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Specification for  
**Electrical safety and performance of  
gas fired space heating appliances  
with inputs 60 kW to 2 MW**

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Spécification pour la sécurité électrique et la performance des appareils  
de chauffage d'ambiance marchant au gaz présentant une énergie absorbée  
allant de 60 kW à 2 MW

Spezifikation für Elektrosicherheit und Leistung von gasbeheizten  
Raumheizgeräten mit Stromaufnahme von 60 kW bis 2 MW

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## Foreword

This standard has been prepared under the direction of the Gas Standards Committee and specifies requirements for the safety and performance of electrical equipment used in the gas fired space heating appliances dealt with in BS 5978, BS 5990 and BS 5991.

Due account has been taken of experience and current practice, both nationally and internationally.

The requirements for electrical equipment have been taken almost entirely from BS 3456 : Part 101 and are those

requirements considered to be particularly relevant to gas fired space heating appliances.

Additional requirements dealing with aspects not covered in BS 3456 : Part 101, but which are specific to gas fired space heating appliances are also included.

The committee acknowledges its debt to the British Gas Corporation for preparing the initial draft.

British Standard Specification for

# Electrical safety and performance of gas fired space heating appliances with inputs 60 kW to 2 MW

## 1. Scope

This standard lays down detailed requirements for the electrical safety and performance, including methods of test, of the gas fired space heating appliances that fall within the scope of BS 5978, BS 5990 and BS 5991.

## 2. References

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

## 3. Definitions

For the purposes of this standard, the definitions given in BS 3456 : Part 101 apply.

The gas fired space heating appliances dealt with in BS 5978, BS 5990 and BS 5991 are considered to be class I appliances as defined in BS 3456 : Part 101.

Supply connections, other than to fixed wiring, are considered to be type X attachments as defined in BS 3456 : Part 101.

## 4. Electrical equipment and wiring

### 4.1 General

**4.1.1** Electrical equipment and wiring shall be suitable for the temperatures to which they are exposed and the service conditions including humidity to which they are subjected.

**4.1.2** In appliances designed for permanent outdoor installation, wiring used shall comply with the requirements for a wet location given in the IEE Regulations for the Electrical Equipment of Buildings.

**4.1.3** Components which may require replacement shall be suitably fixed so as to facilitate replacement.

**4.1.4** All components shall be fitted so that they are adequately protected against mechanical damage.

**4.1.5** Components shall comply with the requirements of the relevant British Standards as far as they reasonably apply.

If components are marked with their operating characteristics, the conditions under which they are used in the appliance shall be in accordance with these markings.

**4.1.6** It shall be possible to connect the supply wires after the appliance has been installed.

### 4.2 Supply connections and external cables and cords

**4.2.1** Cables and flexible cords which are not liable to exceed a temperature of 60 °C under normal working conditions shall conform to the requirements of BS 6007, BS 6500 or BS 6004 as appropriate. Other wiring which is likely to exceed 60 °C under normal working conditions

shall be continuously insulated with suitable high temperature insulation. Where mechanical protection is considered necessary, wiring shall be run in conduits suitable for the purpose. Flexible conduits shall comply with the requirements of BS 731 : Part 1, rigid conduits shall comply with the requirements of BS 31 or BS 4568 as appropriate.

**4.2.2** The space for the supply cables and flexible cords inside the appliance shall be adequate to allow the conductors to be easily introduced and connected, and the covers, if any, fitted without risk or damage to the conductors or their insulation. It shall be possible to check that the conductors are correctly connected and positioned before the cover is fitted.

Detachable flexible cables and cords used for intermediate connection between different parts of an appliance shall not be provided with means for connection such that accessible metal parts are live when one end of the flexible cable or cord is disengaged.

### 4.3 Bushings for cables and cords

**4.3.1** Appliances intended to be permanently connected to fixed wiring shall be provided with cable entries, conduit entries, knock-outs, or glands, which allow connection of the appropriate types of cable or conduit.

**4.3.2** For appliances having a rated current not exceeding 16 A, the entries shall be suitable for cables and conduits having a maximum overall diameter as shown in table 1.

**Table 1. Size of cable and conduit entries**

| Number of conductors<br>including the<br>earthing conductors | Maximum overall diameter |            |
|--------------------------------------------------------------|--------------------------|------------|
|                                                              | Cable                    | Conduit    |
| 2                                                            | mm<br>13.0               | mm<br>16.0 |
| 3                                                            | 14.0                     | 16.0       |
| 4                                                            | 14.5                     | 19.0       |
| 5                                                            | 15.5                     | 19.0       |

**4.3.3** Conduit entries, cable entries and knock-outs shall be so designed or located that the introduction of the conduit does not affect the protection against electric shock or reduce creepage distances and clearances below the values specified in 4.11.

**4.3.4** Inlet openings shall be so designed and shaped, or shall be provided with an inlet bushing, such that the protective covering of the supply cord can be introduced without risk of damage.

Inlet openings in metal for supply cords shall be provided with either a lining or a bushing, both of insulating material, complying with the requirements for supplementary insulation as given in BS 3456 : Part 101.

**4.3.5** Inlet bushings shall be so shaped as to prevent damage to the cable or cord.

They shall be securely fixed and shall not be removable without the aid of a tool.

Inlet bushings shall not be integral with the supply cord nor shall they be of rubber.

**4.3.6** All appliances, except those provided with only a threaded conduit entry for connections to fixed wiring, shall have cord anchorages such that the conductors are relieved from strain, including twisting, where they are connected to the terminals, and that their covering is protected from abrasion, unless the inlet is situated in such a position that stress cannot be applied to the supply wires when the appliance is mounted as specified in the manufacturer's instructions.

Production methods such as moulded-on designs, tying the cable or cord into a knot or tying the ends with string are not permitted; labyrinths or similar means are permitted, provided that it is clear how the power supply cord is to be assembled.

Cord anchorages shall be so designed or located that:

- (a) replacement of the cable or cord is easily performed;
- (b) it is clear how the relief from strain and the prevention of twisting are to be obtained;
- (c) they are suitable for the different types of cable or cord which may be connected, unless the appliance is so designed that only one type of cable or cord can be fitted;
- (d) the cable or cord cannot touch the clamping screws of the cord anchorage, if these screws are accessible or electrically connected to accessible metal parts;
- (e) the cord is not clamped by a metal screw that bears directly on the cord;
- (f) at least one part of the cord anchorage is securely fixed to the appliance;
- (g) screws, if any, that have to be operated when replacing the cable or cord, do not serve to fix any other component, unless, when omitted or incorrectly mounted, they render the appliance inoperative or clearly incomplete or unless the parts intended to be fastened by them cannot be removed without the further aid of a tool during the replacement of the cable or cord;
- (h) they are of insulating material or are provided with an insulating lining, if otherwise an insulation fault on the cable or cord could make accessible metal parts live.

Compliance with this clause shall be checked by inspection and by the following tests.

**TEST.** The appliance shall be fitted with a suitable power supply cord and the conductors shall be introduced into the terminals, the terminal screws, if any, being tightened just sufficiently to prevent the conductors from easily changing their position. The cord anchorage shall be used in the normal way, its clamping screws being tightened with a torque equal to that specified in table 3.

The tests shall first be made with the lightest permissible type of cable or cord of the smallest cross-sectional area specified in 4.4.2, and then with the next heavier type of

cable or cord of the largest cross section specified, unless the appliance is so designed that only one type of cable or cord can be fitted.

It shall not be possible to push the cable or cord into the appliance to such an extent that the cable or cord or internal parts of the appliance could be damaged.

The cable or cord shall then be subjected 25 times to a pull of 100 N. The pulls shall be applied in the most unfavourable directions without jerks, each time for 1 s.

Immediately afterwards, the cable or cord shall be subjected for 1 min to a torque of 0.35 N m.

During the tests the cable or cord shall not be damaged.

After the tests, the cable or cord shall not have been longitudinally displaced by more than 2 mm, the conductors shall not have moved over a distance of more than 1 mm in the terminals and there shall be no appreciable strain at the connection.

For the measurement of the longitudinal displacement, a mark shall be made on the cable or cord at a distance of approximately 20 mm from the cord anchorage or other suitable point before starting the tests. After the tests, the displacement of the mark shall be measured while the cable or cord is subjected to the pull.

Creepage and clearance distances shall not be reduced below the values specified in 4.11.

**4.4 Terminals for external conductors**

**4.4.1** Appliances intended to be permanently connected to fixed wiring and appliances intended to be connected by means of a non-detachable flexible cable or cord shall be provided with terminals in which connection is made by means of screws, nuts or other equally effective devices. Screws and nuts that clamp external conductors shall have an ISO metric thread complying with the requirements of BS 3643 or a thread comparable in pitch and mechanical strength. They shall not serve to fix any other component, except that they may also clamp internal conductors if these are arranged so that they are unlikely to be displaced when fitting the supply conductors.

**NOTE.** Terminals of a component incorporated in the appliance may be used for the connection of external conductors, provided that they comply with the relevant requirements of this specification.

**4.4.2** Terminals shall allow the connection of conductors having nominal cross-sectional areas as shown in table 2.

**Table 2. Conductor cross-sectional areas for which terminals shall be suitable**

| Rated current of appliance     | Nominal cross-sectional area |                         |
|--------------------------------|------------------------------|-------------------------|
|                                | Flexible cables and cords    | Cables for fixed wiring |
| A                              | mm <sup>2</sup>              | mm <sup>2</sup>         |
| Up to and including 6          | 0.75 to 1                    | 1 to 2.5                |
| Over 6 up to and including 10  | 0.75 to 1.5                  | 1.5 to 2.5              |
| Over 10 up to and including 16 | 1 to 2.5                     | 1.5 to 4                |
| Over 16 up to and including 25 | 2.5 to 4                     | 2.5 to 6                |
| Over 25 up to and including 32 | 4 to 6                       | 4 to 10                 |
| Over 32 up to and including 40 | 6 to 10                      | 6 to 16                 |
| Over 40 up to and including 63 | 10 to 16                     | 10 to 25                |

**4.4.3** Terminals shall be so fixed that, when the clamping means is tightened or loosened, the terminal does not work loose, internal wiring is not subjected to stress, and creepage distances and clearances are not reduced below the values specified in 4.11.

Compliance shall be checked by measurement after fastening and loosening a conductor of the largest cross-sectional area specified in 4.4.2 ten times, the torque applied being that shown in table 3.

The conductor shall be moved each time the screw or nut is loosened.

**Table 3. Torque values for screws and nuts**

| Nominal diameter of screw        | Torque               |                       |                        |
|----------------------------------|----------------------|-----------------------|------------------------|
|                                  | I<br>(See<br>note 1) | II<br>(See<br>note 2) | III<br>(See<br>note 3) |
| mm                               | N m                  | N m                   | N m                    |
| Up to and including 2.8          | 0.2                  | 0.4                   | 0.4                    |
| Over 2.8 up to and including 3.0 | 0.25                 | 0.5                   | 0.5                    |
| Over 3.0 up to and including 3.2 | 0.3                  | 0.6                   | 0.6                    |
| Over 3.2 up to and including 3.6 | 0.4                  | 0.8                   | 0.6                    |
| Over 3.6 up to and including 4.1 | 0.7                  | 1.2                   | 0.6                    |
| Over 4.1 up to and including 4.7 | 0.8                  | 1.8                   | 0.9                    |
| Over 4.7 up to and including 5.3 | 0.8                  | 2.0                   | 1.0                    |
| Over 5.3 up to and including 6.0 | —                    | 2.5                   | 1.25                   |

NOTE 1. Metal screws without heads if the screw, when tightened, does not protrude from the hole.

NOTE 2.

(a) Other metal screws and for nuts

(b) For screws of insulating material

(1) having a hexagonal head with the dimension across flats exceeding the overall thread diameter, or

(2) with a cylindrical head and a socket for a key, the socket having a cross-corner dimension exceeding the overall thread diameter, or

(3) with a head having a slot or cross slots, the length of which exceeds 1.5 times the overall thread diameter.

NOTE 3. Other screws of insulating material.

**4.4.4** Terminals shall be so designed that they clamp the conductor between metal surfaces with sufficient contact pressure and without damage to the conductor.

NOTE. Conductors are considered to be damaged if they show deep or sharp indentations.

**4.4.5** Terminals shall not require special preparation of the conductor in order to effect correct connection and they shall be so designed or placed that the conductor cannot slip out when the clamping screws or nuts are tightened.

NOTE. The term 'special preparation of the conductor' covers soldering of the strands, use of cable lugs, formation of eyelets etc., but not the re-shaping of the conductor before its introduction into the terminal or the twisting of a stranded conductor to consolidate the end.

**4.4.6** Dimensions of screw terminals shall be not less than those shown in table 4, except that the length of the thread in the screw hole or nut and the length of thread on the screw may be reduced if the mechanical strength is adequate and at least two full threads are in engagement when a conductor of the largest cross-sectional area specified in 4.4.2 is lightly clamped.

If the required length of thread in a terminal screw hole is obtained by plunging, the edge of the extrusion shall be reasonably smooth and the length of thread shall exceed the specified minimum value by at least 0.5 mm. The length of the extrusion shall be not more than 80 % of the original thickness of the metal, unless the mechanical strength is adequate with a greater length.

If an intermediate part, such as a pressure plate, is used between the head of the screw and the conductor, the length of thread on the screw shall be increased accordingly, but the diameter of the head of the screw may be reduced by:

(a) 1 mm for rated currents not exceeding 16 A;

(b) 2 mm for rated currents exceeding 16 A.

If an intermediate part has more than one screw, screws with the following nominal thread diameter may be used:

(a) 3.5 mm for rated currents not exceeding 25 A;

(b) 4.0 mm for rated currents exceeding 25 A.

If the thread in the screw hole or nut is recessed, the length of headed screws shall be increased accordingly.

**Table 4. Dimensions of screw-type terminals**

| Rated current of appliance     | Nominal thread diameter | Length of thread on screw | Length of thread in screw hole or nut | Nominal difference between diameters of head and shank of screw | Height of head of screw |
|--------------------------------|-------------------------|---------------------------|---------------------------------------|-----------------------------------------------------------------|-------------------------|
| A                              | mm                      | mm                        | mm                                    | mm                                                              | mm                      |
| Up to and including 10         | 3.5                     | 4.0                       | 1.5                                   | 3.5                                                             | 2.0                     |
| Over 10 up to and including 16 | 4.0                     | 5.5                       | 2.5                                   | 4.0                                                             | 2.4                     |
| Over 16 up to and including 25 | 5.0                     | 6.5                       | 3.0                                   | 5.0                                                             | 3.0                     |
| Over 25 up to and including 32 | 5.0                     | 7.5                       | 3.0                                   | 5.0                                                             | 3.5                     |
| Over 32 up to and including 40 | 5.0                     | 8.5                       | 3.0                                   | 5.0                                                             | 3.5                     |
| Over 40 up to and including 63 | 6.0                     | 10.5                      | 3.5                                   | 6.0                                                             | 5.0                     |

**4.4.7** Stud terminals shall be provided with washers; dimensions shall be as shown in table 5.

**4.4.8** Each terminal shall be located in proximity to its corresponding terminal(s) of different polarity and to the earthing terminal.

**4.4.9** Terminal devices shall not be accessible without the aid of a tool, even if their live parts are not accessible.

**4.4.10** Terminal devices intended for the connection of non-detachable flexible cables or cords shall be so located or shielded that, should a wire of stranded conductor escape when the conductors are fitted, there is no risk of accidental connection between live parts and accessible parts.

**TEST.** An 8 mm length of insulation shall be removed from the end of the flexible conductor. One wire of the stranded conductor shall be left free and the other wires shall be fully inserted into and clamped in the terminal. The free wire shall be bent, without tearing the insulation back, in every possible direction without making sharp bends round barriers.

The free wire of a conductor connected to a live terminal shall not touch any metal part which is accessible or is connected to any accessible metal part. The free wire of a conductor connected to an earthing terminal shall not touch any live part.

**4.4.11** With the appliance operating at its maximum rated input and with the supply voltage at 110 % of the maximum stated voltage, the temperature rise on terminals, including earth terminals, shall not exceed 60 K unless they are provided with a supply cord.

**4.5 Internal wiring**

**4.5.1** Wireways shall be smooth and free from sharp edges. Wires shall be protected so that they do not come into contact with burrs, cooling fins etc., that may cause damage to their insulation.

Holes in metal through which insulated wires pass shall have smooth well-rounded surfaces, i.e. where the radius of curvature is at least 1.5 mm, or be provided with bushings.

Wiring shall be effectively prevented from coming into contact with moving parts.

**4.5.2** Internal wiring and electrical connections between different parts of the appliance shall be adequately protected or enclosed.

**4.5.3** Beads and similar ceramic insulators in live wires shall be so fixed or supported that they cannot change their position; they shall not rest on sharp edges or sharp

corners. If beads are inside flexible metal conduits, they shall be contained within an insulating sleeve, unless the conduit cannot move in normal use.

**4.5.4** Internal wiring shall be either so rigid and so fixed or so insulated that, in normal use, creepage distances and clearances cannot be reduced below the values specified in 4.11.

The insulation, if any, shall be such that it cannot be damaged in normal use.

**4.5.5** If the insulation of a conductor is not at least electrically equivalent to that of the cables or flexible cords complying with the requirements of BS 6500, that conductor is considered to be a bare conductor. In case of doubt an electric strength test is made between the conductor and metal foil wrapped round the insulation, a test voltage of 2000 V being applied for 15 min.

**4.5.6** In appliances intended to be permanently connected to fixed wiring, the bottom contact of D-type fuse-bases shall be directly connected to the terminal intended for the phase conductor of the supply.

**4.5.7** Aluminium wires shall not be used for internal wiring.

**4.6 Earthing**

**4.6.1** Accessible metal parts that may become live in the event of an insulation fault shall be permanently and reliably connected to an earthing terminal within the appliance, or to the earthing contact of the appliance inlet. Earthing terminals and earthing contacts shall not be electrically connected to the neutral terminal.

**4.6.2** Earthing terminals for the connection of external conductors shall comply with the requirements specified in 4.4.

External earthing terminals, if any, shall permit the connection of conductors having nominal cross-sectional areas of 2.5 mm<sup>2</sup> to 6 mm<sup>2</sup> and shall not be used to provide earthing continuity between different parts of the appliance.

The clamping means of earthing terminals shall be adequately locked against accidental loosening and it shall not be possible to loosen them without the aid of tools. Screwless terminals shall not be used for the connection of earthing conductors of external flexible cables and cords.

**4.6.3** If detachable parts have an earth connection, this connection shall be made before the current-carrying connections are established when placing the part in position, and the current-carrying connections shall be separated before the earth connection is broken when removing the part.

**Table 5. Dimensions of stud-type terminals**

| Rated current of appliance         | Nominal thread diameter | Difference between thread diameter and: |                                  |
|------------------------------------|-------------------------|-----------------------------------------|----------------------------------|
|                                    |                         | Inner diameter of washers (max.)        | Outer diameter of washers (min.) |
| A                                  | mm                      | mm                                      | mm                               |
| Up to and including 10             | 3.0*                    | 0.4                                     | 4.0                              |
| Over 10 and up to and including 16 | 3.5                     | 0.4                                     | 4.5                              |
| Over 16 and up to and including 25 | 4.0                     | 0.5                                     | 5.0                              |
| Over 25 and up to and including 32 | 4.0                     | 0.5                                     | 5.5                              |

\*For BA threads this value is reduced to 2.8.