BRITISH STANDARD

BS EN
161:2002

Automatic shut-off valves for gas burners and gas appliances

The European Standard EN 161:2001 has the status of a British Standard

ICS 23.060; 27.060.20

National foreword

This British Standard is the official English language version of EN 161:2001. It supersedes BS EN 161:1991 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee GSE/22, Safety and control devices for gas governors and gas burning appliances, to Subcommittee GSE/22/12, Automatic valves and flame failure devices, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

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EUROPEAN STANDARD

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EN 161

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English version

Automatic shut-off valves for gas burners and gas appliances

Robinets automatiques de sectionnement pour brûleurs à gaz et appareils à gaz

Automatische Absperrventile für Gasbrenner und Gasgeräte

This European Standard was approved by CEN on 28 September 2001.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Contents

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 58, Safety and control devices for gas burners and gas-burning appliances, the Secretariat of which is held BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2002, and conflicting national standards shall be withdrawn at the latest by May 2002.

This European Standard replaces EN 161:1991 and prEN 1531:1994.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this standard.

The Annexes A, B, C and ZA are informative. Annex D is normative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies the safety, construction and performance requirements for automatic shut-off valves for gas burners, gas appliances and similar use, hereafter referred to as valves.

This European Standard covers type testing only.

It applies to valves with declared maximum working pressures up to and including 4 bar, for use on burners or in appliances using fuel gases of the 1st, 2nd or 3rd families.

It applies to electrically operated valves and to valves actuated by fluids where the control valves for these fluids are actuated electrically, but not to any external electrical devices for switching the control signal or actuating energy.

It applies to valves where the flow rate is controlled by external electrical signals, either in discrete steps or proportional to the applied signal.

It applies to valves fitted with closed position indicator switches.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies (including amendments).

EN 30-1-1:1998, *Domestic cooking appliances burning gas fuel — Part 1-1: Safety — General.*

EN 50165:1997, *Electrical equipment of non-electric appliances for household and similar purposes — Safety requirements.*

EN 55011:1998, *Industrial, scientific and medical (ISM) radio-frequency equipment — Radio disturbance characteristics; limits and methods of measurement (IEC/CISPR 11:1997, modified).*

EN 55014-1:2000, *Electromagnetic compatibility — Requirements for household appliances, electric tools and similar apparatus — Part 1: Emission (CISPR 14-1:2000).*

EN 55014-2:1997, *Electromagnetic compatibility — Requirements for household appliances, electric tools and similar apparatus — Part 2: Immunity product family standard (CISPR 14-2:1997).*

EN 60529:1991, *Classification of degrees of protection provided by enclosures (IP Code) (IEC 60529:1989).*

EN 60730-1:1995, *Automatic electrical controls for household and similar use — Part 1: General requirements (IEC 60730-1:1993, modified).*

EN 61058-1:1992, *Switches for appliances — Part 1: General requirements (IEC 61058-1:1990).*

ISO 7-1:1994, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation.*

ISO 65:1981, *Carbon steel tubes suitable for screwing in accordance with ISO 7-1.*

ISO 228-1:2000, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation.*

ISO 262:1998, *ISO general purpose metric screw threads — Selected sizes for screws, bolts and nuts.*

ISO 274:1975, *Copper tubes of circular section — Dimensions.*

ISO 301:1981, *Zinc alloy ingots intended for casting.*

ISO 1817:1999, *Rubber, vulcanized — Determination of the effect of liquids.*

ISO 4400:1994, *Fluid power systems and components — Three-pin electrical plug connectors — Characteristics and requirements.*

ISO 6952:1994, *Fluid power systems and components — Two-pin electrical plug connectors with earth contact — Characteristics and requirements.*

ISO 7005, *Metallic flanges.*

3 Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply.

3.1
automatic shut-off valve
valve which opens when energized and closes automatically when de-energized

3.2
valve with step control
valve which controls the flow rate in steps

3.3
valve with modulating control
valve which controls the flow rate continuously between two limits in response to external electrical signals

3.4
closure member
movable part of the valve which shuts off the gas flow

3.5
actuating mechanism
part of the valve which moves the closure member

3.6
closed position indicator switch
switch fitted to a valve which indicates when the closure member is in the closed position

3.7
actuating energy
required energy for the actuating mechanism to move the closure member to the open position. The actuating energy can have an external source (electrical, pneumatic or hydraulic) and can be transformed inside the valve

3.8
opening force
force required to move the closure member to the open position

3.9
closing force
force available to close the valve, independent of any force provided by fuel gas pressure

3.10
sealing force
force acting on the valve seat when the closure member is in the closed position, independent of any force provided by fuel gas pressure

3.11
frictional force
largest force required to move the actuating mechanism and the closure member from the open position to the closed position with the closure spring removed, independent of any force provided by fuel gas pressure

3.12
external leak-tightness
leak-tightness of a gas-carrying compartment with respect to atmosphere

3.13
internal leak-tightness
leak-tightness of the closure member (in the closed position) sealing a gas-carrying compartment with respect to another compartment or to the outlet of the valve

3.14
inlet pressure
pressure at the inlet of the valve

3.15
outlet pressure
pressure at the outlet of the valve

3.16
maximum working pressure
highest inlet pressure declared by the manufacturer at which the valve may be operated

3.17
minimum working pressure
lowest inlet pressure declared by the manufacturer at which the valve may be operated

3.18
actuating pressure
hydraulic or pneumatic pressure supplied to the actuating mechanism of the valve

3.19
pressure difference
difference between the inlet and outlet pressures

3.20
flow rate
volume flowing through the valve in unit time

3.21
rated flow rate
air flow rate at a specified pressure difference declared by the manufacturer, corrected to reference conditions

3.22
opening time
time interval between energizing the valve and the attainment of the maximum or other defined flow rate

3.23
closing time
time interval between de-energizing the valve and the closure member attaining the closed position

3.24
delay time
time interval between energizing the valve and the start of flow

3.25
mounting position
position declared by the manufacturer for mounting the valve

3.26
control valve
valve which controls the fluid (e.g. compressed air) supplied to the actuating mechanism

3.27
maximum ambient temperature
highest temperature of the surrounding air declared by the manufacturer at which the valve may be operated

3.28
minimum ambient temperature
lowest temperature of the surrounding air declared by the manufacturer at which the valve may be operated

3.29
rated voltage
voltage declared by the manufacturer at which the valve may be operated

3.30
rated current
current declared by the manufacturer at which the valve may be operated

4 Classification

4.1 Classes of valve

— *Class A, B and C valves*

Valves where the sealing force is not decreased by the gas inlet pressure. They are classified A, B or C according to the sealing force requirements of 7.8.

— *Class D valves*

Valves which are not subject to any sealing force requirements.

— *Class E valves*

Valves where the sealing force is decreased by the gas inlet pressure and which meet the requirements of 7.8.

— *Class J valves*

Disc-on-seat valves where the sealing force is not decreased by the gas inlet pressure and which meet the requirements of 7.8.

4.2 Groups of valve

A valve is classified as group 1 or group 2 according to the bending stresses that it is required to withstand (see Table 4).

— *Group 1 valves*

Valves for use in an appliance and/or installation where they are not subjected to bending stresses imposed by installation pipework, (e.g. by the use of rigid adjacent supports).

— *Group 2 valves*

Valves for use in any situation, either internal or external to the appliance, typically without support.

NOTE A valve which meets the requirements of group 2 valves also meets the requirements of group 1 valves.

5 Units of measurement

5.1 Dimensions

Dimensions are given in millimetres.

5.2 Pressures

Pressures are static pressures relative to atmospheric pressure and are given in millibars or bars.

5.3 Bending moments and torques

Bending moments and torques are given in newton metres.

6 Construction requirements

6.1 General

6.1.1 Valves shall be designed, manufactured and assembled in such a way that they function correctly when installed and used according to the manufacturer's instructions.

6.1.2 Valves shall be free from sharp edges and corners that could cause damage, injury or incorrect operation.

All parts shall be clean internally and externally.

Dismantling and reassembly of valves shall require the use of tools. There shall be no exposed shafts or operating levers that could adversely affect the ability of valves to close.

6.1.3 Holes for screws, pins, etc., which are used for the assembly of parts of the valve or for mounting, shall not penetrate gasways.

The wall thickness between these holes and gasways shall be at least 1 mm.

6.1.4 Holes necessary during manufacture which connect gasways to atmosphere but which do not affect the operation of the valve shall be permanently sealed by metallic means. Suitable jointing compounds may additionally be used.

6.1.5 Closure parts, including those of measuring and test points, which may be dismantled for servicing, adjustment or conversion, shall be constructed in such a way that leak-tightness in accordance with 7.7 is achieved mechanically (e.g. metal to metal joints, O-rings) without the use of jointing compounds such as liquids, pastes or tapes.

Jointing compounds, where used for permanent assemblies, shall remain effective under normal operating conditions.

6.1.6 Parts which require dismantling, (e.g. for servicing) shall be capable of being dismantled and reassembled using commonly available tools. They shall be constructed or marked in such a way that incorrect reassembly is impossible when following the manufacturer's instructions.

Screwed fastenings which may be removed during servicing shall have metric threads to ISO 262:1998.

Self-tapping screws which cut a thread and produce swarf shall not be used for connecting gas-carrying parts or parts which may be removed during servicing.

Self-tapping screws which form a thread and do not produce swarf may be used provided that they can be replaced with metric machine screws conforming to ISO 262:1998.

6.1.7 The operation of moving parts, (e.g. diaphragms, bellows) shall not be impaired by other parts.

6.1.8 Soldering or other processes where the jointing material has a melting point below 450 °C after application shall not be used for joining gas-carrying parts except for additional sealing.

6.1.9 Closed position indicator switches, where fitted, shall not impair the correct operation of valves. Adjusters shall be sealed to indicate interference. Any drift of the switch and actuating mechanism from its setting shall not impair correct valve operation.

6.1.10 Flow rates of valves with modulating control shall be adjustable over the full range declared by the manufacturer. If the adjustment of one flow rate affects the setting of any other flow rate, this shall be clearly indicated in the manufacturer's instructions for setting up. The setting of any flow rate shall require the use of tools and shall be sealed to discourage unauthorized adjustment.

6.2 Materials

6.2.1 General material requirements

The quality of materials, the dimensions used and the method of assembling the various parts of the valve shall be such that construction and performance characteristics are safe. Performance characteristics of the valve shall not alter significantly during a reasonable life when installed and used according to the manufacturer’s instructions. Under these circumstances, all components shall withstand any mechanical, chemical, and thermal conditions to which they may be subjected during service.

6.2.2 Zinc alloys

Zinc alloys shall only be used for gas-carrying parts of valves up to DN 50 with maximum working pressures up to 200 mbar if of quality ZnAl4 to ISO 301:1981 and if the parts do not exceed a temperature of 80 °C. Where the main inlet or outlet threaded connections are made of zinc alloys, threads shall be external and conform to ISO 228-1:2000.

6.2.3 Housing

Parts of the housing which directly or indirectly separate a gas-carrying compartment from atmosphere shall either be made from metallic materials, or shall be such that, on removal or fracture of non-metallic parts other than O-rings, gaskets, seals and diaphragms, no more than 30 dm^3/h of air escapes at the maximum working pressure, when tested to 8.7.2.2.

6.2.4 Closure members

Closure members of valves above DN 25 shall either have a mechanical support (e.g. metallic) to withstand the sealing force or shall be made of metal.

This requirement also applies to:

— all valves with a maximum working pressure above 150 mbar;

— parts transmitting the closing force.

6.2.5 Springs providing closing force and sealing force

Closing force and sealing force shall be provided by spring action. Springs providing the closing and sealing forces shall be designed for oscillating loads and for fatigue resistance. Springs with wire diameter up to and including 2,5 mm shall be made from corrosion-resistant materials.

Springs with wire diameter above 2,5 mm shall either be made from corrosion-resistant materials or shall be protected against corrosion.

6.2.6 Resistance to corrosion and surface protection

All parts in contact with gas or atmosphere, and springs other than those covered by 6.2.5, shall either be made from corrosion-resistant materials or shall be suitably protected. The corrosion protection for springs and other moving parts shall not be impaired by any movement.

6.2.7 Impregnation

Where impregnation is part of the manufacturing process, it shall be carried out using an appropriate procedure, (e.g. vacuum or internal pressure, using appropriate sealing materials).

6.3 Gas connections

6.3.1 General

Valves above DN 80 shall be flanged to ISO 7005.

NOTE In some countries there is a requirement for flanged connections above DN 50.

Equivalent connection sizes are given in Table 1.

Table 1 — Connection sizes

Nominal size	Designation of threads to ISO 7-1:1994 or to ISO 228-1:2000	Nominal size of flanges to ISO 7005	Outside diameter range for tubes for compression fittings
DN	Inches	mm	mm
6	$^1/_8$	6	$2 \leq 5$
8	$^1/_4$	8	$6 \leq 8$
10	$^3/_8$	10	$10 \leq 12$
15	$^1/_2$	15	$14 \leq 16$
20	$^3/_4$	20	$18 \leq 22$
25	1	25	$25 \leq 28$
32	$1^1/_4$	32	$30 \leq 32$
40	$1^1/_2$	40	$35 \leq 40$
50	2	50	$42 \leq 50$
65	$2^1/_2$	65	—
80	3	80	—
100	4	100	—
125	5	125	—
150	6	150	—

6.3.2 Threads

6.3.2.1 It shall be possible to make all gas connections using commonly available tools, e.g. by suitable spanner flats on the valve body.

6.3.2.2 Inlet and outlet threads shall be to ISO 7-1:1994 or to ISO 228-1:2000 and shall be chosen from the series given in Table 1.

NOTE Additional information on the use of these threads is given in Annex A.

6.3.2.3 Where connections are made with union joints, either the joints shall be included with the valve or full details shall be supplied if the threads do not conform to ISO 7-1:1994 or ISO 228-1:2000.

6.3.3 Flanges

Where flanges are used on valves above DN 50, they shall be suitable for connection to flanges to ISO 7005, PN 6 or PN 16.

Where flanges are used on valves up to and including DN 50 which are not suitable for connection to flanges to ISO 7005, either suitable adapters shall be supplied to enable connection to standard flanges and threads, or full details of mating parts shall be supplied.

6.3.4 Compression fittings

Compression fittings shall be suitable for use with tubes of outside diameter to ISO 274:1975, Table 2. It shall not be necessary to form the tubes before making connections. Olives shall be appropriate to the tubes for which they are intended. Non-symmetrical olives may be used provided they cannot be fitted incorrectly.

6.4 Seals for glands for moving parts

Seals for moving parts that pass through the body to atmosphere and seals for the closure member shall be made only of solid, mechanically stable material of a type which does not deform permanently. Sealing paste shall not be used.

Manually adjustable packing glands shall not be used for sealing moving parts.

NOTE An adjustable gland set by the manufacturer and protected against further adjustment is considered to be non-adjustable.

Bellows shall not be used as the sole sealing element against atmosphere.

6.5 Pressure test points

Pressure test points shall have an external diameter of $(9\,^{0}_{-0,5})$ mm and a useful length of at least 10 mm for connection to tubing. The equivalent diameter of the bore shall not exceed 1 mm.

6.6 Strainers

6.6.1 Where an inlet strainer is fitted to class A, B, C, D and E valves, the maximum strainer hole dimension shall not exceed 1,5 mm and it shall prevent the passage of a 1 mm diameter pin gauge.

Class J valves shall incorporate an inlet strainer. The maximum strainer hole dimension shall not exceed 0,28 mm and it shall prevent the passage of a 0,2 mm diameter pin gauge.

Where an inlet strainer is not fitted to a valve, the installation instructions shall include relevant information on the use and installation of a strainer conforming to the above requirements, to prevent the ingress of foreign matter.

6.6.2 Strainers fitted to valves of DN 25 and above shall be accessible for cleaning or replacement without removing the valve body from the pipework.

6.7 Pneumatic and hydraulic actuating mechanisms

Pneumatically or hydraulically actuated valves shall be provided with protection to ensure that the blockage of an orifice in the control system does not adversely affect the ability of the valve to close.

6.8 Electrical equipment

6.8.1 Electrical equipment shall conform to clause 9 of EN 60730-1:1995.

6.8.2 Insulating materials, live parts and non-detachable connections shall conform to 11.1 of EN 60730-1:1995.

6.8.3 Protection against electric shock shall be in accordance with clause 8 and 11.2 of EN 60730-1:1995.

6.8.4 The degree of protection shall be declared by the manufacturer in accordance with EN 60529:1991.

6.8.5 Inlet openings shall conform to 11.9 of EN 60730-1:1995.

6.8.6 Any creepage or clearance distances that could cause unsafe operation of the valve shall meet the requirements of 20.1 and 20.2 of EN 60730-1:1995.

6.8.7 Safety-related electronic circuits shall conform to Annex H of EN 60730-1:1995.

6.8.8 Terminals and connections shall be declared by the manufacturer to conform to clause 10 of EN 60730-1:1995.

6.8.9 Insulation resistance and electric strength shall be in accordance with 13.1 and 13.2 of EN 60730-1:1995.

These tests shall be carried out after the humidity test in 8.12.7 of this standard.

6.8.10 Switches shall conform to EN 61058-1:1992. The number of operating cycles shall be in accordance with Table 6 of EN 61058-1:1992.

6.8.11 Valves supplied with an assembled electrical plug connector in accordance with ISO 6952:1994 or ISO 4400:1994 shall have connections to the following pins and to earth:

— *Single step valves*

PE	earth contact
Pin 1	N
Pin 2	L

— *Two step valves*

Pin 4 (e)	earth contact
Pin 1	N
Pin 2	L step 1
Pin 3	L step 2

— *Closed position indicators*

Pin 4 (e)	earth contact
Pin 1	common
Pin 2	open valve
Pin 3	closed valve

6.8.12 Valves shall meet the following EMC requirements:

— 19.101.2 of EN 50165:1997. For interruptions and decreases up to and including 20 ms, the valve shall conform to the functional requirements of this standard and shall not show any significant change in flow. For interruptions and decreases exceeding 20 ms, the valve shall operate safely.

— 19.101.4 to 19.101.8 of EN 50165:1997. At level 2, the valve shall not be influenced and shall conform to the functional requirements of this standard. At level 3, the valve shall not show any unspecified functional behaviour and shall be able to shut off the flow of gas.

NOTE Valves should additionally meet the following EMC emission requirements where applicable:

Valves intended to be operated within household appliances: EN 55014-1:2000 and EN 55014-2:1997;

Valves intended to be operated within industrial appliances: EN 55011:1998.

6.9 Power-saving circuits

Valves with power-saving circuits shall be designed such that any fault in the power-saving circuit does not affect the correct closing of the valve.

If the power-saving circuit has been reviewed in accordance with EN 60730-1:1995 on a second fault analysis the test under 8.14 does not apply.

7 Performance requirements

1.1 General

Valves shall close automatically when de-energized or in the absence of actuating energy.

They shall operate correctly under all combinations of the following:

— the full range of working pressures;

— the ambient temperature range from 0 °C to 60 °C or wider limits, if declared by the manufacturer;

— the voltage or current range from 85 % to 110 % of the rated value or from 85 % of the minimum rated value to 110 % of the maximum rated value.

The electrical control valve of pneumatic or hydraulic actuating mechanisms shall also meet these requirements.

The closing of pneumatically or hydraulically actuated valves shall be ensured over the range from 85 % to 110 % of the actuating pressure or pressure range declared by the manufacturer.

7.2 Mounting position

Valves shall operate correctly in all mounting positions declared by the manufacturer.

7.3 Closing function

Valves shall close automatically on reducing the voltage or current to 15 % of the minimum rated value.

Valves with pneumatic or hydraulic actuating mechanisms shall close automatically on reducing the voltage or current to 15 % of the minimum rated voltage of the control valve.

Valves shall close automatically on removal of the voltage or current of between 15 % of the minimum rated value and 110 % of the maximum rated value.

In all cases, the closing time shall be in accordance with 7.6.

7.4 Closing force

Valves with sealing force independent of the closing force (e.g. ball, guillotine valves etc.) shall have a closing force of:

— at least 5 times the value of the frictional force where the frictional force is up to and including 5 N;

— at least 2,5 times the value of the frictional force but at least 25 N where the frictional force is above 5 N.

The frictional force is measured in the ungreased condition.

This requirement also applies to disc-on-seat valves with a working pressure of 500 mbar and above.

7.5 Delay time and opening time

The delay time and the opening time shall be:

— within ±20 % of the manufacturer's declared value for times above 1 s;

— less than 1 s for declared times up to and including 1 s.

7.6 Closing time

7.6.1 Closing time for safety shut-down

The closing time for valves of classes A, B, C and E shall not exceed 1 s when tested to 8.6.

The closing time for class D valves shall not exceed the manufacturer's declared value.

The closing time for class J valves shall not exceed 5 s or any lower value declared by the manufacturer.

7.6.2 Closing time for controlling function

The closing time for any controlling function shall be within ±10 % of the manufacturer's declared value.

7.7 Leak-tightness

Valves shall be leak-tight. They are considered to be leak-tight if the leakage rates given in Table 2 are not exceeded when tested to 8.7.2.1 and 8.7.3.

Table 2 — Maximum leakage rates

Nominal inlet size DN	**Maximum leakage rates** (in cm^3/h of air)	
	Internal leak-tightness	**External leak-tightness**
DN < 10	20	20
10 ≤DN ≤ 25	40	40
25 <DN ≤ 80	60	60
80 <DN ≤ 150	100	60
150 <DN	150	60

Closure parts (see 6.1.5) shall remain leak-tight after dismantling and reassembly.

7.8 Sealing force

Class A, B and C valves shall have a minimum sealing force over the closure member orifice area in accordance with Table 3.

Table 3 — Sealing force requirements

Valve	Test pressure mbar	Maximum leakage rate
Class A	150	see values in Table 2
Class B	50	for internal
Class C	10	leak-tightness

Class E valves shall have a minimum sealing force over the closure member orifice area equivalent to a pressure of 1,5 times the maximum working pressure or at least 150 mbar in excess of the maximum working pressure, whichever is the greater. The internal leakage shall not exceed the values given in Table 2.

Class J valves shall have a minimum sealing force of 1 Newton for every metre length of seal. This is calculated from the spring force in the closed position of the valve divided by the circumference or length of the seal. The spring compression shall be declared by the manufacturer.

Valves which use the inlet pressure to compensate the force to the closure member can be class A, B or C valves. Valves where the compensation area is greater than the closing member area shall be classified as E valve.

Where the test methods of 8.8 are unsuitable for some designs of valve (e.g. valves with compensation of inlet pressure), the sealing force shall be verified by calculation or by a combined method of test and calculation. The minimum sealing force is calculated using pressures equal to 1,25 times the values given in Table 3, as appropriate to the class of valve.

7.9 Torsion and bending

7.9.1 General

Valves shall be constructed in such a way that they have adequate strength to withstand likely mechanical stress to which they may be subjected during installation and service. After testing, there shall be no permanent deformation, and any leakage shall not exceed the values specified in Table 2 for internal and external leakage.

7.9.2 Torsion — group 1 and group 2 valves with threaded connections

Valves shall be subjected to the torque given in Table 4 in accordance with 8.9.2.

7.9.3 Torsion — group 1 and group 2 valves with compression joints

Valves shall be subjected to the torque given in Table 4 in accordance with 8.9.3.

7.9.4 Bending — group 1 and group 2 valves

Valves shall be subjected to the bending moment given in Table 4 in accordance with 8.9.4.1. Group 1 valves shall additionally be tested to 8.9.4.2.

Table 4 — Torque and bending moment

Nominal size DN[1)]	Torque N·m	Bending moment N·m		
	Group 1 and 2	Group 1		Group 2
	10 s	10 s	900 s	10 s
6	15	15	7	25
8	20	20	10	35
10	35	35	20	70
15	50	70	40	105
20	85	90	50	225
25	125	160	80	340
32	160	260	130	475
40	200	350	175	610
50	250[2)]	520	260	1 100
65	325[2)]	630	315	1 600
80	400[2)]	780	390	2 400
100	—	950	475	5 000
125	—	1 000	500	6 000
≥ 150	—	1 100	550	7 600

1) Equivalent connection sizes are given in Table 1.

2) Not applicable for valves with flanges

7.10 Rated flow rate

7.10.1 The maximum flow rate when measured according to 8.10 shall be at least 0,95 times the rated flow rate.

7.10.2 Where the manufacturer declares opening and closing characteristics for valves with modulating control, these shall be within ±10 % of the manufacturer's declared value.

7.10.3 For valves with step control, where applicable, the manufacturer shall declare the maximum flow rate for each step as a percentage of the fully open flow rate. It shall not be possible to adjust the maximum flow rate for each step in excess of 1,1 times the declared value when tested to 8.10.

7.10.4 When the flow rate changes in response to external electrical signals, it shall not, when tested to 8.10, overshoot in either direction while attaining the new flow rate by more than 20 % of the flow rate at that particular set point, or as declared by the manufacturer.

7.11 Closed position indicator switches

A closed position indicator switch shall indicate the closed position of the valve. The switch shall indicate closure when either:

— the flow rate is equal to or less than 10% of the equivalent fully open flow rate at the same pressure difference; or

— the closure member is within 1 mm of its closed position.

7.12 Durability

7.12.1 Elastomers in contact with gas

7.12.1.1 General

Elastomers in contact with gas (e.g. valve seals, O-rings, diaphragms and lip seals) shall be homogeneous, free from porosity, inclusions, grit, blisters and other surface imperfections visible with the naked eye.

7.12.1.2 Resistance to lubricants

The resistance to lubricants of elastomers shall be checked by an immersion test in test oil No. 2 carried out according to 8.12.1.2. After this test, the change of mass shall be between –10 % and +10 %.

7.12.1.3 Resistance to gas

The resistance to gas of elastomers shall be checked by an immersion test using *n*-pentane (minimum 98 % by mass of *n*-pentane, estimated by gas chromatography) carried out according to 8.12.1.3. After this test, the change of mass shall be between –15 % and +5 %.

7.12.2 Marking

Adhesive labels and all marking shall be resistant to abrasion, humidity and temperature and shall neither lift nor discolour such that the marking becomes illegible.

This requirement shall be verified by the test described in 8.12.2.

Parts or assemblies intended by the manufacturer to be service exchangeable shall be clearly identified.

7.12.3 Endurance

After the endurance test described in 8.12.3 the valve shall conform to the requirements of 6.2.5, 7.3, 7.5, 7.6, 7.7, 7.8 and 7.11.

For any setting according to 7.10.2, 7.10.3 and 7.10.4 within the manufacturer's declared adjustment range, the flow rate at the end of the endurance test described in 8.12.3 shall be within ±10 % of the flow rate before the endurance test, when measured under the same conditions according to 8.10.

7.12.4 Resistance to scratching

Surfaces exclusively protected with paint shall withstand the scratch test of 8.12.6 before and after the humidity test of 8.12.7 without the ball penetrating the protective coating to expose bare metal.

7.12.5 Resistance to humidity

All parts including those with protected surfaces, (e.g. coated with paint or plating) shall withstand the humidity test of 8.12.7 without any signs of corrosion, lifting or blistering visible with the naked eye.

8 Methods of test

8.1 Test conditions

Unless otherwise specified, carry out all tests using air at (20 ± 5) °C at an ambient temperature of (20 ± 5) °C.

Correct all measured values to the following reference conditions:

15 °C, 1 013,25 mbar, dry.

8.2 Mounting position

Carry out all tests in the mounting position declared by the manufacturer. Where there are several declared mounting positions, carry out tests in the least favourable position.

8.3 Closing function

Energize the valve at the maximum rated voltage or current and at the maximum actuating pressure, if applicable. Slowly reduce the voltage or current to 15 % of the minimum rated value. Verify that the valve has closed.

Energize the valve at the maximum rated voltage or current and at the maximum actuating pressure, if applicable. Increase the voltage or current to 110 % of the maximum rated value, keeping the actuating pressure, if any, unchanged. De-energize the valve and verify that it has closed. For a.c. valves, remove the voltage at the peak of the current waveform.

Energize the valve at the maximum rated voltage or current and at the maximum actuating pressure, if applicable. Reduce the voltage or current to a value between 15 % of the minimum rated value and 85 % of the maximum rated value, keeping the actuating pressure, if any, unchanged. De-energize the valve and verify that it has closed. Carry out this test at 3 different voltages or currents between 15 % of the minimum rated value and 85 % of the maximum rated value.

8.4 Closing force

This measurement is carried out in the ungreased condition.

Measure the minimum closing force over the travel of the closure member from the open position to the closed position.

Remove the spring(s) providing the closing force from the valve and measure the maximum force required to move the closure member from the open position to the closed position.

8.5 Delay time and opening time

Measure the time interval between energizing the valve and the start of the release of the closure member.

Measure the time interval between energizing the valve and the attainment of a flow rate equal to 80 % of the rated flow rate.

Carry out the tests under the following conditions, allowing the de-energized valve to reach thermal equilibrium before carrying out the tests:

— at 60 °C (or at the maximum ambient temperature, if higher), at the maximum working pressure, at 110 % of the maximum rated voltage or current and at the maximum actuating pressure, if applicable;

— at 0 °C (or at the minimum ambient temperature, if lower), at a working pressure of 6 mbar, at 85 % of the minimum rated voltage or current and at the minimum actuating pressure, if applicable.

8.6 Closing time

Measure the time interval between de-energizing the valve and the closure member attaining the closed position, under the following conditions:

— at the maximum working pressure, at a pressure difference declared by the manufacturer, at 110 % of the maximum rated voltage or current and at the maximum actuating pressure, if applicable;

— at a working pressure of 6 mbar, at the minimum pressure difference declared by the manufacturer, at 110 % of the maximum rated voltage or current and at the maximum actuating pressure, if applicable.

8.7 Leak-tightness

8.7.1 General

Use a method that gives reproducible results, for example:

— the method in Annex B (volumetric method) for test pressures up to and including 150 mbar;

— the method in Annex C (pressure loss method) for test pressures above 150 mbar.

The limits of error of the apparatus used shall be ± 1 cm^3 and $\pm 0{,}1$ mbar.

The accuracy of measurement of leakage rates shall be within ± 5 cm^3/h.

Carry out the tests with an initial test pressure of 6 mbar and repeat the tests at 1,5 times the maximum working pressure or 150 mbar, whichever is the greater.

Where the valve is suitable for use with 3rd family gases with nominal working pressures of 112 mbar or 148 mbar, use a test pressure of at least 220 mbar.

An equation to convert from the pressure loss method to the volumetric method is given in Annex D.

8.7.2 External leak-tightness

8.7.2.1 Complete valve

Pressurize the inlet and outlet of the valve to the test pressures given in 8.7.1 and measure the leakage rate.

Dismantle and reassemble closure parts five times according to the manufacturer's instructions and repeat the test.

8.7.2.2 Valve after removal of non-metallic parts

Remove all non-metallic parts of the housing which separate a gas-carrying compartment from atmosphere, excluding O-rings, seals, gaskets and diaphragms. Pressurize the inlet and outlet of the valve to the maximum working pressure and verify that the leakage rate is in accordance with 6.2.3.

8.7.3 Internal leak-tightness

With the closure member in the closed position, pressurize the inlet of the valve in the direction of gas flow indicated, to the test pressures given in 8.7.1 and measure the leakage rate.

8.8 Sealing force

8.8.1 Class A, B, C and E valves

8.8.1.1 General

Connect an air supply through a flow meter to either the inlet or the outlet of the valve such that the air pressure opposes the closing direction of the closure member.

Energize and de-energize the valve twice.

8.8.1.2 Class A, B and C valves

Pressurize the valve at an increasing pressure not exceeding 1 mbar/s to the appropriate pressure given in Table 3 and measure the leakage rate.

8.8.1.3 Class E valves

Pressurize the valve at an increasing pressure not exceeding 1 mbar/s to 1,5 times the maximum working pressure or 150 mbar in excess of the maximum working pressure, whichever is the greater and measure the leakage rate.

8.8.2 Class J valves

Remove the spring(s) providing the sealing force and measure the spring force at a spring compression corresponding to the closed position of the valve.

8.9 Torsion and bending

8.9.1 General — threaded and flanged connections

Use pipes in accordance with ISO 65:1981, medium series with a length of:

— at least 40 × DN for valves up to and including DN 50;

— at least 300 mm for valves above DN 50.

Use only non-hardening sealing paste on connections.

Determine the appropriate tightening torque to be applied to flange bolts to ISO 7005 from the values in Table 5.

Table 5 — Tightening torque for flange bolts

Nominal size DN	6	8	10	15	20	25	32	40	50	65	80	100	125	≥150
Torque N·m	20	20	30	30	30	30	50	50	50	50	50	80	160	160

Test the valve for external leak-tightness to 8.7.2 and internal leak-tightness to 8.7.3 before carrying out torsion and bending tests.

If the inlet and outlet connections are not on a common axis, repeat the tests with the connections reversed.

8.9.2 Ten second torsion test — group 1 and group 2 valves with threaded connections

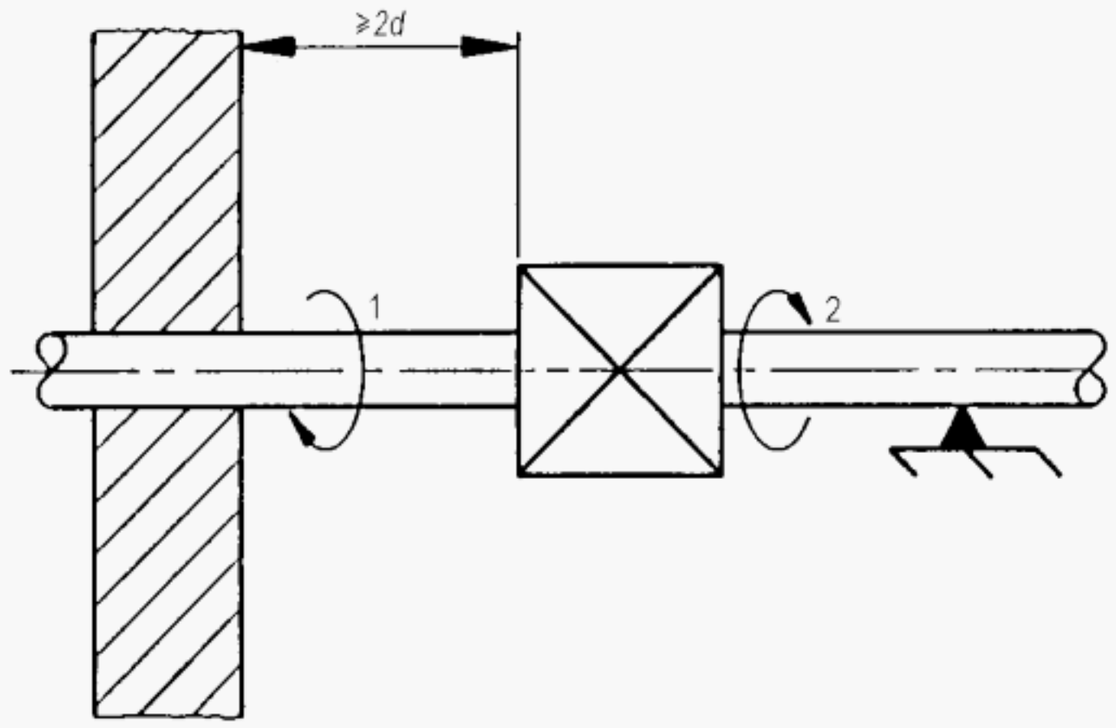
Screw pipe 1 into the valve with a torque not exceeding the values given in Table 4. Clamp pipe 1 at a distance at least 2d from the valve (see Figure 1).

Screw pipe 2 into the valve with a torque not exceeding the values given in Table 4. Ensure that all joints are leak-tight.

Support pipe 2 such that no bending moment is applied to the valve.

Progressively apply the appropriate torque to pipe 2 for 10 s without exceeding the values given in Table 4. Apply the last 10 % of the torque over a period not exceeding 1 min.

Remove the torque and visually inspect the assembly for any deformation, then test the valve for external leak-tightness to 8.7.2 and internal leak-tightness to 8.7.3.



Key

d = external diameter

Figure 1 — Torsion test assembly

8.9.3 Ten second torsion test — group 1 and group 2 valves with compression joints

8.9.3.1 Olive-type compression joints

Use a steel tube with a new brass olive of the appropriate size.

Clamp the valve body rigidly and apply the test torque given in Table 4 to every tubing nut in turn for 10 s.

Visually inspect the valve for deformation, discounting any deformation of the olive seating or mating surfaces consistent with the applied torque. Test the valve for external leak-tightness to 8.7.2 and internal leak-tightness to 8.7.3.

8.9.3.2 Flared compression joints

Use a short length of steel tube with a flared end and follow the method given in 8.9.3.1, discounting any deformation of the cone seating or mating surfaces consistent with the applied torque.

8.9.4 Bending moment tests

8.9.4.1 Ten second bending moment test — group 1 and group 2 valves

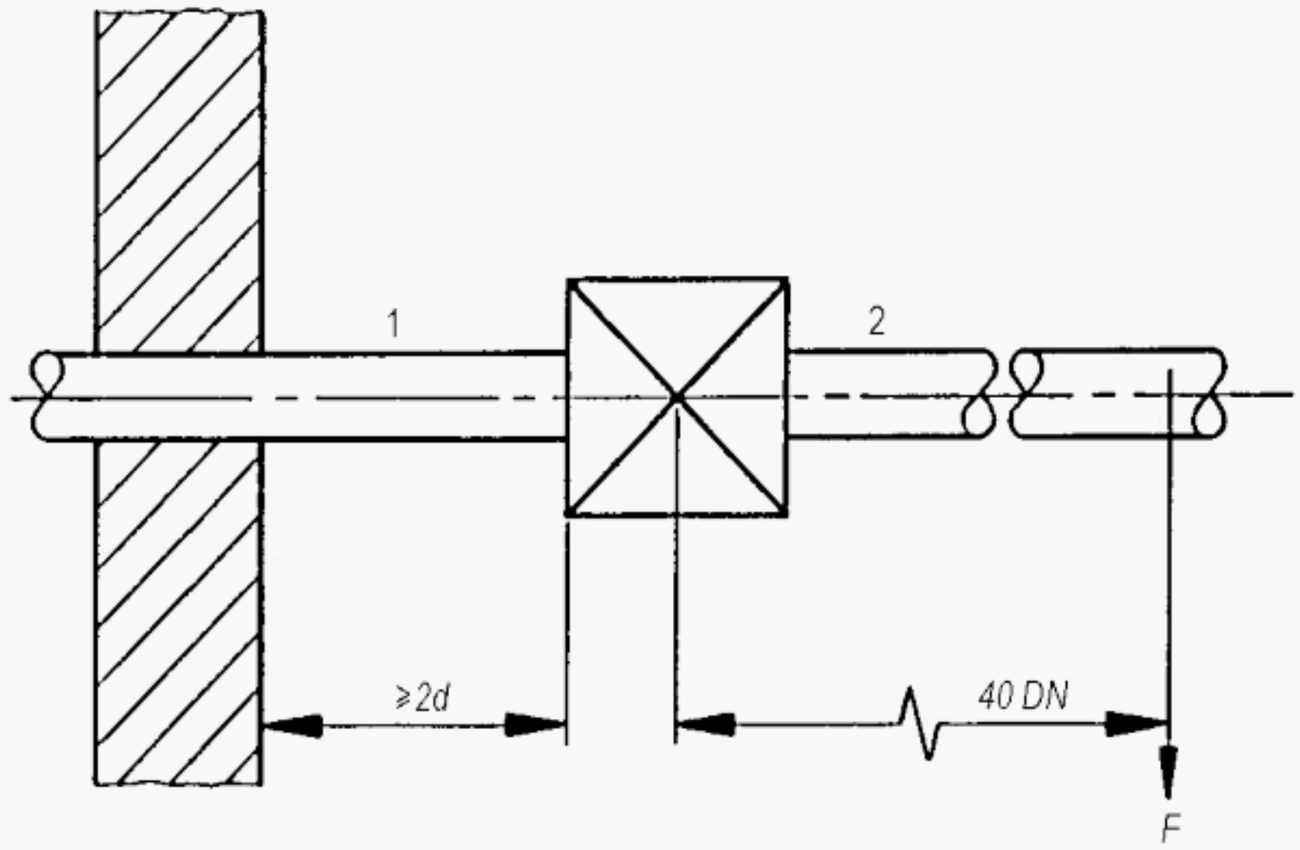
Use the same valve as for the torsion test and the assembly as shown in Figure 2.

Apply the force for the required bending moment for a group 1 or group 2 valve given in Table 4 for 10 s, taking the mass of the pipe into consideration. Apply the force:

— for valves up to and including DN 50, 40 × DN from the centre of the valve;

— for valves above DN 50, at least 300 mm from the valve connection.

Remove the force and visually inspect the assembly for any deformation, then test the valve for external leak-tightness to 8.7.2 and internal leak-tightness to 8.7.3.



Key

d = external diameter

Figure 2 — Bending moment test assembly

8.9.4.2 900 second bending moment test — group 1 valves only

Use the same valve as for the torsion test and the assembly as shown in Figure 2.

Apply the force for the required bending moment for a group 1 valve given in Table 4 for 900 s, taking the mass of the pipe into consideration. Apply the force:

— for valves up to and including DN 50, 40 × DN from the centre of the valve;

— for valves above DN 50, at least 300 mm from the valve connection.

With the force still applied, test the assembly for external leak-tightness to 8.7.2 and for internal leak-tightness to 8.7.3.

8.10 Rated flow rate

8.10.1 Apparatus

Carry out the test using the apparatus shown in Figure 3. The accuracy of measurement shall be at least ±2 %.

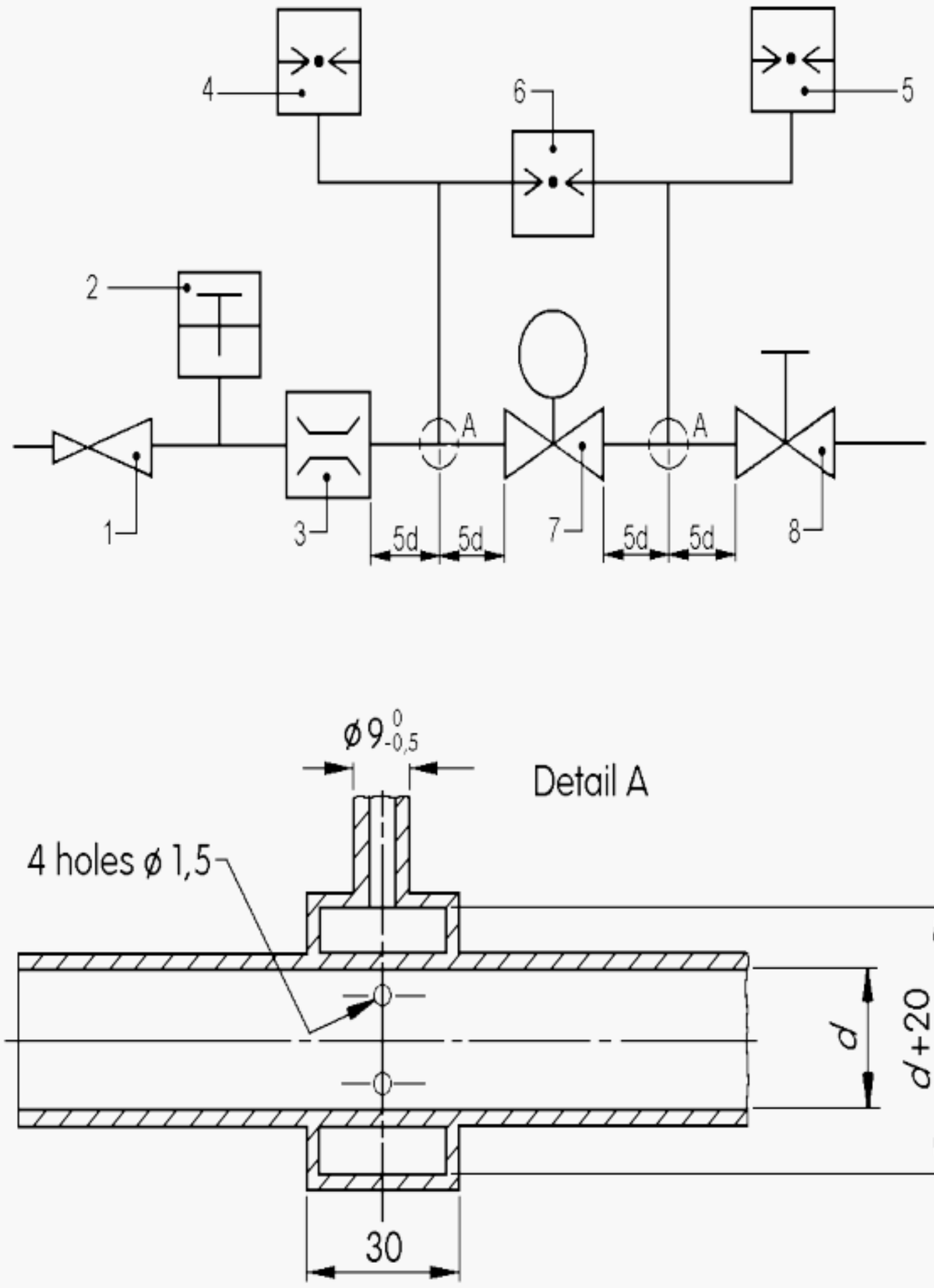
8.10.2 Test procedure

Energize and adjust the valve according to the manufacturer’s instructions.

Adjust the airflow rate, keeping the inlet pressure constant to provide the manufacturer's declared pressure difference.

8.10.3 Characteristics for valves with modulating control

Verify the declared opening and closing characteristics at rated voltage or current before and after the endurance test for conformity with 7.10.2.



Key

1 Adjustable governor for inlet pressure
2 Thermometer
3 Flow meter
4 Inlet pressure gauge
5 Outlet pressure gauge
6 Differential pressure gauge
7 Valve under test
8 Manual control tap

Size DN	d mm
6	6
8	9
10	13
15	16
20	22
25	28
32	35
40	41
50	52
65	67
80	82
100	106
125	131
150	159

Figure 3 — Flow rate test apparatus

8.10.4 Conversion of air flow rate

Use the following equation for conversion of flow rate to reference conditions:

$$q_n = q\left[\frac{p_a + p}{1013{,}25} \times \frac{288{,}15}{273{,}15 + t}\right]^{1/2}$$

where

q_n is the corrected air flow rate at reference conditions in cubic meters per hour (m^3/h);

q is the measured air flow rate in cubic meters per hour (m^3/h);

p is the test pressure in millibars (mbar);

p_a is the atmospheric pressure millibars (mbar);

t is the air temperature in degrees Celsius (°C).

8.11 Closed position indicator switches

Modify a single valve to enable the closure member to be moved and positioned in any partially open position. Slowly move the closure member until the switch just indicates valve closure. Test the valve for flow or distance open, as appropriate, in accordance with 7.11.

8.12 Durability

8.12.1 Elastomers in contact with gas

8.12.1.1 General

Carry out the tests with the finished component or with parts of the finished component.

8.12.1.2 Resistance to lubricants

Carry out the test according to 8.2 of ISO 1817:1999 using the gravimetric method, but with a duration of immersion of (168 ± 2) h in oil No. 2 at the maximum declared ambient temperature of the valve.

Determine the relative change of mass, Δm, using the following equation:

$$\Delta m = \frac{m_3 - m_1}{m_1} \times 100$$

where

m_1 is the initial mass of the test piece in air;

m_3 is the mass of the test piece in air after immersion.

8.12.1.3 Resistance to gas

Carry out the test according to 8.2 of ISO 1817:1999 using the gravimetric method and clause 9 using the method of determination of extracted soluble matter, but with a duration of immersion of (72 ± 2) h at (23 ± 2) °C in *n*-pentane (normal pentane).

Dry the test pieces for a period of (168 ± 2) h in an oven at (40 ± 2) °C at atmospheric pressure.

Determine the relative change of mass, Δm, using the following equation:

$$\Delta m = \frac{m_5 - m_1}{m_1} \times 100$$

where

m_1 is the initial mass of the test piece in air;

m_5 is the mass of the test piece in air after drying.

8.12.2 Marking

Carry out the tests according to the methods given in EN 60730-1:1995, Annex A.

8.12.3 Endurance

Carry out tests for external leak-tightness to 8.7.2 and internal leak-tightness to 8.7.3, before the endurance test, after the test at 60 °C and after the test at 20 °C.

Install the valve in a temperature-controlled chamber according to the manufacturer's instructions.

Energize the valve at 1,1 times the maximum rated voltage or current at maximum ambient temperature for a period of at least 24 h under no flow conditions. Without de-energizing the valve, slowly reduce the voltage or current to 15 % of the minimum rated value. Verify that the valve has closed.

Connect the gas inlet to an air supply at the maximum working pressure. Do not exceed 10 % of the maximum rated flow rate.

Operate the valve to the number of cycles given in Table 6 with a cycle period of no less than that declared by the manufacturer. Ensure that the valve travels to the fully open and fully closed position during each cycle.

Carry out the part of the endurance test at maximum ambient temperature, at the maximum rated voltage or current.

For the test at 20 °C, carry out 50 % of the cycles at the maximum rated voltage or current and 50 % at the minimum rated voltage or current.

If the minimum ambient temperature is below 0 °C, carry out the following endurance test at the minimum rated voltage or current:

— for valves up to and including DN 150, carry out 25 000 cycles at −15 °C. Reduce the number of cycles for the test at 20 °C by 25 000 cycles;

— for valves above DN 150, carry out 5 000 cycles at −15 °C. Reduce the number of cycles for the test at 20 °C by 5 000 cycles.

Where the valve has a pneumatic or hydraulic actuating mechanism, carry out the endurance test at the maximum actuating pressure.

Check the operation of the valve throughout the endurance test, for example by recording the outlet pressure or the flow rate.

Finally, re-test the valve to 8.3.

Table 6 — Operating cycles

Nominal size DN	Number of cycles at:	
	Maximum ambient temperature — at least (60 ± 5) °C	(20 ± 5) °C
DN ≤ 25 Opening time ≤ 1 s maximum working pressure ≤ 150 mbar	100 000	400 000
DN ≤ 25 Opening time ≤ 1 s maximum working pressure >150 mbar	50 000	150 000
DN ≤ 25 Opening time > 1 s	50 000	150 000
≤ DN 80	25 000	75 000
≤ DN 150	25 000	25 000
> DN 150	5 000	20 000

Table 7 — Operating cycles for automatic shut- off valves for cookers according to EN 30-1-1:1998

Nominal size DN	Number of cycles at:	
	Maximum ambient temperature — at least (60 ± 5) °C	(20 ± 5) °C
DN ≤ 25 Opening time ≤ 1 s maximum working pressure ≤ 150 mbar	800 000	200 000

8.12.4 Endurance test for closure switches

Carry out the endurance test described in 8.12.3 on an unmodified valve with the maximum inductive or capacitive load declared by the manufacturer on the closed position indicator switch.

During the test, monitor the switch to show that it indicates that the valve is closed when it is de-energized and open when energized.

After the endurance test, carry out the test for indication of closure according to 8.11.

Where the switch has not been pretested, carry out electrical tests in accordance with the methods given in EN 61058-1:1992.

8.12.5 Flow characteristics

8.12.5.1 Valves with modulating control

In addition to 8.12.3, test the valve for opening to the lowest set point as declared by the manufacturer and to the mid-point in the closing direction.

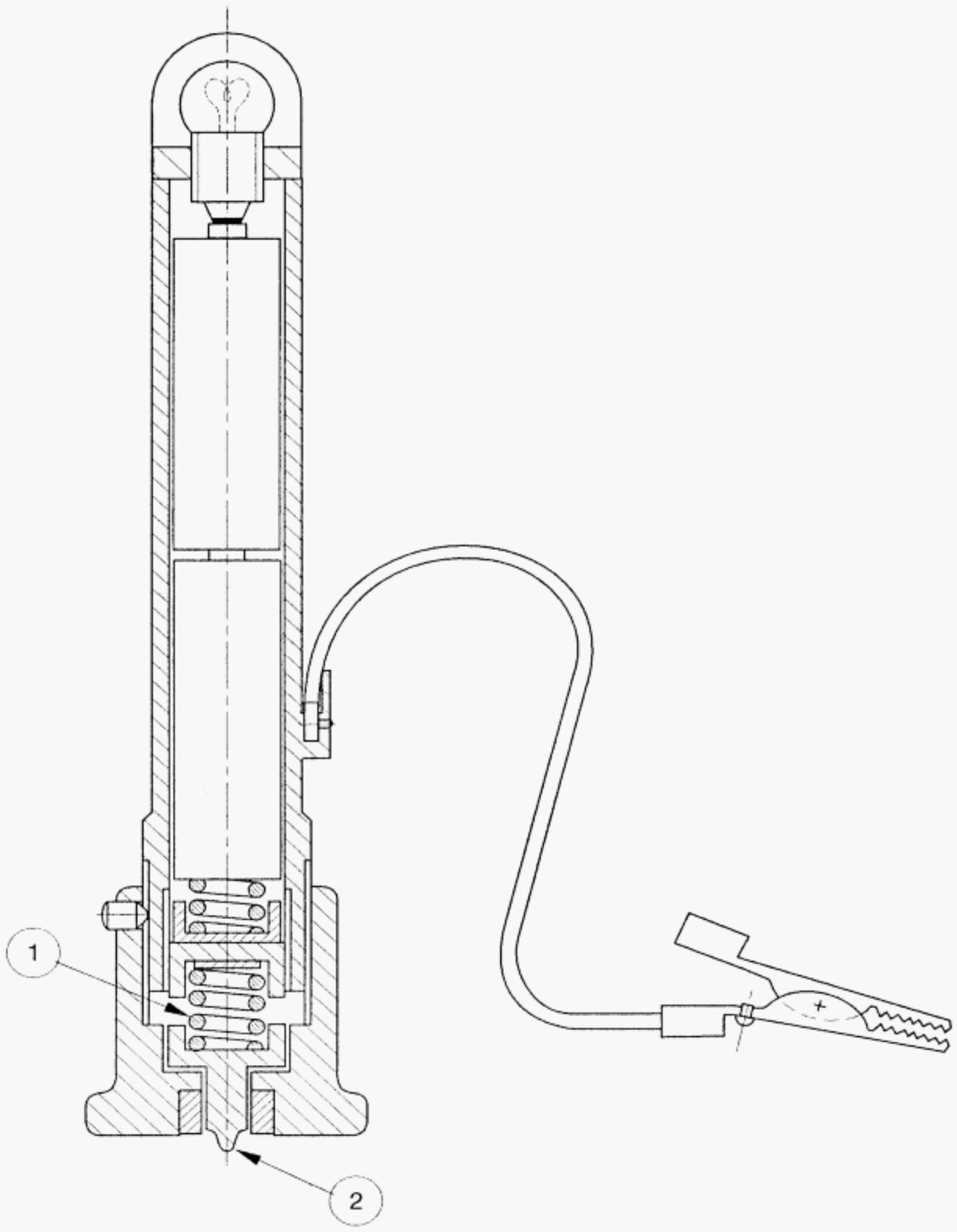
8.12.5.2 Valves with step control

In addition to 8.12.3, test the valve for opening and/or closing to the mid-point of the adjustment range for each step.

8.12.6 Scratch test

Draw a 1 mm diameter fixed steel ball across the surface of the valve at a speed of 30 mm/s to 40 mm/s with a contact force of 10 N (see Figure 4).

Repeat the scratch test after the humidity test.



Key

1 Spring loading = 10 N

2 Scratching point (Ø 1 mm steel ball)

Figure 4 — Scratch test apparatus

8.12.7 Humidity test

Place the valve in a chamber at an ambient temperature of (40 ± 2) °C with a relative humidity exceeding 95 % for 48 h. Remove the valve from the chamber and examine it with the naked eye for signs of corrosion, lifting or blistering of the coated surface. Leave the valve for a further 24 h at (20 ± 5) °C and carry out another examination.

8.13 Electrical equipment tests

The tests shall be carried out in accordance with the relevant electrical standards.

For EMC immunity tests, determine the influence of supply voltage interruptions by monitoring any change of flow through the valve at minimum inlet pressure.

NOTE EMC immunity tests do not have to be performed if a theoretical assessment shows that the components are not susceptible to EMC phenomena.

8.14 Power-saving circuits

Energize the valve at 1,1 times the maximum rated voltage or current at maximum ambient temperature for a period of at least 24 h under no flow conditions with the power saving circuit taken out of function. Without de-energizing the valve, slowly reduce the voltage or current to 15 % of the minimum rated value. Verify that the valve has closed.

The test of power saving circuits with electronic parts shall be carried out according to EN 60730-1:1995.

9 Marking, installation and operating instructions

9.1 Marking

The following information, at least, shall be durably marked on the valve in a clearly visible position:

a) manufacturer and/or trade mark;
b) type reference;
c) class of valve;
d) maximum working pressure in mbar;
e) group 1 (if applicable).

In addition, the valve shall be marked with:

f) direction of gas flow (by a cast or embossed arrow);
g) date of manufacture (at least year), may be in code;
h) marking of the earth connection (if applicable);
i) pressure for external hydraulic or pneumatic actuator in bar (if applicable).

Valves with electrical actuating mechanisms shall additionally be marked with the following:

j) identification of terminals;

k) nature and frequency of supply;

l) rated voltage in V or rated current in A and its related voltage in V;

m) rated load in VA, or in W if above 25 W;

n) degree of protection;

o) symbol of Class II construction for Class II valves (if applicable).

Additional electrically operated devices that are an integral part of the valve, shall be provided with the same information.

9.2 Installation and operating instructions

One set of instructions shall be supplied with each consignment, written in the language(s) of the country into which the valves will be delivered.

They shall include all relevant information on use, installation, operation and servicing, in particular:

a) class of valve (A, B, C, D, E or J);

b) group 1 or 2;

c) rated flow rate at a specified pressure difference;

d) electrical data;

e) ambient temperature range;

f) opening time;

g) closing time (and maximum delay time if applicable);

h) mounting position(s);

i) working pressure range in mbar or in bar;

j) gas connection(s);

k) strainer details;

l) safety class for safety-related electronics;

m) information if usable as automatic shut off valve for cookers according to EN 30.

9.3 Warning notice

A warning notice shall be attached to each consignment of controls. This notice shall state: “Read instructions before use. This control must be installed in accordance with the rules in force”.

Annex A
(informative)

Use of ISO 7-1:1994 and ISO 228-1:2000 threads for gas connections (see 6.3.2.2)

Table A.1

Country	AT	BE	CH	DE	DK	ES	FR	GB	NL
Internal connections inside the appliance									
ISO 7-1:1994 taper/taper	no	—	no	no	no	no	yes	yes	no
ISO 7-1:1994 parallel/taper	yes	—	yes	yes	yes	yes	yes	yes	yes
ISO 228-1:2000	no	—	yes	no	no	no	yes	yes	no
Appliance connections Category I_3									
ISO 7-1:1994 taper/taper	no	—	no	no	no	—	—	yes	no
ISO 7-1:1994 parallel/taper	yes	—	yes	yes	yes	—	—	yes	yes
ISO 228-1:2000	no	—	yes	no	no	—	—	yes	no
Other categories		[1]							
ISO 7-1:1994 taper/taper	no	no	no	no	no	no	no	yes	no
ISO 7-1:1994 parallel/taper	yes	yes	yes	yes	yes	yes	no	yes	yes
ISO 228-1:2000	no	no	yes	no	no	no	yes[2]	yes	no
Installation area		[3]					[4]		
ISO 7-1:1994 taper/taper	no	no	no	no	no	no	no	yes	no
ISO 7-1:1994 parallel/taper	yes	yes	yes	yes	yes	no	no	yes	yes
ISO 228-1:2000	yes	no	yes	yes	no	no	yes	yes	no

[1] Only Category I_2.

[2] G 1/2 for cooking appliances.

[3] Natural gas only.

[4] Installation connected to a distribution system.

Annex B
(informative)

Leak-tightness test — Volumetric method

A.1 Apparatus

The apparatus is shown schematically in Figure B.1, with the dimensions indicated in mm.

The apparatus is made of glass. Taps 1 to 5 are also made of glass, and are spring loaded. The liquid used is water.

The distance *l* between the water level in the constant level bottle and the end of tube G is adjusted so that this height of water corresponds to the test pressure.

The apparatus is installed in a temperature-controlled room.

A.2 Test method

Adjust the pressure of the compressed air at the inlet to tap 1 to the test pressure, by means of pressure regulator F.

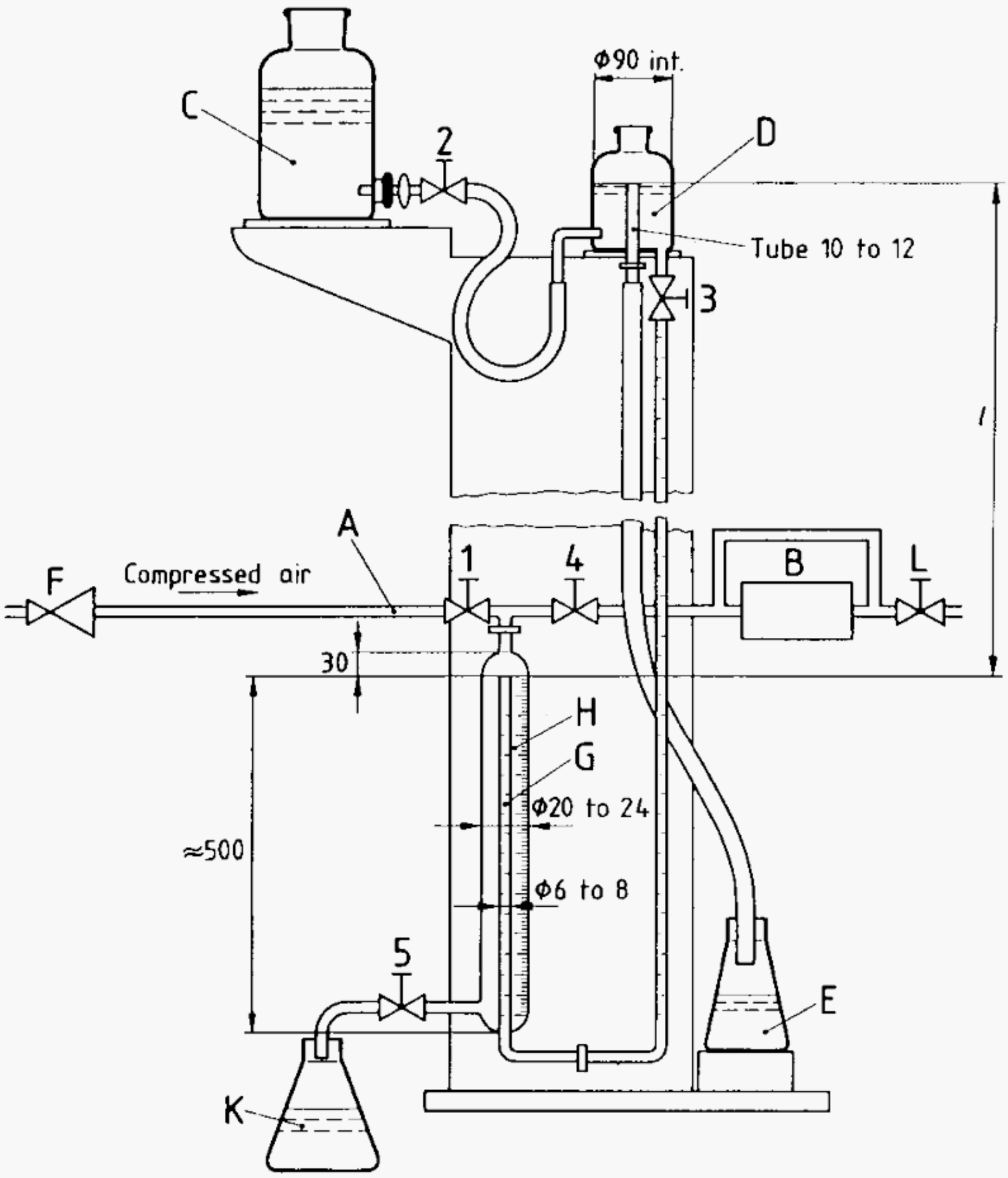
Close taps 1 to 5. Connect the valve under test B to the apparatus. Close outlet valve L.

Open tap 2; close it when the water in the constant level bottle D overflows into the overflow bottle E.

Open taps 1 and 4. Close tap 1 when the measuring burette H and the valve under test B have become pressurized.

Open tap 3. Allow approximately 15 min for the air in the test apparatus and valve under test to reach thermal equilibrium.

Any leakage is shown by water overflowing from tube G into the measuring burette H.



Key

A Inlet
B Test sample
C Water tank
D Constant level bottle
E Overflow bottle
F Regulator
G Pipe
H Measuring burette
K Overflow bottle
L Outlet valve
1 to 5 Manual taps

Figure B.1 — Leak-tightness test apparatus (volumetric method)

Annex C
(informative)

Leak-tightness test — Pressure loss method

A.3 Apparatus

The apparatus is shown schematically in Figure C 1 with the dimensions indicated in mm.

The apparatus consists of a thermally insulated pressure vessel A, which is filled with water such that the volume of air above the water is 1 dm^3. An open-ended glass tube B of internal diameter 5 mm has its lower end in the water in A. This tube is used to measure the pressure loss.

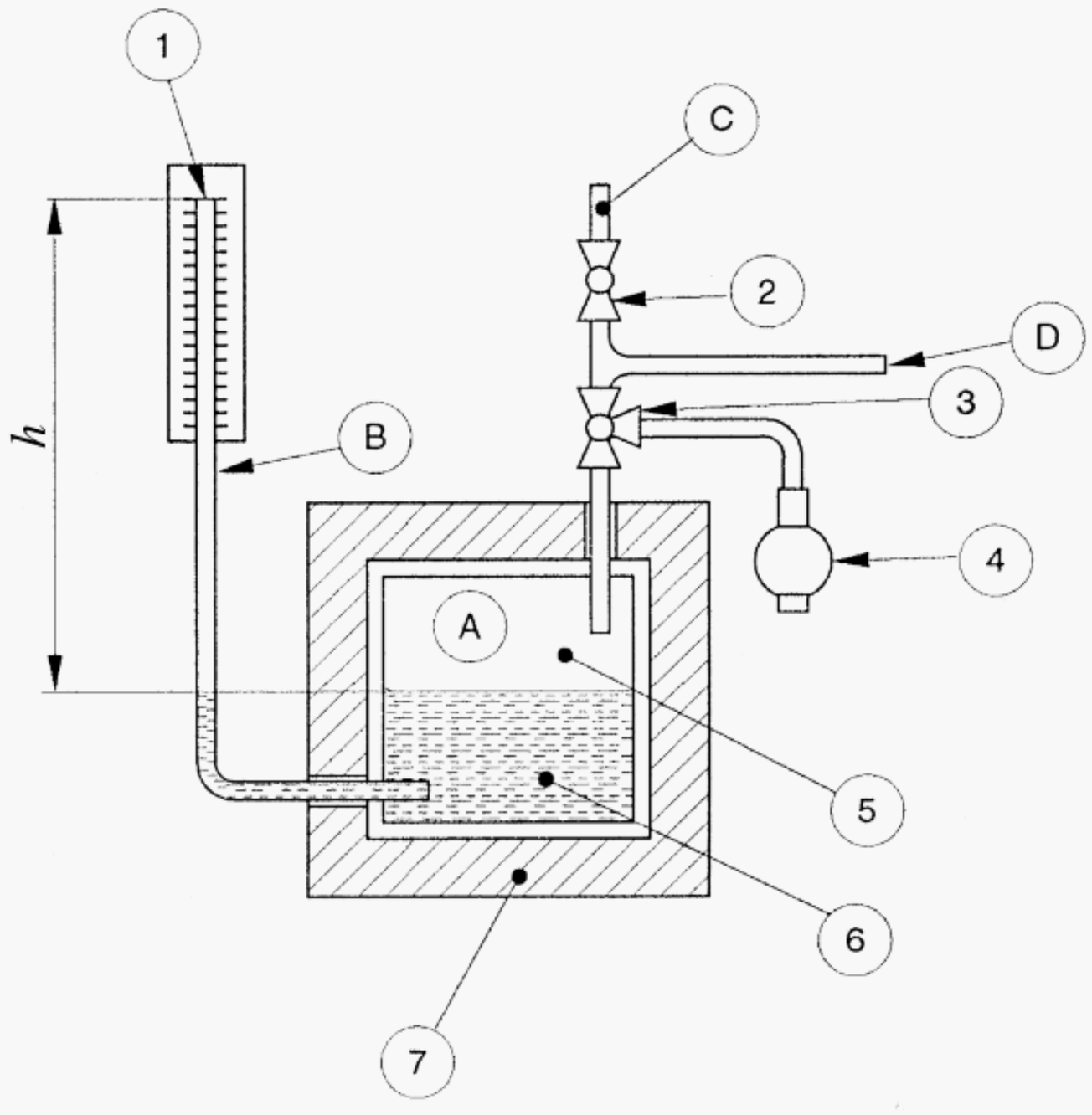
The test pressure is applied to a second tube C, which enters the air chamber of the pressure vessel to which the valve under test is connected by means of a flexible tube of length 1 m and internal diameter 5 mm attached to D.

A.4 Test method

Using a governor, adjust the air pressure through the three-way tap 1 to the test pressure. The rise in water level in the measuring tube B corresponds to the test pressure.

Open the three-way tap 1 to connect the valve under test to A.

Allow 10 min for thermal equilibrium to be established. Wait a further 5 min and read the pressure loss directly from measuring tube B.



Key

1 Scale divided into millimetres
2 Vent
3 Three way tap
4 Air pump
5 1 dm^3 air volume
6 Water
7 Thermal insulation
A Thermally insulated pressure vessel
B Measuring tube
C Pressure tube
D Connection to control under test
h Min. 1 600 mm

Figure C.1 — Leak-tightness test apparatus (pressure loss method)

Annex D

(normative)

Conversion of pressure loss into leakage rate

The following equation is used to calculate the leakage rate (e.g. in cm^3/h) from the pressure loss.

$$q_L = 11{,}85 \times 10^{-3}\ V_g\ (p_{abs}' - p_{abs}'')$$

where

q_L is the leakage rate (cm^3/h);

V_g is the total volume of the valve under test and the test apparatus (cm^3);

p_{abs}' is the absolute pressure at the beginning of the test (mbar);

p_{abs}'' is the absolute pressure at the end of the test (mbar).

The pressure loss is measured over a period of 5 min and the leakage rate is based on 1 h.

Annex ZA

(informative)

Identification of clauses which meet the Essential Requirements of the Gas Appliance Directive (90/396/EEC)

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of the Gas Appliance Directive (90/396/EEC).

WARNING: Other requirements and EU Directives may be applicable to the products falling within the scope of this standard.

The following clauses on this standard are likely to support requirements of the Gas Appliance Directive (90/396/EEC).

Compliance with the clauses of this standard provides one means of conforming with the specific essential requirements of the Directive concerned and associated EFTA regulations.

Table ZA.1

Essential requirement		Clauses of this European Standard
1	**General conditions**	
1.1	Safety of operation	Complete standard
1.2	Installation instructions User instructions Warning notices Official language of instructions	9.2 9.2 9.3 9.2
1.2.1	Installation instructions	9.2
1.2.2	User instructions	9.2
1.2.3	Warning notices	9.3
1.3	Correct operation	7, 9.2
2	**Materials**	
2.1, 2.2	Suitability for safety and intended purpose	6.1.1, 6.2.1, 7.12

3	**Design and construction**	
3.1	General	
3.1.1	Mechanical stability	6.1, 6.4, 7.9
3.1.2	Condensation	N/A
3.1.3	Risk of explosion	6.2
3.1.4	Water penetration	N/A
3.1.5	Normal fluctuation of auxiliary energy	7.1
3.1.6	Abnormal fluctuation of auxiliary energy	6.7, 7.3
3.1.7	Hazards of electrical origin	6.8
3.1.8	Pressurized parts	6.1, 7.7, 7.9
3.1.9	Failure of safety, controlling and regulating devices	N/A
3.1.10	Safety/adjustment	N/A
3.1.11	Protection of parts set by the manufacturer	N/A
3.1.12	Controlling and setting devices	N/A
3.2	Unburned gas release	N/A
3.2.1	Gas leakage	6.2.2, 7.7, 7.8
3.2.2, 3.2.3	Gas accumulation	N/A
3.3	Ignition	N/A
3.4	Combustion	N/A
3.5	Rational use of energy	N/A
3.6	Temperatures	N/A
3.7	Foodstuffs and water used for sanitary purposes	N/A

Annex II		
	Certification procedures	N/A

Annex III		
	CE conformity mark and inscriptions	
1	Mark	N/A
2	Data plate	9.1

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