

BRITISH STANDARD

**Specification for indirect
gas fired forced
convection air heaters
with rated heat inputs
greater than 330 kW but
not exceeding 2 MW for
industrial and commercial
space heating – Safety
and performance
requirements (excluding
electrical requirements)
(2nd family gases)**

ICS 97.100.20

Confirmed December 2011

BSi
British Standards

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ISBN 0 580 48078 X

The following BSI references relate to the work on this standard:
Committee reference GSE/20/4

Publication history

First published, June 1983

Second edition, February 1990

Third edition, July 2006

Amendments issued since publication

Amd. no.	Date	Text affected
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Contents

Foreword *ii*

1	Scope	<i>1</i>
2	Normative references	<i>1</i>
3	Terms and definitions	<i>3</i>
4	Classification of appliances	<i>5</i>
5	General requirements	<i>5</i>
6	General conditions of test	<i>6</i>
7	Design and construction	<i>7</i>
8	Soundness	<i>14</i>
9	Heat input	<i>14</i>
10	Combustion	<i>15</i>
11	Ignition	<i>15</i>
12	Flame stability	<i>18</i>
13	Flue system	<i>19</i>
14	External temperatures	<i>21</i>
15	Heat exchanger: working life	<i>22</i>
16	Manual gas valves	<i>22</i>
17	Automatic controls	<i>23</i>
18	Motors and fans	<i>36</i>
19	Electricity supply	<i>37</i>
20	Manufacturer's instructions	<i>38</i>
21	Facilities for commissioning and testing	<i>39</i>
22	Identification and marking	<i>40</i>
23	Air handling	<i>42</i>
24	Combustion chamber pressure reliefs	<i>42</i>
25	Thermal efficiency	<i>42</i>
26	Air delivery volume	<i>45</i>
27	Weather resistance	<i>48</i>

Bibliography *51*

List of figures

Figure 1	– Paint scratch test apparatus	<i>12</i>
Figure 2	– Test duct for air flow measurement	<i>46</i>
Figure 3	– Anti-swirl device	<i>46</i>
Figure 4	– Air flow regulation device	<i>47</i>
Figure 5	– Connecting bend	<i>47</i>
Figure 6	– Arrangement of spray heads and associated piping for rain test	<i>49</i>
Figure 7	– Details of spray head assembly and construction	<i>50</i>

List of tables

Table 1	– Test gas conditions	<i>16</i>
Table 2	– Heat input conditions	<i>18</i>
Table 3	– Surface temperature rise	<i>22</i>
Table 4	– Valves required for natural draught systems	<i>24</i>
Table 5	– Main gas safety shut-off valve system requirements	<i>24</i>
Table 6	– Purge test gas	<i>27</i>
Table 7	– Flame supervision device drop-out times	<i>30</i>
Table 8	– Fan motor windings: permissible temperature rises	<i>37</i>
Table 9	– Enthalpy data for combustion products	<i>44</i>
Table 10	– Combustion data for test gas G20	<i>44</i>

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 51 and a back cover.

Foreword

Publishing information

This British Standard was published by BSI and came into effect on 20 July 2006. It was prepared by Subcommittee GSE/20/4, *Air heaters (gas)*, under the authority of Technical Committee GSE/20, *Non-domestic space heaters (gas)*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 5991:1989, which is withdrawn.

Relationship with other publications

Requirements for appliances with rated heat inputs up to 300 kW based on the net calorific value are given in BS EN 621:1998 and BS EN 1020:1998 as appropriate.

Corresponding requirements for direct gas fired forced convection air heaters are specified in BS 5990.

Electrical requirements, applicable for both direct and indirect gas fired forced convection air heaters, are specified in BS 5986.

Information about this document

This new edition of BS 5991 incorporates changes made necessary by the publication of BS EN 621:1998 and BS EN 1020:1998. It does not represent a full review or revision of the standard, which will be undertaken in due course.

This edition has been prepared in order to fulfil the obligation to withdraw conflicting national standards. As a consequence, it no longer applies to appliances with rated heat inputs up to 330 kW based on the gross calorific value (300 kW based on the net calorific value).

In anticipation of this standard being the subject of third party certification schemes, it provides for a claim by the appliance manufacturer of a numerical value for the thermal efficiency of a product model. The test authority will then ascertain that a sample submitted for type approval meets this claimed value within a specified test equipment tolerance. Any sample selected from subsequent production of the particular model will be expected to conform to a verification value that will also take into account a specified production tolerance.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is “shall”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

1 Scope

This British Standard specifies detailed requirements, including safety and performance requirements and methods of test, for indirect gas fired forced convection air heaters having heat inputs greater than 330 kW but not exceeding 2 MW, intended for industrial and commercial applications. Appliances covered by this standard are not intended for installation in domestic dwellings.

The scope of this standard includes indirect gas fired forced convection air heaters for use both with and without ducting, and intended primarily for space heating applications.

This standard also specifies the requirements for indirect gas fired forced convection air heaters designed for permanent outdoor installation.

It applies to appliances designed to operate on normal low pressure district supplies of 2nd family gas.

For appliances fitted with gas boosters and/or flue dampers, additional requirements may apply.

This standard does not apply to portable and transportable indirect gas fired forced convection air heaters.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 10, *Specification for flanges and bolting for pipes, valves and fittings*

BS 476-4, *Fire test on building materials and structures – Part 4: Non-combustibility test for materials*

BS 476-7, *Fire test on building materials and structures – Part 7: Method for classification of the surface spread of flame of products*

BS 476-12, *Fire test on building materials and structures – Part 12: Methods of test for ignitability of products by direct flame impingement*

BS 1041 (all parts), *Code for temperature measurement*

BS 1042-2.1 (ISO 3966), *Measurement of fluid flow in closed conduits – Part 2.1: Method using Pitot static tubes*

BS 1179-6, *Glossary of terms used in the gas industry – Part 6: Combustion and utilization including installation at consumers' premises*

BS 5000-11, *Specification for rotating electrical machines of particular types or for particular applications – Part 11: Small power electric motors and generators*

BS 5986, *Specification for electrical safety and performance of gas fired space heating appliances with inputs 60 kW to 2MW*

BS EN 88, *Pressure governors for gas appliances for inlet pressures up to 200 mbar*

BS EN 125, *Specification for flame supervision devices for gas burning appliances – Thermoelectric types*

BS EN 126, *Multifunctional controls for gas burning appliances*

BS EN 161, *Automatic shut-off valves for gas burners and gas burning appliances*

BS EN 257, *Mechanical thermostats for gas burning appliances*

BS EN 298, *Automatic gas burner control systems for gas burners and gas burning appliances with or without fans*

BS EN 437, *Specification for test gases, test pressures and categories of appliance, for gas appliances*

BS EN 621:1998, *Non-domestic gas-fired forced convection air heaters for space heating not exceeding a net heat input of 300 kW, without a fan to assist transportation of combustion air and/or combustion products*

BS EN 1020:1998, *Non-domestic gas-fired forced convection air heaters for space heating not exceeding a net heat input of 300 kW, incorporating a fan to assist transportation of combustion air and/or combustion products*

BS EN 1092-3, *Flanges and their joints – Circular flanges for pipes, valves, fittings and accessories, PN designated – Part 3: Copper alloy flanges*

BS EN 10143, *Continuously hot dip metal coated steel sheet and strip. Tolerances on dimensions and shapes*

BS EN 10226-1, *Pipe threads where pressure tight joints are made on the threads. Taper external threads and parallel internal threads – Part 1: Dimensions, tolerances and designation*

BS EN 10226-2, *Pipe threads where pressure tight joints are made on the threads. Taper external threads and taper internal threads – Part 2: Dimensions, tolerances and designation*

BS EN 12329, *Corrosion protection of metals – Electrodeposited coatings of zinc with supplementary treatment on iron or steel*

BS EN 12540, *Corrosion protection of metals – Electrodeposited coatings of nickel, nickel plus chromium, copper plus nickel and copper plus nickel plus chromium*

BS EN 60730-2-9, *Specifications for automatic electrical controls for household and similar use – Part 2-9: Particular requirements for temperature-sensing controls*

BS EN 61032, *Protection of persons and equipment by enclosures – Probes for verification*

BS EN ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods*

PD CEN/TR 1749¹⁾, *European scheme for the classification of gas appliances according to method of evacuation of the combustion products (types)*

¹⁾ In preparation.

3 Terms and definitions

For the purposes of this British Standard, the following terms and definitions, together with those given in BS 1179-6, BS 6230 and the following apply.

3.1 air temperature control

temperature-actuated control intended to maintain the temperature of the discharged air, the return air to the heater, or the air in the heated space between specified limits

NOTE This is the normal means of air temperature control.

3.2 automatic burner system

burner system in which, when starting from the completely shut-down condition, the start-gas flame is established and the main gas valve(s) is actuated without manual intervention

NOTE 1 Automatic burners may have pilots that are interrupted or intermittent.

NOTE 2 This definition differs from that given in BS 1179-6.

3.3 automatic recycling

automatic repetition of the starting-up sequence without manual intervention

3.4 burner

combustion system under the control of a single system of safety shut-off valves

NOTE 1 An appliance may have more than one burner and a burner may comprise a number of separate nozzles or bars.

NOTE 2 This definition differs from that given in BS 1179-6.

3.5 forced convection air heater

appliance designed to provide space heating from a central source by distributing heated air, by means of an air-moving device, either through ducting or directly into the heated space

3.6 hazardous condition

condition that could result in damage external to the appliance and/or injury to personnel

3.7 indirect fired air heater

appliance in which the products of combustion are separately vented and do not mix with the heated air being supplied to the space

3.8 lock-out

safety shut-down condition of a control system such that restart cannot be accomplished without manual intervention

3.9 minimum operational rate

70% of the minimum rate of the control system

3.10 multifunctional control

assembly comprising two or more gas control devices in addition to a gas tap and any gas rate adjuster within a single housing

3.11 natural draught burner

burner that does not employ a fan for the entrainment of air, either forced or induced

NOTE 1 The term includes atmospheric injectors and neat gas burners

NOTE 2 This definition differs from that given in BS 1179-6.

3.12 non-automatic burner system

burner system that is non-automatic within the meaning of **3.2**, i.e. a burner with a permanent pilot ignited under manual supervision

3.13 overheat (limit) control

temperature-actuated device preset and sealed by the manufacturer and designed to protect the appliance and its surroundings in the event of failure of the normal means of temperature control

NOTE This definition differs from that given in BS 1179-6.

3.14 rated heat input

appliance manufacturer's declared heat input for the appropriate reference test gas

3.15 safety shut-down

action of shutting off all gas and ignition energy by means of a safety control such that restart takes place only after manual intervention or automatic recycling

3.16 setting pressure

pressure, measured at the pressure test point, that is specified by the manufacturer for the purpose of adjusting the appliance heat input

3.17 start-gas flame

flame established at the start-gas rate

NOTE This may be either a pilot flame or the main burner flame at reduced rate.

3.18 claimed efficiency (E_c)

net efficiency of an appliance claimed by the manufacturer

3.19 test house efficiency (E_t)

net efficiency of an appliance measured at the test house on a sample submitted for type approval purposes

3.20 verification efficiency (E_v)

net efficiency of an appliance measured during any surveillance or check testing of production appliances

3.21 heater with integral fan in the secondary flue

appliance incorporating an integral fan downstream of the draught diverter which is used to assist in the evacuation of products of combustion

3.22 equivalent resistance

resistance to flow in mbar, measured at the outlet of the appliance, which is equivalent to that of the flue

4 Classification of appliances**4.1 By category**

BS EN 437 describes the category system of appliance classification in which an appliance is denoted by a category number I, II or III according to the number of gas families that it is designed to burn, these families being identified by subscript numbers 1, 2 and 3 for the 1st, 2nd and 3rd families respectively, and subscript letters identifying specific gas groups.

This standard is concerned with appliances of category I_{2H} only.

4.2 By flue type

Appliances are also classified according to the flue system for which they are designed and the source of combustion air.

- Type A: flueless appliances.
- Type B: open-flued appliances.
- Type C: room-sealed appliances.
- Type C₁: balanced flue appliances.
- Type C₂: se-duct appliances

This standard covers appliances of type B only.

The definitions of the specific variations of type B appliances are as given in PD CEN/TR 1749.

5 General requirements

The appliance shall conform to the requirements of this standard when tested using the test gases specified in BS EN 437 for group H 2nd family gas.

Any new features incorporated in an appliance for which no provision for testing is made in this standard shall not adversely affect the safe and correct operation of the appliance. The new features shall be examined in the light of the manufacturer's claims and instructions. The claims shall be checked against the instructions and shall be valid.

Notwithstanding the requirements in this standard, any new designs, materials and methods of assembly are permissible provided that at least equivalent results are achieved.

6 General conditions of test

6.1 Test room

The test room shall be adequately ventilated but free from draughts that are likely to affect the performance of the appliance.

The temperature in the test room shall be maintained at $(20 \pm 5) ^\circ\text{C}$.

The air in the test room, and any external air supply, shall contain not more than 1 000 parts per million (0.1% (V/V)) of carbon dioxide or 10 parts per million (0.001% (V/V)) of carbon monoxide.

6.2 Preparation of appliance for testing

The appliance shall be set up in accordance with the manufacturer's instructions, with particular reference to minimum declared clearances round the appliance. It shall then be adjusted in accordance with the manufacturer's instructions using test gas G20 at an inlet pressure of 17.5 mbar²⁾.

Before any tests are made, the appliance shall be operated at its maximum rated heat input, using normal distributed gas, for a period sufficient to dry any insulation and remove any temporary finish that might interfere with observations.

Appliances with an integral fan in the secondary flue (natural draught burners) shall be installed on a flue of manufacturer's minimum specified equivalent resistance unless otherwise directed in the particular test.

Other appliances having a vertical flue outlet shall be fitted with the minimum length of vertical secondary flue specified by the manufacturer and having the same nominal diameter as the flue outlet.

Other appliances having a horizontal flue outlet shall be fitted in accordance with the manufacturer's instructions; these shall include the maximum length of horizontal run and the method of adaptation to a vertical flue. Thereafter the vertical flue shall be fitted as above.

6.3 Test procedure

The appliance shall be examined for gas soundness before and after the tests specified in this standard.

The test results shall be deemed to be invalid unless the gas system is sound.

²⁾ 1 mbar = 100 N/m² = 0.1 kPa.

The appliance shall be at room temperature at the start of each test unless the test method specifies otherwise.

Unless the test method specifically requires otherwise, the appliance shall be operated at the design temperature rise $\pm 10\%$.

During testing, the initial adjustment of the appliance shall not be altered unless specifically required by the test method.

Precautions shall be taken to prevent thermostats or other variable controls from acting so as to interfere with the gas flow, except as necessitated by the test.

Gas test pressures shall be accurate to within ± 0.2 mbar and so controlled that the variation does not exceed ± 0.2 mbar.

In general, except for tests involving governor performance, the appliance governor may be put out of action and the specified test pressure obtained by adjustment of the gas pressure at the inlet to the appliance.

The heat input to the appliance shall be determined as specified in **6.3.2** of BS EN 621:1998 or **6.3.2** of BS EN 1020:1998 depending on whether the appliance incorporates a fan to assist transportation of combustion air and/or combustion products.

7 Design and construction

7.1 All appliances

7.1.1 Materials, fittings and finishes

The appliance, including all its component parts, shall be soundly constructed and of a high standard of workmanship and finish.

Materials shall be of a type, quality and thickness appropriate to the application. In particular, all parts of the equipment shall be resistant to mechanical stresses, including shock, vibrationally or chemically or thermally induced, to which they may be exposed during any conditions of operation. Under normal conditions of use, maintenance and adjustment they shall show no changes that might adversely affect their function.

Such materials, fittings and finishes shall conform to the requirements of the relevant British Standards and shall all be appropriate to the conditions arising in the part of the appliance in which they are used.

The appliance and its components shall be free from swarf, grit or other foreign matter.

Materials containing asbestos shall not be used.

7.1.2 Flueways: natural draught burners

For air heaters fitted with natural draught burners, the combustion chamber and flueways shall be so designed that there is no descending section that is capable of creating reverse flows.

7.1.3 Component location

Parts that are intended to be removable for maintenance or cleaning shall be readily accessible, shall be easy to assemble correctly and

impossible to assemble incorrectly where incorrect assembly would create a hazardous condition or result in damage to the appliance and its controls.

The burner(s) shall be positively located and so arranged that misalignment cannot occur.

It shall not be possible to loosen complete burner assemblies, jets or injectors without the use of tools.

7.1.4 Injectors and jets

Injector and jet orifice areas shall be non-adjustable.

7.1.5 Gas rate adjusters

Adjustable gas rate adjusters shall be readily distinguishable from other manual valves.

The setting of adjusters shall be protected by a method that discourages unauthorized adjustment.

7.1.6 Materials in contact with gas

Copper tubing shall not be used where it is likely to be exposed to temperatures above 100 °C.

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

7.1.7 Aeration adjustment (natural draught burners)

Any means of adjusting the primary aeration of natural draft burners shall be preset and locked by the manufacturer.

7.1.8 Insulation

Thermal or acoustic insulation shall be non-combustible in accordance with the requirements of BS 476-4, shall be securely located and shall be protected against mechanical damage, condensate and vermin.

Gas-carrying parts in contact with, or passing through, insulating material shall be adequately protected against possible corrosive effects of the insulant.

7.1.9 Fire properties

The appliance shall, wherever possible, be constructed of materials that are non-combustible in accordance with the requirements of BS 476-4. Any coating that may be applied to the outside surface of the appliance shall have class 1 surface spread of flame characteristics when tested on the substrate according to the requirements of BS 476-7.

Air filter material shall possess ignitability characteristics designated 'P' when tested in accordance with BS 476-12.

7.1.10 Fan compartment

Access to the air fan compartment for maintenance shall not be possible without the use of tools.

Products of combustion shall not be drawn into the air distribution system either under normal operating conditions or when user access panels are removed.

7.1.11 Gas connections

Gas inlet connections shall be suitable for connection to one of the following:

- a) tapered thread installation pipes in accordance with BS EN 10226-1 and BS EN 10226-2;
- b) flanged pipes and fittings in accordance with BS 10 or BS EN 1092-1 and BS EN 1515-1.

7.1.12 Bolts and screws

Drilling for bolts and screws shall not connect with fuel gasways. The minimum wall thickness shall be at least 1 mm.

Self-tapping screws are not recommended, but where they are used to secure components that are removed during servicing, they shall be fitted with spire-type clips.

Where hexagon headed screws are used to secure components that are removed during servicing, they shall be provided with screwdriver slots, where possible, if this facilitates servicing.

7.1.13 Viewing port

Means shall be provided to allow observation of pilot and burner flames. If the means of observation is a viewing port, it shall, when located in an area of positive pressure and high temperature, be covered with heat resistant, toughened glass and sealed with a suitable heat resistant sealant.

7.1.14 Servicing

There shall be easy access to components and controls that might require servicing or adjustment.

The appliance shall be fitted with access doors or removable panels to facilitate servicing.

In addition, union or flanged connections shall be provided to permit the removal of the burner assembly from the appliance and disconnection of the appliance from the gas supply.

Appliances shall be so designed that periodic servicing, inspection or parts replacement are not normally required more than once per year. Any known deviation from this requirement shall be the subject of negotiation between the manufacturer and the testing authority.

NOTE Filters may require changing or cleaning more often than once per year, and this is acceptable.

A burner that can be retracted from the combustion chamber or is provided with swivel flanges to allow the burner to be swivelled from the combustion chamber shall be provided with a safety device to prevent accidental swivelling. If the burner can be retracted or swivelled without the use of tools it shall also be provided with an interlock to cause lock-out if the burner is retracted or swivelled from the firing position.

7.1.15 Panel anchorage

Panels that are normally removed for servicing shall be fitted with anchor lines where the appliance is intended to be installed other than at floor level. This requirement shall be deemed to be satisfied if suitable hinges are fitted.

7.1.16 Unions and flanges

Unions in fuel gasways shall be of the cone or spherical-seated type. Flange joints shall include a gasket resistant to the action of components of the gas and suitable for the temperature to which it is likely to be exposed.

7.1.17 Flexible pipes

Flexible pipes shall be metal armoured and have screwed or flanged connections. Flexible pipes shall withstand at least three times the working pressure with a minimum of 3.5 bar at both maximum and minimum service temperatures. There shall be electrical continuity across such pipes. There shall be a manual isolating valve in a readily accessible position upstream of the inlet of any section of flexible pipe.

7.1.18 Components and controls

Components and controls fitted to the appliance shall conform to the requirements of relevant British Standards.

Gas-carrying controls shall be sited externally to the air duct so as to prevent ingress of gas into the discharged air.

Where controls are enclosed in a separate compartment, the compartment shall be adequately ventilated. The vent shall be so sited that it cannot be obstructed by foreign matter, birds, etc.

Bypasses shall not be provided around any item of safety equipment.

7.1.19 Air inlets

Where the inlet air is intended to be ducted to the heater, the appliance shall be provided with flanged or spigot connections on the air inlet. If necessary the manufacturer shall supply a suitable adaptor in order to meet this requirement.

7.1.20 Air outlets

The air outlet(s) of a ductless heater shall be fitted with directional louvres that are capable of adjustment between horizontal discharge and discharge at an angle of at least 45° downwards from the horizontal. When the louvres are in the position of maximum closure, the minimum requirements for functional purposes shall be satisfied.

Ducted air heaters shall have air outlets equipped with flanges or spigots to facilitate connection of ductwork or flexible connectors.

7.1.21 Facility for remote control

Appliances shall be capable of being controlled remotely by means of thermostats and a time control.

7.1.22 Durability of protective finishes

7.1.22.1 General

Materials that are used for the construction of parts that are not normally subject to service and maintenance shall be adequately protected against corrosion.

7.1.22.2 Galvanized parts

Galvanized parts shall conform to the requirements of BS EN ISO 1461, BS EN 10143 or BS 4921 as appropriate.

Galvanized parts, or samples thereof, shall be subjected to non-destructive tests as specified in BS EN 12329 or other relevant standards and shall conform to the requirements of those standards.

7.1.22.3 Painted and plastics coated parts

Painted or plastics coated surfaces shall conform to the following requirements.

a) *Resistance to heating*

There shall be no appreciable change of colour on any part of the appliance, and the finish shall not become tacky or show other signs of deterioration at the end of the drying out period as specified in 6.2.

NOTE This requirement does not apply to parts that come into direct contact with the flame.

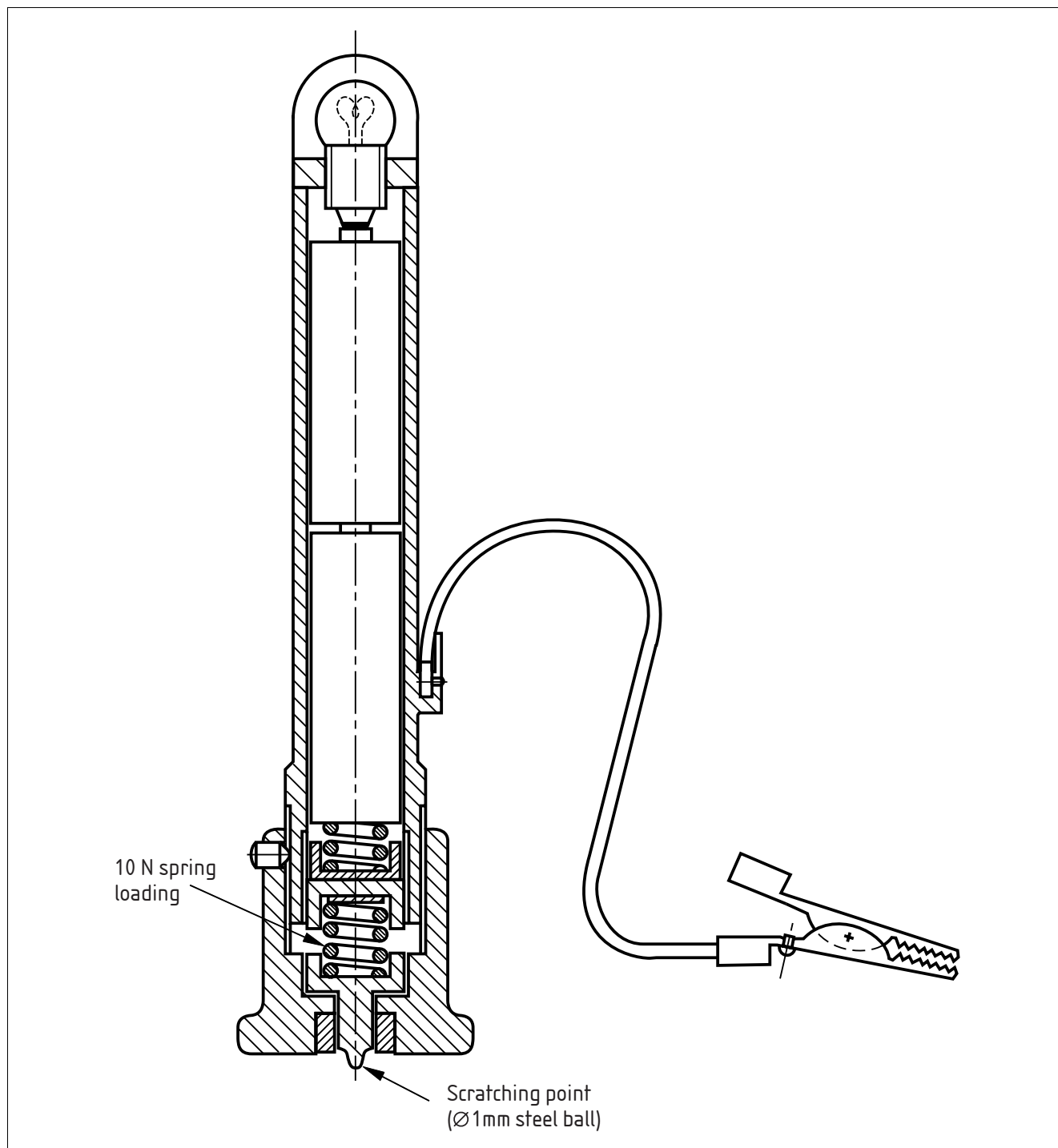
b) *Resistance to abrasion*

Surfaces shall be tested for resistance to scratching. The hardness shall be such that the protective film is not penetrated when subjected to the following test. The scratch shall not have a width greater than 1 mm at any point along its length.

Method

Apply the apparatus (see Figure 1) to the surface under test and move the ball, after loading with a force of 10 N, at 30 mm/s to 40 mm/s relative to the surface. If the indicator lamp lights, the surface is deemed to have been penetrated. A metallic paint applied directly to a metal surface will cause the lamp to light without penetration and, in this case, the paint surface should be visually examined for penetration. Clean the ball after each test and inspect it frequently to verify that it remains a 1 mm sphere.

Figure 1 Paint scratch test apparatus (see 7.1.22.3)



7.1.22.4 Plated parts

Electroplated metal parts shall have a standard of adhesion and resistance to corrosion equivalent to the requirements of BS EN 12540 for service condition no.2 (appliance designed for indoor installation) or service condition no.3 (appliance designed for permanent outdoor installation), as appropriate.

7.1.23 Noise

Noise emission shall not be excessive with regard to the application of the air heater.

7.1.24 Smell

After the initial burning-off period the appliance shall not give rise to any unpleasant smell.

7.1.25 Disposal of condensate

An appliance with a claimed thermal efficiency in excess of 92% (based on the net calorific value) shall be provided with means for collection and disposal of condensate.

7.2 Appliances designed for permanent outdoor installation

7.2.1 General

Appliances designed for permanent outdoor installation shall be so constructed that they are fully protected against the rigours of the environmental conditions under which they are expected to operate.

NOTE The top of outdoor units should preferably be so shaped as to prevent the collection of water.

7.2.2 Combustion air inlets

Combustion air inlets shall be so sited that their lowest edge is at least 500 mm above the base of the appliance, or 500 mm above floor level if this is specified in the manufacturer's installation instructions.

Air inlets shall be so designed as to avoid accidental blockage.

7.2.3 Ventilation

The appliance and its casing shall be adequately ventilated.

7.2.4 Access panels and doors

Access panels and doors and such insulation as needs to be removed during normal servicing shall be so designed that repeated removal and replacement does not damage or impair the weatherproofing of the appliance.

7.2.5 Dimensions of openings

No dimension of any opening from the inside of the appliance to the outside air shall be less than 6.5 mm, nor shall any opening permit the entry of a ball of diameter 16 mm applied with a force of 5 N.

7.2.6 Fixing screws

External panels shall be fixed using only hexagon headed screws, except in the case of access panels, which may be fixed by approved hinges and door catches.