minimum pressure kPa (mbar)	Maximum pressure kPa (mbar)
1st family gases	0,8 (8)	0,6 (6)	1,5 (15)
2nd family gases group 2H	2,0 (20)	1,7 (17)	2,5 (25)
2nd family gases group 2L	2,5 (25)	2,0 (20)	3,0 (30)
2nd family gases group 2E	2,0 (20)	1,7 (17)	2,5 (25)
3rd family gases	2,9 (29)	2,0 (20)	3,5 (35)
	2,9 (29)	2,5 (25)	3,5 (35)
	3,7 (37)	2,5 (25)	4,5 (45)
	5,0 (50)	4,25 (42,5)	5,75 (57,5)
	6,7 (67)	5,0 (50)	8,0 (80)
	11,2 (112)	6,0 (60)	14,0 (140)
	14,8 (148)	10,0 (100)	18,0 (180)

Table 2 — Outlet pressure variation from the outlet setting pressure p_{2s}

Class of pressure regulator	Maximum outlet pressure variation %		
	1st family	2nd family	3rd family
Class A q_{max} to q_{min} and p_{1max} to p_{1min}	±15	±15	±15
Class B By variation of the inlet pressure for each of the rated flow rates	+15 −20	+10 −15	±10

Table 2 *(continued)*

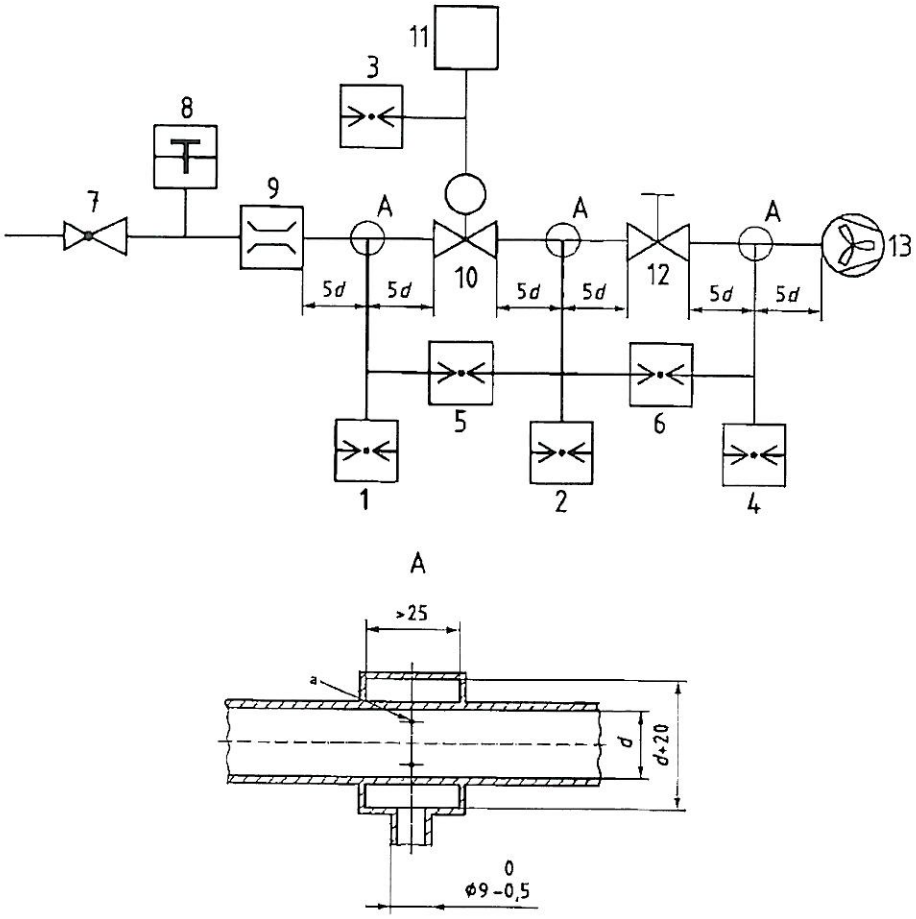
Class of pressure regulator	Maximum outlet pressure variation %		
	1st family	2nd family	3rd family
By variation of rated flow rates from q_{max} to q_{min} (constant inlet pressure) for each of the inlet pressures	+40	+40	+40
Class C			
At constant q (within the rated flow rate range)	+15 –20	+10 –15	±10

7.101.2 General test procedure

7.101.2.1 Apparatus

Carry out the tests using the apparatus shown in Figure 2. The uncertainty of measurement shall not exceed 2 %.

Dimensions in millimetres



Key

1 inlet pressure gauge p_1
2 outlet pressure gauge p_2
3 signal pressure gauge p_3 (see NOTE)
4 load determining pressure gauge p_4 (see NOTE)
5, 6 differential pressure gauges (see NOTE)
7 adjustable regulator for inlet pressure
8 thermometer
9 flow meter
10 control under test
11 signal pressure inlet (optional) (see NOTE)
12 manual control tap (injector orifice)
13 fan (optional) (see NOTE)

NOTE Key numbers 3, 4, 5, 6, 11 and 13 are only applicable for pneumatic gas/air ratio pressure regulators (refer to 3.105).

[a] 4 holes Ø 1,5 mm

Nominal size (DN)	Internal diameter (mm)
6	6
8	9
10	13
15	16
20	22
25	28
32	35
40	41
50	52
65	67
80	80
100	106
125	131
150	159
200	209
250	260

Figure 2 — Performance test apparatus

7.101.2.2 Conversion of the air flow rate

Shall be according to EN 13611:2007, 7.7.3.

7.101.2.3 Methods of test

Class A, class B and class C pressure regulators shall be tested according to 7.101.3.2, 7.101.4.2, and 7.101.5.2, respectively (see also Annex BB).

Steady state conditions shall always be reached before readings are taken.

Examples of performance curves are shown in Annex BB, Figures BB.1 to BB.5.

7.101.3 Class A pressure regulator performance

7.101.3.1 Requirement

Over the full range of inlet pressure from p_{1min} to p_{1max} and over the whole rated flow rate range from q_{min} to q_{max} as stated in the installation and operating instructions the outlet pressure variation from the outlet setting pressure p_{2s} shall not exceed the values given in Table 2 or ±100 Pa (±1 mbar), whichever is the greater. The stated minimum rated flow rate q_{min} shall not exceed 10 % of q_{max}.

7.101.3.2 Test

Class A pressure regulators shall be tested by measuring the outlet pressure p_2 with variation of the inlet pressure p_1 and of the flow rate q, as follows:

a) In order to adjust the outlet setting pressure p_{2s} of the pressure regulator, set the manual control tap to obtain a rated flow rate of 50 % of q_{max} (or any other value declared by the manufacturer). For adjustable pressure regulators, adjust the outlet setting pressure p_{2s} to the maximum outlet pressure p_{2max}, the inlet pressure p_1 being the nominal pressure (or respectively any other value declared by the manufacturer).

   Once the outlet setting pressure p_{2s} has been set, there shall be no further adjustment of the pressure regulator.

b) With inlet pressure p_{1min} kept constant, vary the rated flow rate q to q_{max} to q_{min} and back to q_{max} by using the manual control tap and record the outlet pressure p_2 for at least 5 values of q in each case. Ensure that there is no change of the inlet pressure p_1 during the whole time of this procedure.

c) Readjust the inlet pressure p_1 from p_{1min} to p_{1max} and then vary the rated flow rate from q_{max} to q_{min} and back to q_{max} (as in step b).

d) For adjustable pressure regulators readjust the outlet setting pressure p_{2s} to p_{2min} according to step a) and repeat steps b) and c).

7.101.4 Class B pressure regulator performance

7.101.4.1 Requirement

Over the full range of inlet pressure from p_{1min} to p_{1max} at any rated flow rate q within the rated flow rate range q_{min} to q_{max}, as stated in the installation and operating instructions, the outlet pressure variation from the outlet setting pressure p_{2s} shall not exceed the values given in Table 2 or ±100 Pa (±1 mbar), whichever is the greater.

For any change of rated flow rate q within the rated flow rate from q_{min} to q_{max}, as stated in the installation and operating instructions, at any inlet pressure p_1 within the full inlet pressure range from p_{min} to p_{max} the outlet

pressure variation from the outlet setting pressure p_{2s} shall not exceed the values given in Table 2 or ±100 Pa (±1 mbar), whichever is the greater.

7.101.4.2 Test

Class B pressure regulators shall be tested by measuring the outlet pressure p_2 with variation of the inlet pressure p_1 and of the rated flow rate q, as follows:

a) In order to adjust the outlet setting pressure p_{2s} of the pressure regulator, set the rated flow rate to q_{max} by adjusting the manual control tap. For adjustable pressure regulators, adjust the outlet setting pressure p_{2s} to the maximum outlet pressure p_{2max}, the inlet pressure p_1 being the nominal pressure (or another value declared by the manufacturer).

   Once the outlet setting pressure p_{2s} has been set, there shall be no further adjustment of the pressure regulator.

b) Vary the inlet pressure p_1 from the nominal pressure over the minimum inlet pressure p_{1min}, to the maximum inlet pressure p_{1max}, and back to p_{1min}, and record the outlet pressure p_2 for at least 5 values of p_1 in each direction without resetting the rated flow rate.

c) With inlet pressure p_1 at the nominal pressure or at the value declared under a), readjust the rated flow rate q from q_{max} to q_{min} by using the manual control tap without any other adjustment of the previously set value of the outlet pressure p_2.

d) Repeat step b).

e) For adjustable pressure regulators, readjust the outlet setting pressure p_{2s} according to a) to p_{2min} and repeat steps b) to d).

7.101.5 Class C pressure regulator performance

7.101.5.1 Requirement

Over the full range of inlet pressure from p_{1min} to p_{1max} at any rated flow rate q within the rated flow rate range from q_{min} to q_{max}, as stated in the installation and operating instructions, the outlet pressure variation from the outlet setting pressure p_{2s} shall not exceed the values given in Table 2 or ±100 Pa (±1 mbar), whichever is the greater.

7.101.5.2 Test

Class C pressure regulators shall be tested by measuring the outlet pressure p_2 with variation of the inlet pressure p_1, as follows:

a) In order to adjust the outlet setting pressure p_{2s} of the pressure regulator, set the rated flow rate to q_{max} by adjusting the manual control tap. For adjustable pressure regulators, adjust the outlet setting pressure p_{2s} to the maximum outlet pressure p_{2max}, the inlet pressure p_1 being the nominal pressure (or another value declared by the manufacturer).

   Once the outlet setting pressure p_{2s} has been set, there shall be no further adjustment of the pressure regulator.

b) Vary the inlet pressure p_1 to the minimum inlet pressure p_{1min}, to the maximum inlet pressure p_{1max}, and back to p_{1min}, and record the outlet pressure p_2 for at least 5 values of p_1 in each direction without resetting the rated flow rate.

c) By means of the manual control tap, adjust the rated flow rate to q_{min}, the outlet setting pressure p_{2s} readjusted as in step a).

d) Repeat step b).

e) For adjustable pressure regulators, readjust the outlet setting pressure p_{2s} according to a) to p_{2min} and repeat steps b) to d).

7.101.6 Endurance

7.101.6.1 Requirement

The leak tightness and performance shall remain within the limits specified in 7.2, 7.3, 7.101.1, 7.101.3, 7.101.4, and 7.101.5, respectively, after testing according to 7.101.6.2.

7.101.6.2 Test

Position the pressure regulator in a temperature controlled chamber with an air supply at ambient temperature and maximum inlet pressure p_{1max} as stated in the installation and operating instructions. The pressure regulator is controlled according to manufacturer's instructions to ensure that working diaphragm and safety diaphragm, if any, are fully flexed and the control member moves between fully open and fully closed position.

The test consists of 50 000 cycles with each fully open and fully closed position of the control member is held for at least 5 s.

Of the 50 000 cycles:

a) 25 000 cycles are with the pressure regulator environment at the maximum ambient temperature stated in the installation and operating instructions, but at least 60 °C and

b) 25 000 cycles are with the pressure regulator environment at the minimum ambient temperature stated in the installation and operating instructions, but at most 0 °C.

Provided that the pressure regulator operates over its full range it is not necessary for the cycle time to be equal to the response time.

In addition, where the pressure regulator incorporates an electric device which may be required to run continuously, it shall be additionally operated in a condition where the electric device operates continuously for a period of 3 000 h at 110 % of maximum rated voltage.

The period of 3 000 h shall consist of:

— 2 000 h at ambient temperature of 20 °C;

— 500 h at the maximum ambient temperature stated in the installation and operating instructions, but at least 60 °C and

— 500 h at the minimum ambient temperature stated in the installation and operating instructions, but at most 0 °C.

This electric device shall be in accordance with 8.11.

7.101.7 Lock-up pressure

7.101.7.1 Requirement

When it is stated in the installation and operating instructions that a pressure regulator has the ability to lock-up, the outlet pressure p_2 shall not rise by more than 15 % or +750 Pa (+7,5 mbar), whichever is the greater, above the outlet pressure at 5 % of q_{max}. Such a pressure regulator shall be tested according to 7.101.7.2.

7.101.7.2 Test

Proceed as follows:

a) Install the pressure regulator in the apparatus according to EN 13611:2007, 7.7.1;

b) adjust the inlet pressure p_1 to p_{1max}, the outlet pressure p_2 to p_{2min}, and the manual control tap to 5 % of q_{max};

c) measure the outlet pressure p_2;

d) slowly close the manual control tap in not less than 5 s;

e) 30 s after the manual control tap has been completely closed, measure the outlet pressure p_2;

f) repeat steps b) to e) with the outlet pressure p_2 adjusted to p_{2max};

g) repeat steps b) to f) for every outlet pressure range (typically determined by a different spring).

Check conformity to 7.101.7.1 for every lock-up value p_{2l}.

7.101.8 Requirement for rendered inoperative pressure regulators

If it is stated in the installation and operating instructions that the pressure regulator can be rendered inoperative, for example, for 3rd family gas applications, the method shall be given in the installation and operating instructions.

7.101.9 Test for rendered inoperative pressure regulators

The pressure regulator shall be rendered inoperative according to the method given in the installation and operating instructions. After it has been confirmed by observation that the control member is fixed in the fully open position, the external leak tightness shall meet the requirements of 7.2 and 7.3.

When the action of the pressure regulator is restored, the pressure regulator shall continue to conform to all requirements of this European Standard.

7.102 Pneumatic gas/air ratio pressure regulator performance

7.102.1 General

When carrying out performance tests at any particular setting, the minimum inlet pressure used shall be at least 200 Pa (2 mbar) in excess of the set outlet setting pressure p_{2s}.

If the inlet pressure range includes two corresponding values for the minimum and maximum pressure, as given in Table 1, then the inlet setting pressure shall be the respective nominal pressure according to that table. Otherwise, the inlet setting pressure and the inlet pressure range shall be declared by the manufacturer.

7.102.2 General test procedure

7.102.2.1 Apparatus

Shall be according to 7.101.2.1.

7.102.2.2 Conversion of the air flow rate

Shall be according to EN 13611:2007, 7.7.3.

7.102.3 Control performance and stability

7.102.3.1 Control performance requirement

When tested in accordance with 7.102.3.3 the control performance shall be such that for each test the deviation of pressure difference p_6 is within ±15 % of the value stated in the installation and operating instructions or ±100 Pa (±1 mbar), whichever is the greater. According to the application, as stated in the installation and operating instructions, the control pressure, which is

a) the signal pressure p_3 (e.g. air pressure, air differential pressure, furnace pressure, or a combination of them) or

b) the load determining pressure p_4

is varied.

Where tighter tolerances are stated in the installation and operating instructions, these shall be verified during testing.

7.102.3.2 Stabillty requirement

When tested according to 7.102.3.3 any continuous oscillation or hunting of the pressure difference p_6 shall not exceed ±10 % or ±100 Pa (±1 mbar), whichever is the greater, of the outlet value at any point within the working range stated in the installation and operating instructions, and shall not cause the pressure difference p_6 to fall outside the tolerance defined in 7.102.3.1.

7.102.3.3 Test

For this test the test conditions of 7.102.2.1 are used. The test is performed by recording the pressure difference p_6 as the control pressure is varied according to Table 3 with one offset adjustment as declared by the manufacturer. For each test in Table 3 the manual control tap (see Figure 2) shall be adjusted to the minimum or maximum rated flow rate as stated in the installation and operating instructions and remains unchanged during that test. Ensure that there is no change of the inlet pressure p_1 during each test.

Table 3 — Control performance test procedure

Test	Inlet pressure	Rated flow rate	Control pressure variation	
			Signal pressure [a]	Load determining pressure [b]
	p_1 Pa (mbar)	q m³/h	p_3 Pa (mbar)	p_4 Pa (mbar)
1	p_{1max}	q_{max}	from p_{3max}	from p_{4min}
			to p_{3min}	to p_{4max}
			and back to p_{3max}	and back to p_{4min}
2	p_{1max}	q_{min}	from p_{3min}	from p_{4max}
			to p_{3max}	to p_{4min}
			and back to p_{3min}	and back to p_{4max}