BRITISH STANDARD

BS 6047-1: 1981

Flame supervision devices for domestic, commercial and catering gas appliances —

Part 1: Specification for heat sensitive type

UDC 683.955:62-524

Cooperating organizations

The Gas Standards Committee, under whose direction this British Standard was prepared, consists of representatives from the following:

British Combustion Equipment Manufacturers' Association*
British Gas Corporation*
Chartered Institution of Building Services
Department of Energy (Gas Standards)*
Department of the Environment (Housing and Construction)
Department of the Environment (PSA)
Heating and Ventilating Contractors' Association
Institution of Gas Engineers
Liquefied Petroleum Gas Industry Technical Association (UK)
National Association of Plumbing, Heating and Mechanical Services Contractors
National Gas Consumers' Council
Society of British Gas Industries
Water-tube Boilermakers' Association

The organizations marked with an asterisk in the above list, together with the following, were directly represented on the Technical Committee entrusted with the preparation of this British Standard:

Association of Control Manufacturers Tacma (BEAMA)
British Industrial Measuring and Control Apparatus Manufacturers' Association
British Non-ferrous Metals Federation
Chief and Assistant Chief Fire Officers' Association
National Brassfoundry Association

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Contents

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 flame supervision devices of the heat sensitive type up to DN 25 connection size for non-automatic domestic, commercial and catering appliances 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 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 SI system 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This standard is not intended to prejudice the negotiation of a European standard and will be withdrawn in favour of such a standard as soon as one, acceptable to the UK, is approved.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 10, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This British Standard specifies the requirements for flame supervision devices of the heat sensitive type, hereinafter referred to as flame supervision devices, up to R1 (DN 25) connection size inclusive for non-automatic domestic, commercial and catering appliances burning 2nd or 3rd family gases with an input rating up to 120 kW. It also applies to the flame supervision device used in conjunction with other control devices forming a control system on appliances.

A flame switch, i.e. a device in which the presence or absence of a flame makes or breaks an electrical circuit directly or indirectly, is not considered to be a flame supervision device for the purposes of this standard.

2 References

The titles of the publications referred to in this standard are listed on the inside back cover.

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
flame sensing element

the part of a flame supervision device on which the supervised flame acts directly, and which transmits the flame effect directly or indirectly on to a valve

3.2
flame sensor

the active part of the flame sensing element, as specified by the manufacturer

3.3
flame supervision burner

a burner the flame of which acts on the flame sensing element

3.4
flame supervision device

a device responsive to flame properties that detects the presence of flame and, in the event of ignition failure or subsequent loss of flame, causes safety shut-down

3.5
flame supervision device of heat sensitive type

a flame supervision device that responds to flame temperature, and directly causes safety shut-down

3.6
ignition interlock

that part of a flame supervision device which prevents the operation of the igniter as long as the main gasway is open

3.7
restart interlock

that part of a flame supervision device which prevents the re-opening of the valve during the closing time of the device

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 this standard when approved by a representative and recognized authority.

4.1.2 Any new features incorporated 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.

4.1.3 Flame supervision devices shall be so designed and constructed, and be of such materials, that in normal use they shall function reliably, cause no danger to persons or danger to the surroundings and be fail-safe.

4.1.4 Removal of the energizing source or failure of the flame sensing element shall result in the direct closure of the valve in the flame supervision device within the closing time declared by the manufacturer (see **5.8**).

4.2 Materials for gas-carrying parts. Parts of the body 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 no circumstances shall more than 30 dm^3/h of air escape when tested with air at the declared maximum operating pressure.

Notwithstanding this requirement "O" ring seals complying with the requirements of BS 1806 or BS 4518 and jointing materials complying with the requirements of BS 5292 are permitted.

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

4.3 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 device, only alloy A is used.

4.4 Accessibility. Components designed to be serviced during normal use shall be easily accessible and shall be so manufactured that parts cannot readily be incorrectly reassembled.

4.5 Noise. The entire device shall not be unduly noisy when opening, closing or in continuous use.

4.6 Tubing. Pilot tubing shall be confined to two sizes, namely 4 mm and 6 mm outer diameter conforming to dimensions quoted in BS 2871-2, but may be of any suitable metal.

Copper tubing shall not be used where the ambient temperature exceeds 100 °C.

4.7 Operation

4.7.1 The torque required to operate any spindle directly by hand shall not exceed 0.6 N m when the spindle is turned at an angular velocity of π rad/s. (See Appendix A.)

4.7.2 The force or pressure required to operate a push button directly by hand shall not exceed 30 N for nominal valve sizes of less than DN 15 and, for nominal valve sizes of DN 15 to DN 25, 45 N or 0.5 N/mm^2, whichever is the smaller value.

No push button shall be less than 40 mm^2 in area or 7 mm in diameter.

4.8 Electrical construction. Any electrical construction of the control shall comply with the relevant requirements of BS 3955-3, except for any thermoelectric circuitry. If snap-on connectors are used they shall comply with the requirements of BS 5057 and be of sizes 2.8 mm and/or 6.3 mm.

4.9 Assembly and workmanship

4.9.1 Castings shall be visibly 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).

4.9.2 Hot-pressed components shall be sound, homogeneous, without laminations and shall be smooth and well finished.

4.9.3 The device shall be free from sharp edges which might cause personal injury or damage to other components, electrical wiring, etc.

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

4.9.5 Holes used in the assembly of the device, e.g. for fixing screws, shall not be closer than 1 mm to gasways.

4.9.6 Holes communicating with gasways and used for manufacturing purposes shall be closed mechanically with a metallic seal so as to ensure a gas-tight seal for the life of the device and shall be treated in such a way that unauthorized interference can be detected.

4.10 Non-metallic materials

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

4.10.2 *Leather diaphragms.* Leather diaphragms and any leather associated with the valve bob in the form of bob cover shall be of good quality "East Indian" sheep-skin free from flaying defects and serious imperfections of grain and shall generally be in accordance with BS 2797. All leather shall be similarly treated to ensure flexibility, soundness and a reasonable life and shall be suitably dressed (e.g. with a double refined straight mineral oil of kinematic viscosity 183 cSt[1)] at 60 °C).

4.10.3 *Sealing gaskets and jointing compounds.* Sealing gaskets, jointing compounds and any other sealing agent, shall form an effective seal and shall comply with the appropriate section of BS 1806, BS 4518 or BS 5292.

4.10.4 *Sealing materials and diaphragms in contact with 2nd family gas.*

4.10.4.1 *Requirement.* The device shall comply with the requirements of **4.10.4.2**, and additionally, if declared by the manufacturer to be suitable for use in ambient temperatures below 0 °C, the device shall comply with the requirements of **4.10.4.3**.

[1)] 1 cSt = 1 mm^2/s.

4.10.4.2 *Test on the assembled device.* The device shall be exposed for a period of 264 h to NGA gas, nitrogen, or air, at a temperature of 20 ± 1 °C[2)]. This gas shall be saturated to 35 ± 2 % with toluene vapour and shall have a relative humidity of 65 ± 5 %. During the test the flow rate shall not be less than 30 dm^3/h. The test shall be so arranged that any "working" diaphragm or valve pad operates in the normal mode and over the full stroke at least 5 000 times at a rate of 20 cycles/h. Other devices shall be maintained in their normal operating state.

After the exposure period the device shall continue to function correctly and shall comply with the requirements of **5.3**, **5.4** and **5.5**.

Where the nominal size of the device is less than R ¾ (DN 20) the device shall also comply with the requirements of **5.7.1**. In addition, the device shall be observed to operate correctly over its full range of nominal working pressures, the voltage range of rated voltage + 10 % – 15 %, and under any combination of these conditions, but with the ambient temperature maintained at 20 ± 1 °C.

NOTE The initial performance of the device has to be determined on the carrier gas prior to adding toluene.

4.10.4.3 *Test on the materials.* A test sample shall be cut from the component, immersed and allowed to swell freely in a solution of test liquid B, as specified in BS 903-A16, for a period of 168 h at an ambient temperature of 20 ± 1 °C. The volume ratio of liquid to material shall not be less than 50 : 1.

After the test, the length of the liquid-soaked sample shall be measured as quickly as possible. The latter is conveniently carried out by placing the wet sample between two microscope slides. The length of the sample shall not exceed the initial length by more than 10 %.

After drying the sample to constant mass at room temperature, its mass shall not be less than 90 % of its initial mass.

4.10.5 *Sealing materials and diaphragms in contact with 3rd family gases.* Diaphragms shall comply with the requirements of **3.3** 1) and **3.3** 6) of BS 3016:1972.

Valve pads shall comply with the requirements of **3.4** 1), **3.4** 4) and **3.4** 5) of BS 3016:1972.

Non-metallic materials shall show no marked deterioration when subjected to an accelerated ageing test for seven days at a temperature of 20 °C in excess of the manufacturer's maximum recommended temperature.

NOTE The requirements of **4.10.5** may not be met by materials made of some silicone rubbers although these rubbers are claimed to be satisfactory. Criteria for testing silicone rubber materials are still under consideration and, in the meantime, components and appliances containing such a material will be considered acceptable provided that the appropriate manufacturer can demonstrate that it has proved satisfactory in use.

4.11 Corrosion resistance

4.11.1 *General requirements.* All parts of the device shall have adequate resistance to corrosion, either by the use of corrosion-resistant materials or by means of suitable protective coating, e.g. paint. Moving parts of the device shall be made from corrosion-resistant materials. No part of the device shall corrode to an extent that will affect its safe and correct operation.

4.11.2 *Scratch test*

4.11.2.1 *Requirement.* Parts of the device coated for protection and not solely for decoration shall be subjected to a scratch test as described in **4.11.2.2** both before and after the humidity test specified in **4.11.3**. There shall be no penetration of the protective coating by the ball.

4.11.2.2 *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 constant force of 10 N. An example of a suitable test instrument is shown in Figure 2.

4.11.3 *Humidity test*

4.11.3.1 *Requirement.* The device shall be subjected to the procedure given in **4.11.3.2**, after which the following requirements shall apply.

a) No part of a device 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.

4.11.3.2 *Humidity test method*

a) The device 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 device is examined for compliance with **4.11.3.1** a).

[2)] When air is used as the carrier gas the mixture of air and toluene vapour should be exhausted to atmosphere, (*not* burnt), via a flame trap.

b) The device is then allowed to stand for 24 h at room temperature after which it is examined for compliance with **4.11.3.1** a) and **4.11.3.1** b).

4.12 Connections

4.12.1 *Bosses, nuts and screws.* Bosses, nuts and screws used during servicing or installation shall not require the use of special tools.

4.12.2 *Pipe threads.* Where the connecting threads of a device are pipe threads they shall be parallel or taper threads complying with the requirements of BS 21.

4.12.3 *Self tapping screws.* Self tapping screws, other than of the thread forming type giving a fully formed ISO metric machine type thread, shall not be used to secure together parts which could be removed in servicing. The application of such self forming screws shall be limited to malleable materials, and to prevent cracking of the material they shall be centred not closer to the edge than 1.5 times the major diameter of the thread unless the material is in the form of bar stock or an extrusion when they shall be centred not less than the major diameter from the edge. For servicing purposes it shall be possible to fit a machine screw complying with the requirements of BS 4183 in place of a forming type self tapping screw.

4.12.4 *Compression fittings.* Compression fittings for auxiliary connections (e.g. pilot connections) shall be of the type to suit tubes to the dimensions given in BS 2871-1.

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. The cone angle shall be smooth.

4.12.5 *Flange connections.* Flange connections shall be to the manufacturer's specification. Suitable mating flanges shall be available to permit connections to standard screw threads or standard flanges.

4.12.6 *Thermocouple connection.* This connection shall have an internal thread conforming to size M8, M9 or M10 × 1-6H of BS 3643-3 or shall be ASA 11/32-32NS-2B, and shall be dimensioned to provide a minimum engagement of 3 mm.

4.13 Mechanical strength

4.13.1 *Requirements.* The device shall have sufficient mechanical strength to resist the stresses and conditions of normal use. A device which complies with the requirements of the torque test and bending moment test, as specified in **4.13.2** and **4.13.3** respectively, without showing signs of permanent distortion or cracking and which remains functional without exceeding the leakage rates given in **5.1** and **5.2**, shall be deemed to have sufficient mechanical strength.

The bending moment test does not apply to compression fittings.

Table 1 — Torque and bending moment values

Nominal size			Torque	Bending moment
R	DN	Tubing (outside diameter)	Threaded and compression fittings	Threaded fittings
		mm	N m	N m
⅛	6	3 and 4	15	25
¼	8	6 and 8	20	35
⅜	10	10 and 12	35	70
½	15	15	50	105
¾	20	22	85	225
1	25	28	125	340

4.13.2 ***Torque test methods***

4.13.2.1 *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 device and the inlet pipe is clamped at a distance not less than 2*D* from the device where *D* is the nominal diameter of the pipe. The test torque appropriate to the nominal size given in Table 1 is then applied to the outlet pipe for approximately 10 s.

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

The device is checked for deformation and leakage.

4.13.2.2 *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 device rigidly clamped the test torque given in Table 1 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.

The device 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 device is checked for deformation and leakage.

4.13.3 *Bending moment test.* Following the torque test the inlet pipe is clamped at a distance not less than 2*D* from the device and a force equivalent to the test bending moment given in Table 1 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). These directions are chosen to include the direction of minimum strength of the device.

The outlet pipe is then clamped at a distance not less than 2*D* from the device and the test forces are applied to the inlet pipe.

The device is checked for deformation and leakage.

4.14 Taps. If the flame supervision device incorporates a gas tap this shall comply with the requirements of BS 5494.

5 Performance

5.1 General. Unless a flame acts directly on the flame sensor, a flame supervision device shall, without manual intervention, prevent gas from being supplied to an outlet, or limit the gas supply to an outlet to the bypass rate as specified by the manufacturer. A flame supervision device shall directly close the main gas supply.

5.2 Flame supervision burners incorporated with the flame supervision device

5.2.1 Any flame supervision burner incorporated with the flame supervision device shall have its position fixed relative to the flame sensing element.

5.2.2 The flame supervision and cross-lighting flames shall ignite each other directly and shall be formed on the same burner head.

5.2.3 The burner shall be capable of correct performance throughout the following ranges of gas pressure.

Family	Test gas	Inlet pressure
		mbar[a]
2nd	NGA	12.5 to 27.5
	NGB, NGD	17.5 to 27.5
3rd	LPGA, LPGB	20 to 35
	LPGC, LPGE	25 to 45

[a] 1 mbar = 10^2 N/m^2 = 100 Pa.

Any adjustable burner shall have been previously adjusted for operation at 20 mbar for 2nd family gas, or at 28 mbar or 37 mbar for butane or propane, respectively.

5.2.4 The flame stability of the flame supervision burner and the cross-lighting burner shall be maintained during the opening and closing of the main valve throughout the full range of gas flows.

5.3 External leak-tightness (soundness). When tested with air pressures up to 1.5 times the maximum pressure declared by the manufacturer, but at least 60 mbar for 2nd family gas devices and at least 150 mbar for 3rd family gas devices, the following leakage rates shall not be exceeded when the device is in either the open or the closed position. Devices intended for use with more than one gas family shall comply with the requirement at the highest appropriate pressure.

Nominal size, *DN*	cm^3/h of air
$DN < 10$	20
$10 \leqslant DN \leqslant 25$	40

5.4 External leak-tightness (soundness) of seals for spindles (shafts)

5.4.1 *Requirement.* When spindles, that are moved only during ignition, are operated, the leakage rate through their seals shall not exceed 150 cm^3/h of air at any pressure up to 1.5 times the maximum pressure declared by the manufacturer, but at least 60 mbar for 2nd family gas devices or at least 150 mbar for 3rd family gas devices.

Devices intended for use with more than one gas family shall comply with the requirement at the highest appropriate pressure.

5.4.2 *Method of test.* With the main outlet and pilot (if fitted) blocked, air at up to 1.5 times the maximum pressure declared by the manufacturer, but at least 60 mbar for 2nd family gas devices or at least 150 mbar for 3rd family gas devices, is supplied to the inlet of the device. The spindle is then moved to the ignition position and held there for the ignition opening time as declared by the manufacturer. This operation is repeated 10 times and then the leakage rate is measured.

5.5 Internal leak-tightness (let-by)

5.5.1 *Non-bypass type.* When tested with air in accordance with the method described in **5.5.2**, any leakage through the closed valve of the flame supervision device shall not exceed the values specified in **5.3**.

5.5.2 *Method of test (non-bypass type).* Forward flow direction: air pressures up to 1.5 times the maximum pressure declared by the manufacturer, but at least 50 mbar for 2nd family gas devices or at least 60 mbar for 3rd family gas devices, are applied to the inlet connection of the closed valve of the flame supervision device.

Any flame supervision device which may be used in both directions of flow shall be tested as above in both directions.

5.5.3 *Bypass type.* When tested with air in accordance with the method described in **5.5.2**, with the bypass blanked off, any leakage through the closed valve of the flame supervision device shall not exceed the values given in **5.3**.

5.5.4 ***Valve closing force requirements***

5.5.4.1 The valve of the flame supervision device shall have sufficient closing force when, with the device mounted in any position including the least favourable one, a pressure up to 10 mbar is applied to the inlet of the device. The let-by shall not exceed the value specified in **5.3**.

5.5.4.2 Where in its construction and design the closing force of the valve is provided by servo-gas, the valve of the flame supervision device shall also withstand an air pressure of 10 mbar applied to the outlet of the device with a let-by not exceeding the value specified in **5.3**.

5.5.4.3 Where a manufacturer declares that the flame supervision device is suitable for use in applications where a reverse pressure can arise, the device shall comply with the requirements of **5.5.4.4**.

If a valve closing force requirement is specified in an appliance standard, conformity with the requirement may be claimed by the manufacturer or a test method may be agreed between the manufacturer and the testing authority.

5.5.4.4 The let-by shall not exceed the value specified in **5.3** when an air pressure equal to the declared reverse pressure is applied to the outlet of the device. The declared reverse pressure shall be one of the following.

10 mbar, 50 mbar[3)] or 150 mbar[3)].

5.6 Range of operating conditions. A flame supervision device shall operate correctly over its full range of nominal working pressure and an ambient temperature range 0 °C to 60 °C, or wider limits if claimed by the manufacturer.

5.7 Rated flow rate

5.7.1 ***Non-bypass type***

5.7.1.1 *Requirement.* The equivalent gas rate when measured as described in **5.7.1.2** shall not be less than the manufacturer's declared rating.

5.7.1.2 *Method of test (non-bypass type).* Air is supplied at a constant pressure of approximately 7.5 mbar to a position displacement or inferential meter of a suitable range and having an error not greater than 5 % of the rate to be measured. The air then passes through a control cock to a straight length of pipe directly connected to the inlet of the flame supervision device. This pipe is the same size as the inlet connection of the flame supervision device and is at least 10 pipe diameters in length with a pressure tapping 5 pipe diameters upstream of the flame supervision device. The other pressure tapping is positioned 5 pipe diameters downstream of the device. A pressure gauge capable of being read directly to 0.05 mbar or less is connected across these tappings.

The air flow rate is adjusted to give a pressure drop of 1 mbar across the flame supervision device, the valve of the device being maintained in the fully open position.

The equivalent gas rate is calculated as follows.

$$Q_g = F \frac{\Delta P_g}{\Delta P_a} Q_a$$

where:

Q_g is the equivalent gas rate;

Q_a is the measured air rate;

ΔP_g is the gas pressure differential across the control;

ΔP_a is the air pressure differential across the control;

F is a non-dimensional density correction factor

= 1.29 for 2nd family gas (assumed specific gravity 0.60);

= 0.71 for butane (assumed specific gravity 2.0);

= 0.82 for propane (assumed specific gravity 1.5).

NOTE In the particular case of the pressure differential being measured in mbars, and ΔP_g being 1.0 mbar, the above formula may be conveniently expressed as follows.

$$Q_g = \frac{F \times Q_a}{\sqrt{\text{applied pressure differential}}\ \text{(mbars)}}$$

5.7.2 ***Rated bypass rate***

5.7.2.1 *Requirement.* When tested with air in accordance with the method described in **5.7.2.2**, the air flow rate shall be within ± 10 % of the manufacturer's declared bypass rate at the declared pressure.

[3)] 50 mbar and 150 mbar are also the reverse pressure test values for electrically operated gas safety shut-off valves of class 2 and class 1 respectively.

5.7.2.2 *Method of test (bypass type).* An air pressure equal to the manufacturer's declared pressure is applied to the inlet connection of the closed valve of the flame supervision device.

5.8 Opening and closing times. When a flame supervision device is fitted in accordance with the manufacturer's instructions, the closing time, and the opening time where manual intervention is not required, shall not exceed those declared by the manufacturer.

If manual resetting is required, not more than 20 s manual operation shall be required before the valve remains open.

NOTE Closing times are specified in the individual appliance standards.

5.9 Flame sensing element

5.9.1 The flame supervision device shall operate satisfactorily or the valve of the device shall be closed and remain closed after the flame sensor, as defined by the manufacturer, has been maintained at a temperature of 1 000 ± 50 °C for a period of 4 h. Care shall be taken that only the flame sensor is subject to direct impingement of the flame.

5.9.2 Overheating of the flame sensing element may result in its failure but shall not result in failure to shut down.

5.9.3 Rupture of the flame sensing element shall result in closure of the valve of the flame supervision device.

5.10 Ignition interlock. Any ignition interlock shall be checked five times to prove that it prevents the operation of the igniter as long as the main gasway is open.

5.11 Restart interlock

5.11.1 *Requirement.* If the device incorporates a restart interlock, this shall withstand either a test torque of 1 N m or a test force of 90 N, as appropriate, applied 10 times.

A restart interlock shall also be tested five times in accordance with the method given in **5.11.2** to check that it prevents the re-opening of the valve during the closing time of the flame supervision device.

5.11.2 *Test method.* An amount of air equal to the nominal flow rate flows through the safety device. The flame sensing element is heated to the highest permissible temperature declared by the manufacturer.

The air flow and the heating of the flame sensing element are stopped simultaneously after 300 s at operating temperature. It shall not then be possible for air to flow when the valve is operated manually during the closing time.

5.12 Endurance

5.12.1 *Requirement.* A flame supervision device shall have an adequate life for the duty for which it is intended. The minimum number of operations which a flame supervision device shall be capable of performing with no failure whatsoever is 6 000, or the declared number, whichever is the greater.

After the endurance test specified in **5.12.2** all of the test samples shall comply with the requirements of **5.1**, **5.3**, **5.4**, **5.5**, **5.6**, **5.7**, **5.8**, **5.9.1**, **5.9.3**, **5.10** and **5.11**. The relevant manufacturer's declarations of **6.2** shall also be rechecked and, with reference to **6.2** d) in particular, the following shall apply.

a) For devices with a declared closing time up to and including 60 s, the closing time of any sample shall not be less than one third or more than 10 s in excess of its initial measured value.

b) For devices with a declared closing time greater than 60 s, the closing time of any sample shall not be less than one third or more than 20 % in excess of its initial measured value.

5.12.2 *Test method.* Three test samples are rigidly mounted in their recommended mounting attitude and are operated on-off as follows.

1 000 operations at 60 °C or higher if claimed by the manufacturer;

followed by

1 000 operations at 0 °C or lower if claimed by the manufacturer;

followed by

4 000 operations at 20 ± 5 °C.

Where there are a number of permitted mounting attitudes the most onerous attitude is chosen. Where the declared number of operations is greater than 6 000 the test operations are divided proportionately.

During at least 10 % of the endurance test (5 % at the beginning and 5 % at the end) each opening and closing is proved.

For thermo-electric flame supervision devices the thermocouple output is replaced by an artificial e.m.f. equivalent to the highest value declared by the manufacturer.

For mechanical flame supervision devices the flame sensing element is subjected to the highest temperature declared by the manufacturer, when heated according to the manufacturer's recommendations.

The cycle rate is such as to permit the moving parts to reach equilibrium in both the open and the closed positions.

6 Marking and information

6.1 Marking. The following information shall be legibly marked on the flame supervision device.

a) The manufacturer's name, mark or symbol.

b) Unique Type reference.

c) The direction of gas flow, e.g. an arrow, stamped or cast in, and clearly visible on the body of uni-directional devices.

d) If electricity is used the polarity of the terminals shall be identified. For thermo-electric flame supervision devices the thermocouple shall also carry an identification mark.

e) Identification of the date of manufacture.

All markings shall be indelible as specified in BS 3955-3. Self adhesive labels are not acceptable unless declared able to last the life of the component and proved to remain legible and attached during the testing of the device.

6.2 Declared information. The following information shall be declared by the manufacturer.

a) Rated flow rate in air at 1 mbar pressure drop (dm^3/h).

b) Ambient temperature range (°C).

c) Working gas pressure range (mbar).

d) Opening and closing times (s).

e) Permissible mounting attitudes, if not universal.

f) Maximum permissible temperature of the flame sensor.

g) Maximum permissible temperatures of the hot and cold junctions of thermocouples.

h) Operational data such as heat input to integral pilot; resistances (including maximum external resistance that may be inserted into the circuit), voltages and currents for thermo-electric devices.

i) Number of operations.

j) Materials specification.

k) Bypass rate (air) at the declared pressure.

l) Maximum reverse gas pressure.

m) Minimum valve closing force (N/mm^2).

6.3 Instructions. Servicing and maintenance instructions and details of replacement parts shall be provided.

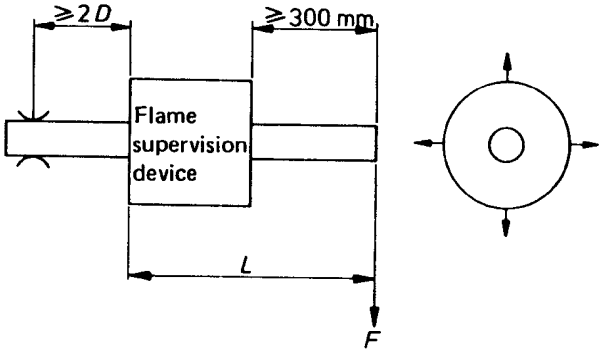
7 Packaging

7.1 Gas connections shall be covered to exclude foreign matter.

7.2 Packages shall be clearly marked on an external surface so that the device may be easily identified without unpacking.

Appendix A Recommended requirement for flame supervision device applications

When a flame supervision device becomes part of an appliance which is the subject of another standard it is recommended that that standard should contain a requirement that the torque required to operate the spindle shall not exceed 0.017 N m per millimetre of effective knob diameter.



D is the nominal diameter of pipe
Bending moment = $F \times L$

Figure 1 — Bending moment test (schematic)

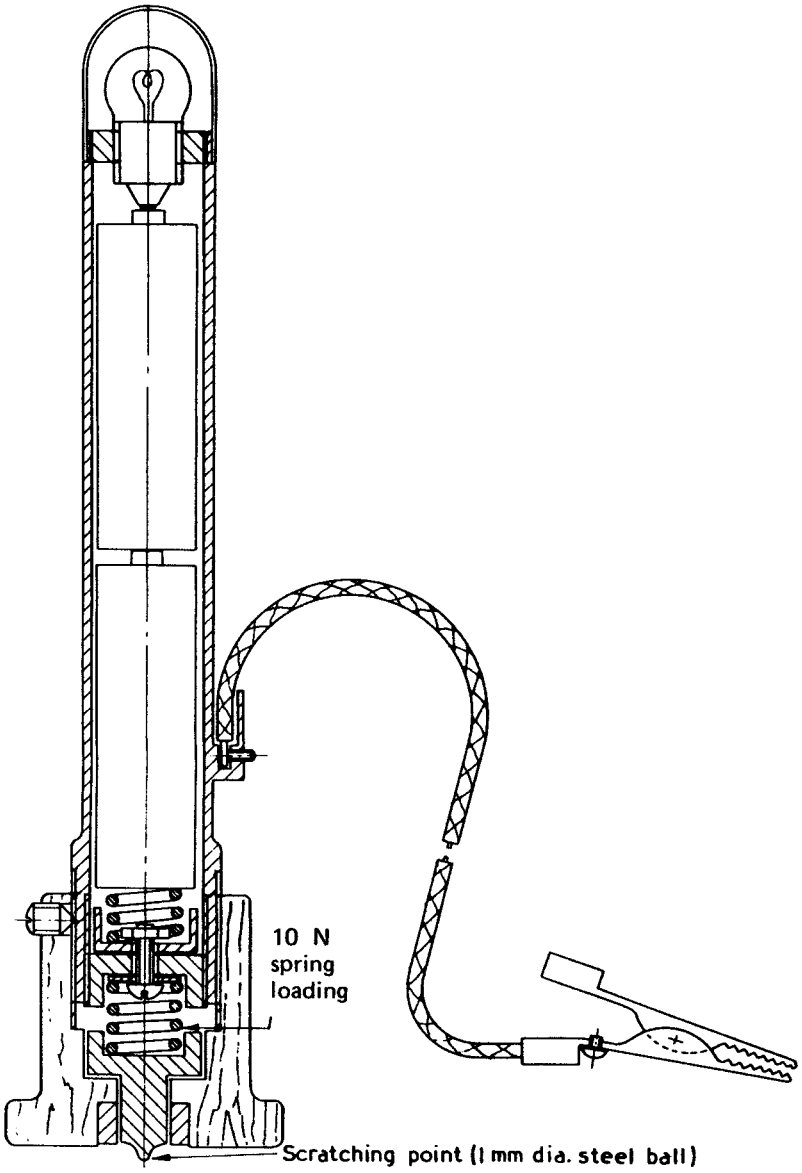


Figure 2 — Paint scratch test apparatus

Publications referred to

BS 21, *Pipe threads for tubes and fittings where pressure-tight joints are made on the threads.*
BS 903, *Methods of testing vulcanized rubber.*
BS 903-A16, *The resistance of vulcanized rubber to liquids.*
BS 1004, *Zinc alloys for die casting and zinc alloy die castings.*
BS 1179, *Glossary of terms used in the gas industry.*
BS 1806, *Dimensions of toroidal sealing rings ("O" seals and their housings).*
BS 2797, *Specification for leathers for gas meter diaphragms.*
BS 2871, *Copper and copper alloys. Tubes.*
BS 2871-1, *Copper tubes for water, gas and sanitation.*
BS 2871-2, *Tubes for general purposes.*
BS 3016, *Pressure regulators and automatic changeover devices for liquefied petroleum gases.*
BS 3643, *ISO metric screw threads.*
BS 3643-3, *Limits and tolerances for fine pitch threads (constant pitch series).*
BS 3763, *The International System of units*[4)].
BS 3955, *Electrical controls for domestic appliances.*
BS 3955-3, *General and specific requirements.*
BS 4183, *Machine screws and machine screw nuts — metric series.*
BS 4518, *Metric dimensions of toroidal sealing rings ("O"-rings) and their housings.*
BS 5057, *Snap-on connectors.*
BS 5292, *Jointing materials and compounds for installations using water, low-pressure steam or 1st, 2nd and 3rd family gases.*
BS 5338, *Code of practice for zinc alloy pressure die casting for engineering (formerly CP 3001).*
BS 5494, *Specification for gas taps for domestic and catering appliances.*

[4)] Referred to in foreword only.

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