

Specification for

Installation of gas-fired forced convection air heaters for commercial and industrial space heating (2nd family gases)

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Gas Standards Policy Committee (GSE/-) to Technical Committee GSE/30, upon which the following bodies were represented:

- British Flue and Chimney Manufacturers' Association
- British Gas plc
- Confederation for the Registration of Gas Installers
- Consumer Policy Committee of BSI
- Department of Trade and Industry (Consumer Safety Unit, CA Division)
- Health and Safety Executive
- Institute of Domestic Heating and Environmental Engineers
- Institution of Gas Engineers
- Liquefied Petroleum Gas Industry Technical Association (UK)
- Society of British Gas Industries
- Trades Union Congress

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

- British Combustion Equipment Manufacturers' Association
- Home Office
- Loss Prevention Council

This British Standard, having been prepared under the direction of the Gas Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 28 June 1991

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Foreword

This British Standard has been prepared under the direction of the Gas Standards Policy Committee. It is a revision of BS 6230:1982 which is withdrawn. The 1982 edition of this standard as amended by Amendment No. 1 of June 1989 dealt with the installation of air heaters of rated output exceeding 60 kW but, because of the difficulty in interpreting domestic installation standards for industrial applications, the opportunity has been taken to incorporate the installation of air heaters of less than 60 kW rated input into this revision. Any reference to rated input in the title and the scope has not been included.

NOTE In the preparation of this standard the opportunity has been taken to present it in the format of a practice specification as defined in PD 6501. This format allows the requirements of the specification to be supported by recommendations. To comply with this specification the user has to comply with all its requirements. He may depart from recommendations but this would be on his own responsibility and he would be expected to have good reasons for doing so.

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. In particular, attention is drawn to the following.

- a) Statutory Instrument 1358:1984: The Gas Safety (Installation and Use) Regulations 1984.
- b) Statutory Instrument 1065:1985 (as amended): Building Regulations 1985.
- c) Statutory Instrument 1596:1981 (as amended): The Building Standards (Scotland) Regulations 1981.
- d) Statutory Instrument 2000:1988: The Noise Insulation (Amendment) Regulations: 1988.
- e) Statutory Instrument 635:1989: The Electricity at Work Regulations: 1989.
- f) Model Water Bye-laws.
- g) Health and Safety at Work etc. Act 1974.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 22, 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.

Section 1. General

1 Scope

This British Standard specifies the installation requirements of direct and indirect gas-fired forced convection air heaters for space heating, designed for commercial or industrial applications and meeting the requirements of BS 5990 or BS 5991.

This standard applies to installations supplied with 2nd family gases (e.g. natural gas), including mixtures of liquefied petroleum gas (LPG) and air, distributed by a gas supplier and to the installation of heaters in areas where petroleum or other flammable heavier-than-air vapours may be present (see clause 12).

It does not include the safety requirements for installation where flammable dusts, toxic gases or flammable lighter-than-air gases may be present in significant quantities. In such cases it is essential that liaison takes place with the Health and Safety Executive.

The provisions of this standard also apply to air heaters designed to supply make-up air, door curtain heaters, spray booth heaters and transportable air heaters; air heaters designed for use with and without ducting and air heaters designed for permanent outdoor installation.

The provisions of this standard do not apply to heaters complying with BS 5258-4 or BS 5258-13 which are designed for domestic applications.

NOTE 1 If heaters designed primarily for domestic application and complying with BS 5258-4 or BS 5258-13 are installed in commercial or industrial applications, the environment may be such as to require the application of the provisions in this standard relating to hazardous areas, and the presence of flammable and/or corrosive products.

NOTE 2 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 definitions given in BS 1179:1967 and BS 1179-6 apply, together with the following.

2.1 compartment¹⁾

an enclosure specially designed or adapted to house a gas appliance

2.2 condensing appliance

a heater in which condensation of a part of the water vapour in the combustion products is designed to occur within the heater under equilibrium conditions, in order to make use of the latent heat in the water vapour

2.3 damper

a device to regulate, direct or stop the flow of gases/fluids through an opening or duct

2.4 direct-fired air heater

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

2.5 forced convection air heater²⁾

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

2.6 forced-draught burner³⁾

a burner where the combustion air is provided under pressure

2.7 grille³⁾

a non-closable fitment for an opening through which air passes

2.8 hazardous area

an area in which explosive mixtures are or may be expected to be present in such quantities as to require special precautions for the type of construction, installation and use of electrical apparatus and fuel-fired appliances

2.9 indirect-fired air heater

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

¹⁾ Repeated from BS 1179-6:1980.

²⁾ Repeated from BS 5990:1990 and BS 5991:1989.

³⁾ Repeated from BS 1179-6:1980.

2.10**induced-draught burner⁴⁾**

a burner where combustion air is introduced by providing a suction in the combustion chamber by mechanical means

2.11**plant room**

a room in a building which houses plant or machinery

2.12**plenum chamber**

a chamber for receiving air before delivery to a heated space or a combustion system

2.13**recirculation air**

air returned to a forced convection air heater from the space being heated and expressed as a percentage of the total air delivered by the heater, under the same temperature conditions

2.14**transportable direct-fired 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 Exchange of information and planning

NOTE 1 Collaboration is essential between those concerned with the design and installation both at the planning stage and during the execution of work.

Particular matters that shall be considered are:

- a) type of building and form of construction;

- b) sizes and purposes of rooms and working areas;
- c) size, height and route of flue (if any);
- d) provision of adequate air for combustion and ventilation;
- e) assessment of heat losses and heat gains;
- f) gas pressures and the availability of supplies;
- g) electrical supplies;
- h) Statutory Regulations and any local bye-laws;
- i) liaison with fire insurers;
- j) transmission of noise and vibration;
- k) any hazardous area classification of the system's location.

It is the customer's responsibility to ensure that:

- 1) the local authority is consulted with regard to building regulations and planning application requirements;
- 2) the fire authority and/or the enforcing authority under the Health and Safety at Work etc. Act 1974, as appropriate, is consulted in respect of fire precautions;
- 3) the fire insurers are notified of any proposed changes in the means of heating;
- 4) the local gas supplier is advised of the proposed installation of any gas booster or compressor which is either part of the appliance, or an addition to it.

NOTE 2 Main contractors may need to draw their customers' attention to 1), 2), 3) and 4).

⁴⁾ Repeated from BS 179-6:1980.

Section 2. Application

4 Indirect-fired air heaters

4.1 Where vapours/gases or air borne dusts are present in the air which degrade to components that are potentially damaging to the appliance when passed through the combustion zone of a flame, all air to the burner shall be outside air.

Products of combustion from indirect-fired heaters shall discharge into a flue which terminates outside the building (see clause 19).

4.2 Indirect-fired heaters marketed as portable or transportable units shall be installed in exactly the same manner as fixed units.

5 Direct-fired air heaters

5.1 General

5.1.1 Where vapours/gases or air borne dusts are present which degrade to products that are potentially harmful to health when passed through the combustion zone of a flame (see Health and Safety Executive Guidance Note EH 40), all air to the burner shall be outside air.

Recirculation, if practised, shall be downstream of the burner combustion zone.

COMMENTARY AND RECOMMENDATIONS

ON 5.1.1. *In some applications the production process or products stored in the heated space may be affected by constituents of the diluted products of combustion. Where there is any doubt the heater manufacturer should be consulted.*

5.1.2 The total installation, that is the combination of the heater or heaters and the ventilation facilities in the room or rooms supplied with heated air, shall be designed and operated such that the concentration of carbon dioxide at positions where the air is normally, or is likely to be, inhaled by persons present shall not exceed 0.28 % (V/V) (2 800 p.p.m.).

COMMENTARY AND RECOMMENDATIONS

ON 5.1.2. *The specified maximum carbon dioxide concentration is approximately equivalent to one volume of products to 38 volumes of outside air being supplied to the spaces being heated, the volumes being referred to the same temperature. The concentration of carbon dioxide is also approximately equivalent to a net heat input by direct firing of 86 kJ per cubic metre of outside air that enters the room per hour (see Appendix A); or to a gross heat input of 27 W per cubic metre of outside air (which equates to 37 m³ of outside air per kilowatt of gross heat input) that enters the room per hour.*

Where air extraction is not achieved wholly by positive means, e.g. where it is extracted either by relief grilles or partly by fans, knowledge of the air change rate of the room concerned is required in order to assess the maximum heat input that avoids excessive carbon dioxide concentrations.

The recirculation air intake should be located downstream of the burner, unless the appliance is designed for upstream recirculation. (See also 5.1.1.)

It should be noted that systems designed to comply with this standard give environmental concentrations of carbon dioxide, carbon monoxide, oxides of nitrogen and aldehydes as the result of the use of direct fired-gas heating plant well below the limits specified in Health and Safety Executive Guidance Note EH 40.

5.1.3 In rooms where products of combustion are present from sources other than from the direct-fired heater system, e.g. releases from small unflued appliances, the maximum values of combustion products concentrations shall include these local ambient levels (see Appendix B).

COMMENTARY AND RECOMMENDATIONS

ON 5.1.3. *This requirement may limit or preclude the use of direct-fired heaters in some locations.*

5.1.4 Heaters intended for intermittent use, e.g. door curtain heaters, shall not be installed to operate continuously where combustion products concentrations higher than those specified in this standard would be produced and sustained at inhalation levels. A system that ensures that the heater operates intermittently, e.g. door position interlocks, shall be fitted to such installations.

5.2 High and low temperature fixed air heaters

Installations of low temperature fixed air heaters that are subject to adjustment of the recirculation air flow shall be provided with interlocks to prevent changes that would adversely affect combustion.

COMMENTARY AND RECOMMENDATIONS

ON 5.2. *For low temperature fixed air heaters, recirculation air should preferably enter the heater downstream of the burner.*

For high temperature fixed air heaters the temperature of the air discharged into the heated space should not exceed 60 °C. Dilution of the heated air with fresh and/or room air may be necessary to achieve the temperature (see also clause 12).

Elevated duct/appliance exit temperatures may lead to poor temperature distribution in the heated space.

5.3 Transportable air heaters

5.3.1 Adequate ventilation air shall be provided so that the maximum level of concentration of carbon dioxide taken at positions where the heated air will, or is likely to be, inhaled does not at any time exceed 0.28 % (V/V) (2 800 p.p.m.) (see **5.1.2**).

5.3.2 Transportable heaters shall not be controlled by time switches or other remote controls.

5.4 Testing of combustion products

5.4.1 General

Heater installations shall comply with **5.1**, **5.2** and **5.3** when tested in accordance with **5.4.2** and **5.4.3**.

COMMENTARY AND RECOMMENDATIONS
ON **5.4.1**. *Heaters complying with BS 5990 should provide combustion product concentrations equal to or less than those shown in column 3 of Table 2.*

5.4.2 Air heaters supplied with 100 % fresh air

For heaters installed so that all the inlet air over the burner is fresh air, either the carbon dioxide concentration in the heated air or the air temperature rise across the heater (where the temperature rise can be correlated to carbon dioxide levels) shall be measured under conditions of maximum heat input at the minimum and at all other available settings of the fresh air supply rate.

COMMENTARY AND RECOMMENDATIONS
ON **5.4.2**. *For low temperature fixed air heaters, where the temperature rise through the heater does not exceed 55 K, the carbon dioxide concentration will not exceed 0.28 % as specified in 5.1.2. For all other installations, sufficient ventilation will be required to ensure that the specified carbon dioxide concentration is not exceeded (see clauses 12 and 13).*

For installations where air extraction is not achieved wholly by positive means as described in 5.1.2, compliance with specified maximum values can only be checked with certainty by actually testing the atmosphere. In addition, temperature rises below 55 K may be necessary to prevent condensation.

5.4.3 Air heaters with recirculation

For heaters installed with recirculation air, the carbon dioxide concentration in the heated air shall be measured under conditions of maximum heat input and maximum recirculation.

6 Heat input rating for full space heating

If the heater(s) is specified to be the sole means of heating and intended to provide full heating, and not partial or localized heating, the rating shall be adequate to:

- satisfy the steady state requirements of the room(s) to be heated;
- provide a margin above the steady state losses to ensure an appropriate heating up time;
- provide for the heat losses from supply ducting that do not contribute heat to the room concerned.

7 Fan capacity

The heater shall be fitted with a fan of sufficient capacity to overcome all pressure losses in the total system including duct work, filters, heater grilles, etc.

8 Outside location (see clause 11)

Where an air heater is required to be installed outdoors, it shall be of a type specifically designed for open air installations.

Section 3. Selection and installation

9 Materials and components

All materials and components used shall comply with the appropriate British Standard. Materials containing asbestos shall not be used.

10 Heaters

Air heaters for industrial and commercial applications shall comply with BS 5990 or BS 5991, as appropriate. Burner systems shall comply with BS 5885-1, or BS 5885-2, as appropriate.

Electrical equipment shall comply with BS 5986.

COMMENTARY AND RECOMMENDATIONS ON CLAUSE 10. *The burners in these heaters may be either upstream or downstream of the main air fan. The range of heaters includes low temperature and high temperature models. For the purposes of this standard, the low temperature model is limited to an operating temperature rise of 55 K or less, whilst the high temperature model is considered to operate with temperature rises greater than 55 K (see 5.2).*

11 Installation and siting

11.1 General (see clause 8)

11.1.1 Installation and siting shall be in accordance with the manufacturer's installation instructions and associated data sheets.

COMMENTARY AND RECOMMENDATIONS ON 11.1.1. *Heaters which comply with clause 10 will be provided with installation instructions.*

11.1.2 Heaters shall only be installed in locations where the environmental conditions are suitable.

COMMENTARY AND RECOMMENDATIONS ON 11.1.2. *Corrosive or salty atmospheres can cause corrosion and/or failure of metal components, particularly heat exchangers, burners and controls.*

In some locations, dusts from plastics forming/handling processes or gases from cleaning or curing are emitted into the heated space. Such products when passed through the combustion zone of space heating or other fuel burning appliances can produce both toxic and corrosive emissions. It is therefore recommended that in such cases precautions be taken to prevent the dusts/gases from entering the working atmosphere or from entering the combustion spaces or flues of appliances.

High wind speeds can adversely affect burner performance.

Where there is any doubt, the installer should consult the heater manufacturer.

11.1.3 Free-standing heaters shall be either stable or rigidly fixed.

11.1.4 Heaters fitted above floor level shall be securely supported and where necessary constrained to prevent a hazard to personnel.

COMMENTARY AND RECOMMENDATIONS ON 11.1.4. *In addition, consideration should be given to the installation of walkways to assist servicing.*

11.1.5 Heaters sited such that they may suffer external mechanical damage, e.g. from overhead cranes, fork lift trucks, etc., shall be suitably protected.

11.1.6 Combustion and ventilation air shall be provided as specified in clause 13.

11.1.7 Any ducting shall be kept as short and direct as possible having regard to the satisfactory distribution of the heated air and any other relevant factor.

11.1.8 Adequate space shall be allowed and means provided to give ready access for installing, operating and servicing of the burner(s), filter(s), pulleys, motor(s), controls, flueways and any other parts that require regular attention.

COMMENTARY AND RECOMMENDATIONS ON 11.1.8. *Where there is any doubt, the installer should consult the heater manufacturer.*

11.1.9 Clearance shall also be allowed between the heater and its flue and any combustible material (see 11.1.1, 19.1.1 and 19.8).

11.1.10 Floors on which heaters are to be sited shall be capable of withstanding temperatures of at least 65 °C.

11.1.11 Heaters shall not be installed in those parts of spaces within buildings that have been classified as hazardous areas as defined in BS 5345-2.

COMMENTARY AND RECOMMENDATIONS ON 11.1.11. *It should be noted that correct hazardous area classification will normally result in the identification of distinct zones within spaces, i.e. zone 0, 1 and 2. Consequently it may be possible to install heaters in safe areas, as defined, outside or above zones exposed to heavier-than-air vapours/gases.*

11.2 Siting where petroleum and other heavier-than-air flammable vapours are present

11.2.1 Heaters supplying air to hazardous areas shall be located either in the open air (see clause 8) or in a separate room or compartment as specified in 11.2.4.

11.2.2 Heaters shall not be used to supply heated air to hazardous areas unless:

- a) all incoming air to the heater is outside air;