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Specification for

Electrically operated automatic gas shut-off valves

Spécification de la robinetterie d'arrêt de gaz automatique à commande électrique

Spezifikation für elektrisch gesteuerte automatische Gasabsperrventile

British Standards Institution

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Foreword

This British Standard has been prepared under the direction of the Gas Standards Committee to meet the need for a standard covering the safety and performance of electrically operated automatic gas shut-off valves for use on domestic, commercial and industrial appliances and plant burning 2nd and 3rd family gases.

During the last decade there has been a progressive change from 1st to 2nd family gas and hence 1st family gas is not referred to in this standard due to its greatly diminished use in the United Kingdom. However, present day appliances are often designed to burn 2nd and 3rd

'Additional requirements and tests for valves incorporating start-gas flow control and for valves in which the flow rate may be varied in response to electrical signals'.	8
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family gases and consequently the requirements appropriate to both these gases have been included.

In accordance with current practice, quantities given in this standard are expressed in metric (SI) units.

Information on the international system of units will be found in BS 3763.

This standard is not intended to prejudice the negotiation of a European Standard and will be withdrawn in favour of such a standard as soon as one, acceptable to the UK, is approved.



British Standard Specification for

Electrically operated automatic gas shut-off valves

1. Scope

1.1 This standard specifies the requirements for electrically operated automatic gas shut-off valves:

- (a) which open without manual assistance when electrically energized, and close automatically when de-energized;
- (b) for use on plant and appliances burning 1st, 2nd and 3rd family gases
- (c) up to and including DN 150 connection size;
- (d) for declared operating pressures up to 2 bar*.

1.2 The specification also includes valves operated by an electrical control that is not an integral part of the valve. It does not include valves operated by an external pneumatic or hydraulic supply.

1.3 Where a manufacturer declares that a valve is suitable for only one gas family, only the relevant tests apply.

2. References

The titles of the standards publications referred to in this standard are listed on page 9.

3. Definitions

For the purposes of this British Standard the following definitions apply. Definitions of other terms are to be found in BS 1179.

3.1 automatic gas shut-off valve. A valve designed to open when energized and close automatically when de-energized.

3.2 opening time. The time interval between the energization of the valve and the achievement of a flow rate equal to 80 % of the full rate as measured.

3.3 closing time. The time interval between the de-energization of the valve and the cessation of flow.

3.4 class 1 and class 2 valves. Automatic gas shut-off valves designed primarily for safety shut-off purposes and activated by the safety controls of a burner system.

NOTE. These valves differ in their closing force requirements as defined by reverse pressure capability and maximum permitted leakage (see tables 4 and 5).

3.5 class 3 and class 4 valves. Automatic gas shut-off valves designed primarily for control purposes (see tables 4, 5 and 6).

NOTE. These valves differ in their endurance test requirements.

3.6 closing force. The force provided by the closing mechanism of the valve independent of any force provided by gas pressure.

* 1 bar = 10^5 N/m² = 100 kPa

3.7 start gas rate. The restricted gas flow rate admitted either to a separate pilot burner or to the main burner during the start-gas flame establishment period.

4. Design and construction

4.1 General

4.1.1 Notwithstanding the requirements specified in this standard, any new designs, materials and methods of assembly giving at least equivalent results may be considered as complying with the requirements of this standard when approved by a representative and recognized authority.

Any new features incorporated in a valve for which no provision for testing is made in this standard shall be examined and approved by a recognized and representative authority in the light of the manufacturer's claims.

4.1.2 The additional requirements for:

- (a) valves fitted with proof of closure switches shall be as detailed in appendix A;
- (b) valves with closed position indicator switches shall be as detailed in appendix B;
- (c) valves in which the flow rate may be varied in response to external electrical signals shall be as detailed in appendix C.

4.2 Closing force. For class 1 and 2 valves, the forward flow of the gas shall not decrease the closing force of the valve.

4.3 Security. All valves shall be tamper-proof. For class 1, 2 and 3 valves there shall be no exposed shafts or operating levers, interference with which could affect the ability of the valve to close, and access shall require the use of tools.

NOTE. Class 4 valves may incorporate a facility to open the valve manually.

4.4 Noise. Valves shall not be unduly noisy when considered with respect to the intended application.

4.5 Pressure test points. Where provision is made for pressure test points on a valve body then they shall be in the form of either:

- (a) a suitable boss threaded to BS 21 (Female) or BS 2779 (Female) which is either plugged or fitted with a suitable test nipple; or
- (b) an integrally cast test nipple having an external diameter of 9 +0, -0.5 mm and useful length of at least 10 mm for connection to tubing. The equivalent diameter of the hole in the test nipple shall not exceed 1 mm.

4.6 Materials for gas-carrying parts. Parts of the body other than 'O' rings and gasket seals which directly or indirectly separate a gas-carrying chamber from the atmosphere shall be made of either:

- (a) metallic material, or
- (b) non-metallic material provided that upon removal or fracture of this non-metallic part under all circumstances not more than 30 dm³/h of air can escape, when the valve is tested with air, at the declared maximum operating pressure.

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Solder that has a melting point below 450 °C after application shall not be used for gas-carrying parts.

4.7 Breather holes. Breather holes shall be so designed that when any diaphragm or other flexible seal is damaged, no more than 70 dm³/h of air shall flow through at the maximum declared operating pressure.

This requirement is considered to be met for inlet pressures up to 30 mbar if the diameter of a breather hole is not greater than 0.7 mm.

Breather holes shall be protected against blockage or shall be located so that they do not easily become blocked. They shall be so arranged that any diaphragm or other flexible seal cannot be damaged by a sharp cleaning device inserted through the breather hole.

4.8 Zinc alloys. Zinc alloys shall be used only if:

- (a) they comply with all the requirements of BS 1004;
- (b) the casting is manufactured in accordance with the recommendations of BS 5338;
- (c) the parts will not be subjected to a temperature higher than 80 °C;
- (d) for gas-carrying parts and parts which could affect the safe operation of the valve, only alloy A is used;
- (e) for valve bodies and gas-carrying parts, the valves are not larger than DN 15 gas connection size.

4.9 Accessibility and ease of servicing. Components requiring servicing during normal use shall be easily accessible and the valve shall be capable of being serviced without the valve body being removed from the flow line. The valve shall be so manufactured that parts cannot be readily incorrectly assembled.

4.10 Corrosion resistance

4.10.1 General requirements. All parts of the valve shall have adequate resistance to corrosion, either by the use of corrosion-resistant materials or by means of suitable protective coating, e.g. paint. No part of the valve shall corrode so as to affect the safe and correct operation of the valve.

4.10.2 Scratch test. Parts of the valve, coated for protection and not just for decoration, shall be subjected to a scratch test as described in 4.10.2.1 both before and after the humidity test specified in 4.10.3. There shall be no penetration of the protective coating by the ball.

4.10.2.1 Scratch test method. A 1 mm diameter fixed steel ball is drawn across the surface of the valve at a speed of 30 mm/s to 40 mm/s with a contact force of 10 N. An example of a suitable test instrument is shown in figure 2.

4.10.3 Humidity test. The valve shall be subjected to a

humidity test as detailed in 4.10.3.1. Following this humidity test:

- (a) No part of the valve shall show signs of undue corrosion; coated surfaces shall not show signs of bubbling or blistering.

Where evidence of minor corrosion of a valve part exists, the part shall be substantial enough to ensure an adequate margin for the safety of the valve.

- (b) Notwithstanding the above requirements, parts of the valve, corrosion of which could adversely affect the continued safe working of the valve, shall not show any signs of corrosion.

4.10.3.1 Humidity test method

- (a) The valve with connections open is placed in an ambient temperature of 43 ± 2 °C with a relative humidity exceeding 95 % for a period of 48 h. The valve is then examined for compliance with 4.10.3 (a).

- (b) The valve is then allowed to stand for 24 h at room temperature after which it is examined for compliance with 4.10.3 (a) and 4.10.3 (b).

4.11 Non-metallic materials

4.11.1 General. Non-metallic materials shall not be affected by their specified working environment so as to interfere with the safe operation of the valve.

4.11.2 Sealing gaskets and jointing compounds. Sealing gaskets, jointing compounds and any other sealing agent, shall form an effective seal and shall comply with the requirements of the appropriate section of BS 5292.

4.11.3 Rubber-type materials. Rubber-type materials used for valve pads, diaphragms and seals shall comply with the requirements of BS 6505 for 1st, 2nd or 3rd family gas as appropriate.

4.11.4 Tests on the assembled device

4.11.4.1 1st and 2nd family gases

4.11.4.1.1 Requirements. After exposure to the test given in 4.11.4.1.2 the valve shall continue to function correctly and shall comply with the requirements of 5.2.2.1 and 5.3.

Where the nominal size of the valve is less than R ¼ (DN 20) the valve shall comply with the requirements of 5.8. In addition, the valve shall be observed to operate correctly over its full range of nominal working pressures, the voltage range of 15 % below the rated voltage to 10 % above the rated voltage, and under any combination of these conditions, but with the ambient temperature maintained at 20 ± 5 °C.

4.11.4.1.2 Method of test. Expose the valve for a period of 264 h to TGA* gas, nitrogen, or air, at a temperature of 20 ± 5 °C. This gas is saturated to 35 ± 2 % with toluene vapour and has a relative humidity of 65 ± 5 %. During the test, maintain the flow rate at not less than 30 dm³/h. Arrange the test so that any 'working' diaphragm operates in the normal mode and over the full stroke at least 5000 times at a rate of 20 cycles/h. Other devices are maintained in their normal operating state.

4.11.4.2 3rd family gas

4.11.4.2.1 Requirements. Where the manufacturer declares an operating temperature below 0 °C, or where the nominal working pressure exceeds 50 mbar, the valve pad, fitted in its housing, shall show no evidence of being forced out of position due to swelling or other causes after exposure to the test given in 4.11.4.2.2.

4.11.4.2.2 Method of test. Immerse the valve pad, fitted in its housing, for 72 h in test gas LPGE* at 20 ± 5 °C.

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* See BS 4947.

4.12 Assembly and workmanship

4.12.1 Castings shall be free from laps, blow holes and pitting, and both the external and internal surfaces shall be clean and smooth. They shall be neatly dressed, and shall not be burned, plugged, stopped or patched. This does not exclude accepted methods of impregnation of castings (e.g. vacuum impregnation with thermosetting resin).

4.12.2 Hot pressed components shall be sound, homogeneous, without laminations and they shall be smooth and well finished.

4.12.3 The valve shall be free from sharp edges which might cause personal injury or damage to other components, electrical wirings, etc.

* See BS 4947.

4.12.4 The valve shall not contain dirt, casting sand, swarf or other foreign matter. There shall be no excess diaphragm or other dressing, jointing compound, or insulation varnish that could cause failure or otherwise interfere with the safety and performance of the valve.

4.12.5 Holes for screwed fastenings (see 4.14) and pins, which are used for the assembly of parts and for mounting, shall not penetrate gasways. The wall thickness between holes (including threads) and gasways shall be not less than 1 mm.

4.12.6 Holes used for manufacturing purpose shall be blocked mechanically with a metallic seal to ensure a gas-tight seal for the life of the valve and shall be treated in such a way that unauthorized interference can be detected. The additional use of a suitable sealing compound is permitted.

4.12.7 The leak tightness seal of throughput adjusters, test nipples, etc. shall be achieved by mechanical means, e.g. metal-to-metal seals or 'O'-rings. Sealing paste, tape or similar products shall not be used.

4.13 Pipe connections

4.13.1 Connection bosses. Connection bosses shall be such as to permit the use of standard spanners, preferably metric complying with the requirements of BS 192.

4.13.2 Pipe threads. Where the connecting threads of a valve are pipe threads, they shall be parallel or tapered threads complying with the requirements of BS 21†.

4.13.3 Compression fittings. Compression fittings shall be of the type to suit tubes conforming to the dimensions of BS 2871 : Part 1. The olives of such fittings shall be appropriate to the tubes for which they are intended. Non-symmetrical olives may be used if they cannot be fitted the wrong way round. Sealing faces shall be smooth. It is recommended that standard thread ends of compression fittings be in accordance with BS 21 so that the valve will be suitable for either compression fittings or screwed threads.

4.13.4 Flange connections.

Flange connections shall be to the manufacturer's specification. Where these are not to the fixing dimensions of table 16 of BS 4504 : Part 1 : 1969, suitable mating flanges shall be available to permit connections to standard screw thread or standard flanges.

Valves greater than DN 80 connection size shall be flanged.

4.14 Screwed fastenings

Screwed fastenings that might be removed during servicing shall have metric threads complying with the requirements of BS 4183 unless a different thread is essential for the correct functioning and adjustment of the valve.

Self-tapping screws that cut a thread and produce swarf shall not be used for connecting gas-carrying parts or parts that might be removed in servicing.

Where self-tapping screws are used for these purposes, only those that form a thread and do not produce swarf shall be used. They shall permit replacement by metric machine screws complying with the requirements of BS 4183.

The application of such self-tapping screws shall be limited to malleable materials, and to prevent cracking of the material they shall be positioned such that the centres are no closer to an edge than one major diameter of the thread.

NOTE. For the purposes of this clause, metal dust produced during the insertion and removal of the screw is not regarded as swarf.

† Other recognized pipe threads, e.g. NPT, may be accepted for specific industrial applications subject to clear and permanent identification.

4.15.1 Where an inlet strainer is fitted to a valve, the maximum strainer hole dimension shall not exceed 1.5 mm and it shall prevent the passage of a 1 mm pin gauge.

4.15.2 For servo-operated valves where blockage of the weep could result in failure to danger, there shall be protection to avoid any such blockage.

4.15.3 Strainers shall be accessible for cleaning or replacement purposes. For valves of connection size DN 25 and above, this operation shall be carried out without requiring removal of the valve body from the flowline.

4.16 Mechanical strength

4.16.1 Requirements. The valve shall have sufficient mechanical strength to resist the stresses and conditions of normal use. A valve that satisfies the requirements of the torque test and bending moment test as specified in 4.16.2 and 4.16.3 respectively, without showing any sign of cracking or any significant permanent distortion and that remains functional without exceeding the leakage rates given in 5.2 and 5.3 will be deemed to have sufficient mechanical strength. The bending moment test does not apply to compression fittings.

4.16.2 Torque test methods

4.16.2.1 For connections complying with the requirements of BS 21*. Pipes threaded in accordance with BS 21 and at least 300 mm in length are screwed hand tight to the inlet and outlet of the valve and the inlet pipe is clamped at a distance not less than $2D$ from the valve, where D is the nominal diameter of the pipe. The test torque appropriate to the nominal size given in table 2 is then applied to the outlet pipe for approximately 10 s.

The outlet pipe is then clamped at a distance not less than $2D$ from the valve and the test torque is applied to the inlet pipe for approximately 10 s.

The valve is checked for deformation and leakage.

Table 2. Torque and bending moment values

Size			Torque	Bending moment
	R	DN o.d. of tubing	Threaded and compression fittings	Threaded and flanged connections
		mm	N m	N m
1/8	6	3 and 4	15	25
1/4	8	6 and 8	20	35
3/8	10	10 and 12	35	70
1/2	15	15	50	105
3/4	20	22	85	225
1	25	28	125	340
1 1/4	32	—	160	475
1 1/2	40	—	200	610
2	50	—	250	1100
2 1/2	65	—	325	1600
3	80	—	400	2400
—	100	—	—	5000
—	125	—	—	6000
—	150	—	—	7600

4.16.2.2 For compression fittings

(a) For olive compression fittings, a steel tube is used with a new brass olive of the recommended size. With the body of the valve rigidly clamped, the test torque given in table 2 is applied to the tubing nut for approximately 10 s. The same procedure is followed for all the connections. Any deformation of the olive seating or mating surfaces consistent with the applied torque is discounted.

* For other threads the equivalent strength tests are applied.

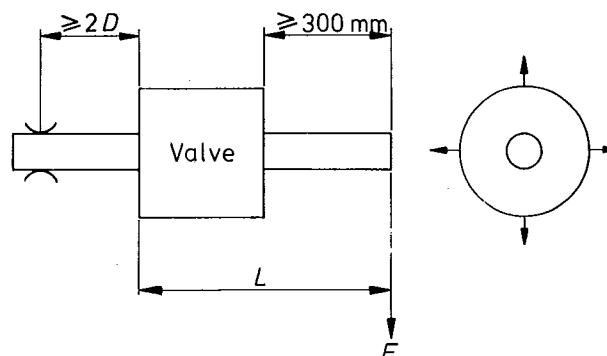
The valve is checked for deformation and leakage.

(b) For flared compression fittings, a short length of steel tube with a flared end is used, and the procedure given in (a) is followed. Any deformation of the cone seating or mating surfaces consistent with the applied torque is discounted.

The valve is checked for deformation and leakage.

4.16.3 Bending moment tests

4.16.3.1 Bending moment test method for valve with threaded connections. Following the torque test, the inlet pipe is clamped at a distance not less than $2D$ from the valve, and the force to give the test bending moment specified in table 2 is applied to the outlet pipe. The force is applied for approximately 10 s in each of four directions, perpendicular to each other and to the axis of the pipe, see figure 1.



$$\text{Bending moment} = F \times L$$

Figure 1. Schematic illustration of bending moment test

The outlet pipe is then clamped at a distance not less than $2D$ from the valve, and the test force is applied to the inlet pipe.

The valve is checked for deformation and leakage.

4.16.3.2 Bending moment test method for flanged valves. The valve inlet flange is bolted to a rigid mounting plate and a flanged section of pipe at least 300 mm long is bolted to the outlet flange. A force to give the test bending moment (see table 2) is applied to the pipe for 10 s in each of four directions perpendicular to each other and to the axis of the pipe. The valve is then reversed so that the outlet flange is fixed, and the force is applied to the pipe connected to the inlet flange.

The valve is checked for deformation and leakage.

The force F is calculated as the test bending moment M divided by the distance L from the fixed flange to the point of application of the force.

4.17 Electrical requirements

4.17.1 Notwithstanding its scope, the relevant electrical requirements of BS 3955 : Part 3 shall be applied to all valves covered by this document. Valves for use on UK mains supply shall have a rated voltage which covers use at 240 V and a rated frequency which covers use at 50 Hz. The valves shall operate satisfactorily at all voltages from +10 % to -15 % of the voltage or voltage range shown on the nameplate.

4.17.2 Where snap-on connectors are used for external connections, the tab terminals shall accept receptacles having dimensions in accordance with BS 5057, preferably of sizes 2.8 mm and/or 6.3 mm.

New clause 4.18

Insert the following new clause:

4.18 Throughput adjusters

4.18.1 General

4.18.1.1 Throughput adjusters shall be clearly identified and shall be marked to indicate the direction of adjustment.

4.18.1.2 For adjusters operating over a single turn, means shall be provided for indicating the actual setting and the minimum and maximum positions.

4.18.1.3 For adjusters operating with a multi-turn screw, the direction of increase and/or decrease shall be indicated.

4.18.1.4 Adjusters shall retain their set position under normal conditions of use and shall either:

- (a) require the use of tools for their access and setting; or
- (b) require the use of tools for adjustment and be capable of being sealed after setting.

4.18.2 Adjusters forming part of the valve body

4.18.2.1 The adjuster shall be operated over its full range of adjustment 25 times, following which it shall be tested for leak tightness (see 5.3) and shall meet the requirements of 4.18.1.4.

A single sample shall be examined for each size of adjuster.

4.18.2.2 Where the adjuster limits the travel of the valve disc, an additional endurance test, as specified in 5.9.2, shall be carried out on three samples with the adjuster set to give minimum flow. Following this endurance test, any variation in the set flow shall not exceed $\pm 10\%$.

4.18.3 Adjusters forming part of the valve actuating mechanism. These shall meet the requirements of 4.18.2.2.

4.19 Manual opening facility

For class 4 valves having a manual opening facility, the opening means shall be operated 25 times following which the valve shall comply with the requirements of 5.2 and 5.3.



5. Operational requirements

5.1 General requirements

5.1.1 Valves shall close with sufficient closing force to ensure reliable closure and tight shut-off under operating conditions.

5.1.2 In order to ensure a tight seal between the sealing members when the valve is in the closed position, class 1 and class 2 valves shall have a closing force over the full stroke of the valve or a sealing force, as appropriate, of not less than that specified in table 3. The effect of differential pressure shall not reduce the closing force below that specified in table 3.

5.1.3 Where more than one valve is incorporated in a single body, each valve shall be subjected independently to the tests detailed in 5.2 to 5.9.

5.1.4 Valves shall comply with the requirements of 5.2 to 5.9 in each of their declared mounting positions.

5.1.5 Valves shall comply with the requirements of 5.2, 5.3, 5.6 and 5.7.1 at the end of their minimum reliable life (as specified in 5.9.2) and the requirements of 5.2, 5.3, 5.5, 5.6 and 5.7 at the end of their minimum safe life (as specified in 5.9.2).

Table 3. Minimum closing force

Class of valve	Minimum closing force per unit area of valve orifice
	N/mm ²
Class 1	15×10^{-3}
Class 2	5×10^{-3}

5.2 Internal leak tightness (let-by)

5.2.1 *Requirements.* When the valve is tested with air, in accordance with the method described in 5.2.2, any leakage through the closed valve shall not exceed the value specified in table 4. Grease, oil or other sealing compound shall not be used on the seating surfaces of the valve during the test. In order to check the adequacy of the closing force on a disc-on-seat type valve, a pressure test in the reverse flow direction shall be made. For other types of valve, the adequacy of the closing/sealing force shall be established by means of a test method agreed between the manufacturer and the test authority. Class 3 valves and class 4 shall not be subjected to a reverse pressure test.

5.2.2 Method of test

5.2.2.1 *Forward flow direction.* Air pressure as specified in table 3 is applied to the inlet connection of the closed valve, and any leakage through the valve is measured by means of a flow indicator connected to the outlet connection. The flow indicator shall give an accuracy of measurement better than $\pm 5 \text{ cm}^3/\text{h}$ at the maximum permitted leakage rate and shall present a back pressure not exceeding 2.5 mbar.

The applied pressure is increased gradually from atmospheric to the required test pressure.

NOTE. Valves that may be used in both directions of flow should be tested as above in both directions.

* For certain applications, particularly when the valve is used with 3rd family gas, operating temperatures below 0 °C will be encountered.

5.2.2.2 *Reverse flow direction.* Air pressure as specified in table 4 is applied to the outlet connection of the closed valve and any leakage through the valve is measured by means of a flow indicator connected to the inlet.

The applied pressure is increased gradually from atmospheric to the required test pressure.

5.3 External leak tightness

5.3.1 *Requirement.* When the valve is tested with air in accordance with the method described in 5.3.2, any leakage shall not exceed $50 \text{ cm}^3/\text{h}$.

5.3.2 *Method of test.* An air pressure equal to 1.5 times the maximum rated working pressure of the valve, or the pressure given in table 5, whichever is the greater, is applied at both inlet and outlet connections of the valve simultaneously; any leakage from the valve is measured by means of a suitable flow indicator giving an accuracy of measurement better than $\pm 5 \text{ cm}^3/\text{h}$. The test is carried out with the valve closed, with the valve open, and at intermediate positions on modulating valves.

Table 5. Minimum external leakage test pressure

Class of valve	Min. external leakage test pressure
	mbar
1	75
2	50
3	50
4	50

5.4 Range of operating conditions

5.4.1 *Requirements.* The valve shall operate correctly over its full range of nominal working pressures; the ambient temperature range 0 °C to 60 °C, or wider limits* if claimed by the manufacturer; the voltage range from +10 % to -15 % of the rated voltage or voltage range; and under any combination of these conditions.

5.4.2 Methods of test

5.4.2.1 Operation at high temperature.

The valve with a straight pipe 300 mm in length (or an equivalent heat sink) connected at each end is energized at 10 % above its maximum rated voltage while in an ambient temperature of 60 °C or at its declared maximum ambient temperature where higher, until equilibrium conditions are reached.

Cont on pg 6.....

Table 4 Test pressure and maximum permitted internal leakage

	Class 1 valves		Class 2 valves		Class 3 and class 4 valves
Forward flow test pressure (max.)	1.5 times rated working pressure but not less than 75 mbar.		1.5 times rated working pressure but not less than 50 mbar.		1.5 times rated working pressure but not less than 50 mbar.
Reverse flow test pressure	150 mbar 100 mbar for valve size > 50 mm		50 mbar		None
Maximum permitted leakage	Valve size mm	Leakage (let-by) cm ³ /h	Valve size mm	Leakage (let-by) cm ³ /h	As for class 2 valves
	≤ 25	50	≤ 25	100	
	≤ 32	60	≤ 32	120	
	≤ 40	75	≤ 40	150	
	≤ 50	100	≤ 50	200	
	≤ 65	125	≤ 65	250	
	≤ 80	150	≤ 80	300	
	≤ 100	200	≤ 100	300	
	≤ 150	300	≤ 150	300	

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