

Specification for

**Direct gas-fired forced
convection air heaters
with rated heat inputs
up to 2 MW for
industrial and
commercial space
heating: safety and
performance
requirements
(excluding electrical
requirements)
(2nd family gases)**

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Committees responsible for this British Standard

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- British Combustion Equipment Manufacturers' Association
- British Gas plc
- Calor Gas Limited
- Chartered Institution of Building Services Engineers
- Chief and Assistant Chief Fire Officers' Association
- Health and Safety Executive
- Home Office
- Institution of Gas Engineers
- Liquefied Petroleum Gas Industry Technical Association (UK)
- Loss Prevention Council
- Society of British Gas Industries

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Contents

	Page
Committees responsible	Inside front cover
Foreword	iii
1 Scope	1
2 Definitions	1
3 Classification of appliances	2
3.1 By category	2
3.2 By flue type	2
4 General requirements	2
5 General conditions of test	2
5.1 Test room	2
5.2 Preparation of appliance for testing	2
5.3 Test procedure	3
6 Design and construction	3
6.1 All appliances	3
6.2 Appliances designed for permanent outdoor installation	5
7 Soundness	5
7.1 General	5
7.2 Complete assembly	6
8 Heat input	7
8.1 Measurement	7
8.2 Tolerance	7
8.3 Adjustment	7
9 Combustion	7
9.1 Combustion requirements	7
9.2 Methods of analysis	7
9.3 Conditions of test	8
10 Ignition	8
10.1 Pilot burners and ignition devices	8
10.2 Ignition performance; burner systems with permanent pilots	9
10.3 Ignition performance: burner system with interrupted or intermittent pilots	9
10.4 Ignition performance: burner systems employing direct main flame spark ignition	9
11 Flame stability	9
12 External temperatures	10
12.1 Surface temperatures	10
12.2 Component temperatures	10
13 Manual gas valves	10
14 Automatic controls	10
14.1 General	10
14.2 Governors	10
14.3 Gas strainers	10
14.4 Safety shut-off valves	11
14.5 Combustion air, pre-purge and post-purge	11
14.6 Flame supervision system	12
14.7 Start-gas flame establishment	12
14.8 Main flame establishment	13
14.9 Air-gas ratio control	13
14.10 Thermostats and control of air temperature	13

	Page
15 Motors and fans	14
15.1 General	14
15.2 Fan motor temperature	14
15.3 Lubrication	14
15.4 Marking	14
16 Electricity supply	15
17 Manufacturer's instructions	15
17.1 General	15
17.2 Installation instructions	15
17.3 Servicing instructions	16
17.4 User's instructions	16
18 Facilities for commissioning and testing	16
19 Identification and marking	16
19.1 General	16
19.2 Data plate	17
19.3 Name badge	17
19.4 Appliance parts	17
19.5 Electrical data	17
19.6 Warning notices	17
19.7 Lighting instructions	17
20 Air handling	18
20.1 Air flow rate	18
20.2 Air flow adjustment	18
20.3 Profile plate (where fitted)	18
20.4 Recirculation air	18
21 Surface heat dissipation	18
22 Air delivery volume	18
23 Weather resistance	20
Figure 1 — Paint scratch test apparatus	6
Figure 2 — Test duct for air flow measurement	19
Figure 3 — Anti-swirl device	20
Figure 4 — Air flow regulating device	20
Figure 5 — Connecting bend	21
Figure 6 — Arrangement of spray heads and associated piping for rain test	22
Figure 7 — Details of spray head assembly and construction	23
Table 1 — Surface temperature rise	10
Table 2 — Application of safety shut-off valves	11
Table 3 — Flame supervision device drop-out times	12
Table 4 — Fan motor windings: permissible temperature rises	15
Publications referred to	Inside back cover

Foreword

This British Standard, which has been prepared under the direction of the Gas Standards Policy Committee, replaces BS 5990:1981, which is withdrawn.

This edition introduces technical changes to bring the standard up-to-date, by incorporating Amendments 1 and 2 to the 1981 edition and further technical changes to the titles and clauses **14**, **15** and **19**. It does not reflect a full review of the standard, which will be undertaken in due course.

Corresponding requirements for indirect gas-fired forced convection air heaters are specified in BS 5991.

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

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 to iv, pages 1 to 24, 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 gives detailed requirements, including safety and performance requirements and methods of test, for direct gas fired forced convection air heaters having heat inputs up to 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 direct gas fired forced convection air heaters for use both with and without ducting, and intended primarily for space heating applications. It therefore includes air heaters designed to provide make-up air, door curtain heaters, spray booth heaters, portable air heaters and direct fired air heaters capable of providing full space heating.

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

It also specifies the requirements for transportable direct gas fired forced convection air heaters.

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

For appliances fitted with gas boosters, additional requirements may apply.

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

2 Definitions

For the purposes of this British Standard, the following definitions, together with those given in BS 1179 and the relevant installation standards and codes of practice, apply.

2.1

air-gas ratio control

a system that automatically controls gas and air flow rates so as to maintain the desired air-gas ratio throughout the heat input range of the appliance

2.2

air temperature control

a temperature-actuated control intended to maintain the temperature of the discharged air between specified limits. This is the normal means of air temperature control

2.3

automatic recycling

the automatic repetition of the starting up sequence without manual intervention

2.4

burner

a combustion system under the control of a single system of safety shut-off valves. An appliance may have more than one burner and a burner may comprise a number of separate nozzles or bars

NOTE This definition differs from that given in BS 1179.

2.5

direct fired forced convection air heater

a forced convection air heater in which the products of combustion mix with the heated air being supplied to the space

2.6

forced convection air heater

an 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

2.7

hazardous condition

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

2.8

high temperature direct fired forced convection air heater

a direct fired forced convection air heater designed to operate with an air temperature rise through the appliance greater than 55 K

2.9

lock-out

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

2.10

low temperature direct fired forced convection air heater

a direct fired forced convection air heater designed to operate with a maximum air temperature rise through the appliance of 55 K or less

2.11

overheat (limit) control

an overheat control is a 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.

2.12

profile plates

adjustable plates fitted for the purpose of setting the air flow velocity across the burner

2.13**proved air flow**

the minimum air flow at which the air proving device indicates the presence of air flow

2.14**rated heat input**

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

2.15**safety shut-down**

the 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

2.16**setting pressure**

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

2.17**start-gas flame**

a flame established at the start-gas rate. This may either be a pilot flame or the main burner flame at reduced rate

2.18**transportable direct fired forced convection air heater**

a trolley or skid-mounted direct fired forced convection air heater designed to operate with a maximum air temperature rise through the appliance of 55 K or less

3 Classification of appliances**3.1 By category**

BS 4947 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 subscripts T, N and L for the 1st, 2nd and 3rd families respectively.

This standard is concerned with appliances of category I_N only.

3.2 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 is concerned with appliances of type A only.

4 General requirements

The appliance shall comply with the requirements of this standard when tested using the test gases specified for 2nd family gas. Full details of the test gases are given in BS 4947.

Appliances submitted for test shall be supplied complete with all ancillary equipment, e.g. air filter, bird screens, etc. necessary for normal installation and operation.

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.

5 General conditions of test**5.1 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 ± 5 °C.

The air in the test room, and any external air supply, shall contain not more than 1 000 p.p.m. [0.1% (V/V) of carbon dioxide, 10 p.p.m. (0.001% (V/V)) of carbon monoxide, 0.5 p.p.m. [0.00005 % (V/V)] of nitric oxide or 0.5 p.p.m. [0.00005 % (V/V)] of nitrogen dioxide.

5.2 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 the test gas NGA at an inlet pressure of 17.5 mbar¹⁾.

¹⁾ 1 mbar = 10^2 N/m² = Pa.

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.

5.3 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.

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

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 BS 4947.

6 Design and construction

6.1 All appliances

6.1.1 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 comply with 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.

6.1.2 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.

6.1.3 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.

6.1.4 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.

6.1.5 Fire behaviour 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 476-5.

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

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

- a) tapered thread installation pipes in accordance with BS 21;
- b) flanged pipes and fittings in accordance with BS 4504-1 and BS 4504-2, or BS 10.

6.1.8 Bolts and screws. Drillings 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.

6.1.9 Viewing port. Means shall be provided to allow the installer, commissioning engineer or servicing engineer to observe the pilot and main 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.

6.1.10 Servicing. There shall be easy access to components and controls that may 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.

The burner which can be retracted from the appliance, or which is provided with swivel flanges to allow it to be swivelled from the appliance, shall be provided with a safety device to prevent accidental retraction or swivelling and an interlock which will prevent operation of the burner if it is not located in its normal firing position.

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.

6.1.11 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.

The fittings of suitable hinges is deemed to satisfy this requirement.

6.1.12 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.

6.1.13 Components and controls. Components and controls fitted to the appliance shall comply with 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.

6.1.14 Air strainer. A strainer shall be fitted on the air inlet to the appliance. The maximum strainer hole dimension shall be not less than 6.5 mm, nor shall it permit the entry of a ball of diameter 16 mm applied with a force of 5 N.

The strainer shall be readily accessible for cleaning or replacement; it may be of the cleanable or throw-away type.

6.1.15 Air inlets. Air heaters, other than portable air heaters, shall have flanged or spigot connections on the air inlet.

6.1.16 Air outlets. The air outlet(s) of a ductless heater, other than a transportable 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.

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

6.1.18 Durability of protective finishes

6.1.18.1 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.

6.1.18.2 Galvanized parts. Galvanized parts shall comply with the requirements of BS 729, BS 2989 or BS 4921 as appropriate.

Galvanized parts, or samples thereof, shall be subjected to non-destructive tests as specified in BS 1706, or other relevant standards, and shall comply with the requirements specified in those standards.

6.1.18.3 Painted and plastics coated parts. Painted or plastics coated surfaces shall comply with 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 5.2.