

Specification for installation of gas-fired forced convection air heaters for commercial and industrial space heating (2nd and 3rd family gases)

ICS 97.100.20

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee GSE/30, Gas installations (1st, 2nd and 3rd family gases), upon which the following bodies were represented:

- British Flue and Chimney Manufacturers Association
- Boiler and Radiator Manufacturers Association Ltd.
- BSI Consumer Policy Committee
- Catering Equipment Suppliers Association (CESA)
- Centrica plc
- Council for Registered Gas Installers (CORGI)
- Department of Trade and Industry — Consumer Safety Unit
- Health and Safety Executive
- Heating and Ventilating Contractors' Association
- ICOM Energy Association
- Institute of Domestic Heating and Environmental Engineers
- Institution of Gas Engineers and Managers
- L P Gas Association
- Society of British Gas Industries
- Co-opted members

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Foreword

This British Standard has been prepared by Technical Committee GSE/30. It is a revision of BS 6230:1991, which is withdrawn.

This standard allows manufacturer's instructions to specify a method of installation, testing, commissioning or maintenance which differs in points of detail from this standard. This reference to manufacturer's instructions is allowed only where it will result in at least an equivalent level of safety. In such circumstances, it is important that the manufacturer's instructions are followed.

In particular, attention is drawn to the following regulations. The regulations may be amended from time to time. The commentary in this British Standard reflects the state of the regulations in 2004.

- a) The Gas Appliances (Safety) Regulations [1].
- b) The Gas Safety (Installation and Use) Regulations [2].

These control all aspects of the ways in which gas-fired appliances and systems may be installed, maintained and used, mainly in domestic and commercial premises, and the classes of persons who may undertake gas work.

NOTE These regulations currently do not apply to industrial premises, except those parts used for domestic purposes and sleeping accommodation.

- c) The Building Regulations (for the appropriate legislative region) [3], [4], [5].

These control work carried out in the construction of new buildings or the extension of existing buildings. Detailed advice for England and Wales is given in approved documents [6], [7] and for Northern Ireland, in technical booklets [4]. The Building Standards (Scotland) [5] are accompanied by methods that are deemed to satisfy them.

- d) The Water Supply (Water fittings) Regulations [8].
- e) The Health and Safety at Work etc. Act [9].
- f) The Electricity at Work Regulations [10].

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

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 30, an inside back cover and a back cover.

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1 Scope

This British Standard specifies the installation requirements for direct and indirect gas-fired forced convection air heaters for space heating that are designed for commercial or industrial applications and to which the Gas Appliances (Safety) Regulations 1995 [1] apply.

This standard applies to the installation of appliances that are designed to utilize gases of Group H of the second family (e.g. natural gas), gases of group P of the third family (e.g. propane) as well as gases of group B of the third family (e.g. butane) when supplied under the conditions of the third family pressure couple (see BS EN 437:2003).

NOTE 1 This standard does not specifically cover LPG/air for which additional requirements might be necessary.

This standard applies to the installation of direct gas-fired air heaters within the scope of BS EN 525:1998 and to indirect gas-fired forced convection air heaters within the scope of BS EN 621:1998, BS EN 1020:1998 and, where appropriate, BS EN 1196:1998. These standards cover air heaters having a net heat input not exceeding 300 kW. This standard also applies to the installation of direct gas-fired air heaters within the scope of BS 5990:1990 and to indirect gas-fired forced convection air heaters within the scope of BS 5991:1989. These standards cover air heaters having a gross heat input greater than 330 kW but not exceeding 2 MW (1.8 MW net).

NOTE 2 For the purposes of this standard, installation includes design, inspection and commissioning. It is recognized that each of the tasks can be performed at the same time by different persons.

NOTE 3 The ratio of gross to net heat input is approximately 1.11:1 for Group H (natural gas), 1.09:1 for group P (propane) and 1.08:1 for group B (butane).

NOTE 4 The ventilation rates in cm^3/kW of heat input given in this standard are based on the net calorific value.

This standard also applies to air heaters designed to supply make-up air, door curtain heaters and transportable air heaters. It also covers installation of heaters in areas where petroleum or other flammable heavier-than-air vapours can be present (see 5.1.2).

It does not include the safety requirements for installation where flammable dusts, toxic gases or flammable lighter-than-air gases might be present in significant quantities.

NOTE 5 In such cases it is essential that liaison takes place with the Health and Safety Executive.

This standard does not apply to the installation of air heaters to which the Gas Appliances (Safety) Regulations 1995 [1] do not apply, or that are designed for use in domestic premises.

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 476-20:1987, *Fire tests on building materials and structures — Part 20: Method for determination of the fire resistance of elements of construction (general principles)*.

BS 476-21:1987, *Fire tests on building materials and structures — Part 21: Methods for determination of the fire resistance of loadbearing elements of construction*.

BS 476-22:1987, *Fire tests on building materials and structures — Part 22: Methods for determination of the fire resistance of non-loadbearing elements of construction*.

BS 476-23:1987, *Fire tests on building materials and structures — Part 23: Methods for determination of the contribution of components to the fire resistance of a structure*.

BS 5990:1990 including Amendment 1:1990, *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)*.

BS 5991:1989, *Specification for indirect 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)*.

BS 7671:2001, *Requirements for electrical installations — IEE Wiring Regulations — Sixteenth edition*.

BS EN 525:1998, *Non-domestic direct gas-fired forced convection air heaters for space heating not exceeding a net heat input of 300 kW*.

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 1196:1998, *Domestic and non-domestic gas-fired air heaters — Supplementary requirements for condensing air heaters.*

BS EN 60079-10:2003, *Electrical apparatus for explosive gas atmospheres — Part 10: Classification of hazardous areas.*

EH 40:2002, *Occupational exposure limits.* Sudbury: HSE Books, 2002.¹⁾

IGE/UP/2, *Gas installation pipework, boosters and compressors on industrial and commercial premises.* Institution of Gas Engineers and Managers: London, 1994 (amended in 1995).²⁾

Code of practice No. 22: *LPG Piping System Design and Installation.* LP Gas Association, 1996.³⁾

3 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in BS EN 525:1998, BS EN 621:1998, BS EN 1020:1998, BS EN 1196:1998, BS 5990:1990, BS 5991:1998 and the following apply.

3.1

condensing appliance

air heater in which, under normal operating conditions, the water vapour in the combustion products is totally or partially condensed in order to make use of the latent heat in the water vapour for heating purposes

3.2

damper

device to regulate, direct or stop the flow of gases or fluid through an opening or duct

3.3

direct gas-fired air heater

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

3.4

enclosure

space in which an air heater(s) is installed which is not large enough to permit access for work other than maintenance

3.5

forced convection air heater

appliance that provides space heating from a single source by distributing heated air by means of an air-moving device, either through ducting or directly into the heated space

3.6

grille

non-closable fitment for an opening through which air passes

¹⁾ Obtainable from HSE Books, PO Box 1999, Sudbury, Suffolk, CO10 2WA.

²⁾ Obtainable from Publications Sales, IGEM, Charnwood Wing, Ashby Close, Loughborough, Leicestershire, LE11 3GR.

³⁾ Obtainable from the LP Gas Association, Pavilion 16, Headlands Business Park, Salisbury Road, Ringwood, Hampshire, BH24 3PB.

3.7**hazardous area**

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

NOTE See BS EN 60079-10:2003 which also defines hazardous areas.

3.8**indirect-fired air heater**

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

3.9**plant room**

room which houses plant or machinery including air heaters

3.10**plenum chamber**

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

3.11**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

3.12**transportable direct-fired air heater**

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

4 Selection of equipment and pre-installation**4.1 Exchange of information and planning****4.1.1 General**

Where this is required under the provisions of the Gas Safety (Installation and Use) Regulations [1] the installation work shall be carried out by a business or self-employed person, who is a “member of a class of persons approved for the time being by the Health and Safety Executive (HSE)”.

Persons carrying out the work shall be competent.

COMMENTARY AND RECOMMENDATIONS ON 4.1.1. *At the time of publication, the body with HSE approval to operate and maintain a register of businesses who are “members of a class of persons” is the Council for Registered Gas Installers (CORGI).*

Persons deemed competent to carry out gas work are those who hold a certificate of gas safety competence acceptable to CORGI, which includes (without limitation) the Accredited Certification Scheme (ACS) and the Gas Services S/NVQ that has been aligned with ACS. However, some ACOP certification for industrial installations might continue for some time.

4.1.2 Design considerations

The design shall be such that the installation is in accordance with the heater manufacturer's instructions.

NOTE 1 It is essential that persons who design the system or installation have a knowledge and understanding of the standards and regulations that apply to ensure that the completed plans will produce a safe and satisfactory installation.

NOTE 2 In case of doubt, contact the heater manufacturer.

NOTE 3 Collaboration is essential between those concerned with the design and installation both at the planning stage and during the execution of work. Particular matters to be taken into account are as follows:

- 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) and the position of termination, including the possible consequences of any plumbing, together with the materials of construction⁴⁾;
- 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) liaison with fire insurers;
- i) transmission of noise and vibration;
- j) any hazardous area classification of the system's location;
- k) the position of any drains for condensate.

NOTE 4 Attention is drawn to statutory regulations and local byelaws.

Installers shall make customers aware, by providing them with the following list in writing, that it is their responsibility to ensure that:

- 1) the local authority is consulted with regard to planning application requirements;
- 2) the fire authority and/or the enforcing authority under the Health and Safety at Work etc. Act 1974 [9], 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 responsible gas conveyor is advised of the proposed installation of any gas booster or compressor which is either part of the appliance, or an addition to it;
- 5) the gas conveyor is consulted to ensure that the gas service is suitable to supply all of the gas to the complete installation at the correct pressure, including any existing load.

NOTE 5 Attention is drawn to the relevant building regulations [3], [4], [5] and The Health and Safety at Work etc. Act [9].

NOTE 6 Main contractors might need to draw their customers' attention to 1), 2), 3), 4) and 5).

4.2 Selection of air heaters

4.2.1 General

In order to verify that the heater or multi-burner system is appropriate for installation in accordance with this standard it shall be ensured that it either carries a CE mark together with the identification number of the notified body carrying out EC Quality Surveillance (see Figure 1), or have the CE mark affixed upon installation.

NOTE Attention is drawn to the EC unit verification procedures in the Gas Appliances (Safety) Regulations 1995 [1].

The air heater shall only be connected to and supplied with the gas for which it was designed.

The installer shall ensure that the air heater is correctly adjusted in accordance with the manufacturer's instructions. Conversion to another gas, if necessary, shall be carried out strictly in accordance with the air heater manufacturer's instructions, using the manufacturer's supplied kit of parts.

The air heater shall only be fitted with external control devices of a type recommended by the air heater manufacturer. In case of doubt, the air heater manufacturer shall be consulted.

COMMENTARY AND RECOMMENDATIONS ON 4.2.1. *The HSE publication "L 56: Safety in the installation and use of gas systems and appliances" [11] should be consulted.*

In particular the installer should ensure that the air heater and the packaging, if any, are marked with at least the following:

- a) the letters "GB";
- b) the type of gas and the pressure of utilization indicated as follows:
 - 1) "G20 — natural gas — 17.5 mbar (or 17.5–20 mbar)" for an air heater adjusted for natural gas;
 - 2) "G31 — propane — 37 mbar (or 50 mbar)" for an air heater adjusted for propane;
 - 3) "G30 — butane — 29 mbar (or 28–30 mbar)" for an air heater adjusted for butane. *This identification only applies when a category I₃₊ (or category II_{2H3+}) air heater, which is capable of utilizing butane and propane at different pressures, is adjusted for butane use.*

⁴⁾ Guidance on chimney and flue design is given in Appendix 3 of IGE /UP/10 *Installation of gas appliances in industrial and commercial premises, Part 1: Flued appliances* [11].

The data plate of a CE marked air heater will carry one of the following designations CAT: I_{2H} , I_{3P} , I_{3+} , II_{2H3P} or II_{2H3+} to identify the appliance category.

Full details on the appliance category scheme are given in BS EN 437:2003.

In all, four items of information should be given, which, dependent on the appliance or system category and the appliance or system adjustment or state of conversion, should be one of the alternatives listed in Table 1.

If the “Unit Verification” procedure is utilized, the appropriate information from Table 1 should be affixed to the appliance and/or its data plate after commissioning the appliance.

The installer should check the data provided with the air heater to confirm that the air heater is appropriate for the installation, and should confirm the basis on which the nominal heat input, or heat input rating, is quoted, i.e. gross or net. The ratio of gross to net heat input is approximately 1.11:1 for group H (natural gas), 1.09:1 for group P (propane) and 1.08:1 for group B (butane).

Further information on the labelling of gas appliances is given in CR 1472:1997.



NOTE The CE mark consists of the “CE” symbol followed by the identification number of the notified body involved in the production control (i.e. ongoing surveillance) phase. Examples are shown in this figure.

Figure 1 — The CE mark

Table 1 — Air heater categories/adjustment for UK gas supply conditions

Alternatives ^a	Country code	Type of gas	Gas pressure ^b mbar	Air heater category
a)	GB	G 20, natural gas	17.5 or 17.5 to 20	I _{2H}
b)	GB	G 20, natural gas	17.5 or 17.5 to 20	II _{2H3P} or II _{2H3+} (when adjusted to use natural gas)
c)	GB	G 31, propane	37 or 50	I _{3P} or II _{2H3P} (when adjusted to use propane)
d)	GB	G 31, propane	37	I ₃₊ or II _{2H3+} (when adjusted to use propane)
e)	GB	G 30, butane	29 or 28 to 30 ^c	I ₃₊ or II _{2H3+} (when adjusted to use butane)

^a If the information on the appliance, its packaging or the data plate is not in accordance with alternatives a), b), c), d) or e), or if there is any doubt about the suitability of the air heater for a particular gas, the appliance manufacturer should be consulted prior to installation.

^b If the gas pressure is not as indicated in Table 1, the gas conveyor should also be consulted prior to installation.

^c Appliances in categories I₃₊ or II_{2H3+}, when adjusted for butane, may be used without adjustment at the specified supply pressures of 28 mbar to 30 mbar.

4.2.2 Indirect gas-fired air heaters

4.2.2.1 General

Products of combustion from indirect-fired heaters shall discharge into a flue which terminates outside the building (see 5.10).

Where vapours or gases or airborne dusts are present in the air which degrade into components that are potentially damaging to the appliance:

- a) when passed through the combustion zone of a flame; and, possibly
- b) as a result of heat transmitted through the heat exchanger,

all air supplied to the burner and, if necessary, to the heat exchanger shall be outside air that is free from such contaminants.

4.2.2.2 Condensing appliances

Condensing air heaters shall be installed in accordance with the manufacturer's instructions, paying particular attention to any instructions concerning the management of condensate, which might have implications on the siting of the appliance and/or its flue terminal.

COMMENTARY AND RECOMMENDATIONS ON 4.2.2.2. *The manufacturer's installation instructions will describe any particular requirements for the condensing air heater, e.g. a means for the disposal of condensate.*

When siting a condensing air heater, early consideration should be given to the following.

- a) *The siting of any flue terminal.*

Condensing air heaters have a tendency to form a plume of water vapour from the flue terminal. The terminal should be sited such that the wet combustion products are unlikely to cause damage or nuisance. The effect of wind conditions and the dispersal of the plume relative to adjacent wall surfaces, openable windows and neighbouring buildings should be considered.

- b) *The positioning and termination of the condensate drain pipe.*

Preferably the condensate pipe should run and terminate internally to a soil and vent stack or a waste pipe. Alternatively, the condensate can be discharged into the rainwater system or a purpose-made soakaway.

All connecting drainage pipework should have a fall of at least 2.5° to the horizontal or approximately 50 mm per metre of pipe run. If the drainage pipe has a run externally, it is recommended that the pipe is insulated to protect against frost. It should be noted that the connection of a condensate pipe to a drain might be subject to local building controls.

c) *The choice of condensate drainage pipe.*

The condensate drainage pipe should be made from standard drain pipe material, e.g. polyvinyl chloride (PVC), unplasticized polyvinyl chloride (PVC-U), acrylonitrile-butadiene-styrene (ABS), polypropylene polypropene (PP) or cross-linked polyvinyl chloride (PVC-C). Any internal pipework should be of a diameter specified in the air heater manufacturer's instructions. Any external pipework should be kept to a minimum to avoid freezing and should have a diameter of not less than 22 mm.

4.2.3 Direct gas-fired air heaters

4.2.3.1 General

4.2.3.1.1 Where vapours or gases or airborne dusts are present which degrade to products that are potentially harmful to health when passed through the combustion zone of a flame (see the HSE publication EH 40, *Occupational exposure limits*), all air to the burner shall be outside air free from such contaminants.

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

COMMENTARY AND RECOMMENDATIONS ON **4.2.3.1.1**. *In some applications the production process or products stored in the heated space might be affected by constituents of the diluted products of combustion. Where there is any doubt the air heater manufacturer should be consulted.*

4.2.3.1.2 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 %.

COMMENTARY AND RECOMMENDATIONS ON **4.2.3.1.2**. *In the case of group H natural gas of the 2nd family, 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, 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.

Any recirculation air intake should be located downstream of the burner, unless upstream recirculation is specifically authorized in the manufacturer's installation instructions. (See also 4.2.3.1.1.)

4.2.3.1.3 Additional ventilation shall be provided, if necessary, to ensure that the concentrations of other combustion gases (e.g. carbon monoxide and oxides of nitrogen) present within the room or rooms as a result of use of the direct gas-fired heater or heaters do not exceed the limits specified in the HSE publication EH 40 *Occupational Exposure Limits*.

COMMENTARY AND RECOMMENDATIONS ON **4.2.3.1.3**. *Direct gas-fired air heaters that are designed to conform to BS EN 525:1998 or BS 5990:1990 and installed so as to conform to 4.2.3.1.2, should produce environmental concentrations of combustion gases that are well within the limits specified in the HSE publication "EH 40 Occupational Exposure Limits" (see Table A.1).*

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

COMMENTARY AND RECOMMENDATIONS ON **4.2.3.1.4**. *This requirement can limit or preclude the use of direct gas-fired air heaters in some locations.*