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BSI Standards Publication

Specification for installation and maintenance of gas-fired overhead radiant heaters for industrial and commercial heating (2nd and 3rd family gases)

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Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 26, an inside back cover and a back cover.

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Foreword

Publishing information

This British Standard is published by BSI and came into effect on 30 June 2011. It was prepared by Panel GSE/30/-/17, *Non Domestic Radiant Heaters*, under the authority of Technical Committee GSE/30, *Gas Installations (1st, 2nd and 3rd family gases)*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This British Standard supersedes BS 6896:2005, which is withdrawn.

Information about this document

This is a full revision of the standard. The standard has been updated to reflect changes in installation practice and legislation.

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 results in at least an equivalent level of safety. It is important that the manufacturer's instructions are followed. This standard is applicable where manufacturers' instructions do not give specific advice.

Presentational conventions

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

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

Contractual and legal considerations

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

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

In particular, attention is drawn to the following regulations which may be amended from time to time. The commentary in this British Standard reflects the state of the regulations in 2010.

- The Gas Appliances (Safety) Regulations [1];

  This standard only applies to appliances falling within the scope of these regulations.

- 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.

- The Gas Safety (Installation and Use) Regulations 1994, as amended and applied by the Gas Safety (Application) Order (Isle of Man) 1996 [3];
- The Gas Safety (Installation and Use) (Northern Ireland) Regulations 2004 [4];
- The Health and Safety (Gas) (Guernsey) Ordinance 2006 [5];

- The Building Regulations [6], [7], [8] (for the appropriate legislative region);

  These control work carried out in the construction of new buildings or the extension and/or refurbishment of existing buildings. Detailed advice for England and Wales is given in approved documents [9], [10] and for Northern Ireland, in technical booklets [7]. The Building Standards (Scotland) [8] are accompanied by methods that are deemed to satisfy them.

- The Water Supply (Water Fittings) Regulations [11];
- The Health and Safety at Work etc. Act 1974 [12];
- The Electricity at Work Regulations [13].

1 Scope

This British Standard specifies the installation requirements for gas-fired overhead radiant heaters and systems for the environmental heating of premises other than domestic dwellings. This standard only applies to appliances falling within the scope of the Gas Appliances (Safety) Regulations 1995 [1].

It is applicable to the installation of heaters that are designed to use gases of group H of the 2nd family (e.g. natural gas), gases of group P of the 3rd family (e.g. propane) as well as gases of group B of the 3rd family (e.g. butane) (see BS EN 437+A1).

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

It is applicable to the installation of gas-fired overhead luminous radiant heaters conforming to BS EN 419-1, single burner gas-fired overhead radiant heaters conforming to BS EN 416-1 and multi-burner gas-fired overhead radiant tube heater systems conforming to BS EN 777-1, BS EN 777-2, BS EN 777-3 and BS EN 777-4.

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

NOTE 3 The heat inputs and ventilation rates in cm^2/kW of heat input given in this standard are based on the net calorific value.

It is not applicable to the installation of gas-fired overhead radiant heaters and systems:

a) to which the Gas Appliances (Safety) Regulations 1995 [1] do not apply;

b) that are designed for use in domestic premises;

c) that are supplied with a heated fluid from a separate source; or

d) that are portable or transportable.

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.

Standards publications

BS 669-2, *Flexible hoses, end fittings and sockets for gas burning appliances – Part 2: Specification for corrugated metallic flexible hoses, covers, end fittings and sockets for catering appliances burning 1st, 2nd and 3rd family gases*

BS 5440-1, *Flueing and ventilation for gas appliances of rated input not exceeding 70 kW net (1st, 2nd and 3rd family gases) – Part 1: Specification for installation of gas appliances to chimneys and for maintenance of chimneys*

BS 5482 (all parts), *Code of practice for domestic butane- and propane-gas-burning installations*

BS 6501-1, *Metal hose assemblies – Part 1: Guidance on the construction and use of corrugated hose assemblies*

BS 7671, *Requirements for electrical installations – IEE Wiring Regulations – Seventeenth edition*

BS 7967-5, *Carbon monoxide in dwellings and other premises and the combustion performance of gas-fired appliances – Part 5: Guide for using electronic portable combustion gas analysers in non-domestic premises for the measurement of carbon monoxide and carbon dioxide levels and the determination of combustion performance*

BS 8487, *The design and construction of gas boosters used in association with combustion equipment – Specification*

BS EN 416-1, *Single burner gas-fired overhead radiant tube heaters for non-domestic use – Part 1: Safety*

BS EN 419-1, *Non-domestic gas-fired overhead luminous radiant heaters – Part 1: Safety*

BS EN 777-1, *Multi-burner gas-fired overhead radiant tube heater systems for non-domestic use – Part 1: System D – Safety*

BS EN 777-2, *Multi-burner gas-fired overhead radiant tube heater systems for non-domestic use – Part 2: System E – Safety*

BS EN 777-3, *Multi-burner gas-fired overhead radiant tube heater systems for non-domestic use – Part 3: System F – Safety*

BS EN 777-4, *Multi-burner gas-fired overhead radiant tube heater systems for non-domestic use – Part 4: System H – Safety*

BS EN 13410, *Gas-fired overhead radiant heaters – Ventilation requirements for non-domestic premises*

BS EN 60079-10-1, *Explosive atmospheres – Part 10-1: Classification of areas – Explosive gas atmospheres*

Other publications

[N1] EH 40, *Occupational exposure limits*. Sudbury: HSE Books, [1] 2005 as amended

[N2] IGEM/UP/2, *Installation pipework on industrial and commercial premises*. Kegworth: IGEM. [2]

3 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in BS EN 416-1, BS EN 419-1, BS EN 777-1, BS EN 777-2, BS EN 777-3, BS EN 777-4 and the following apply.

3.1 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 60079-10-1 which also defines hazardous areas.

3.2 high-level ventilation
ventilation above the level of the heater

3.3 low-level ventilation
ventilation below the level of the heater

[1] Obtainable from HSE Books, PO Box 1999, Sudbury, Suffolk, CO10 2WA.
[2] Obtainable from Publications Sales, IGEM, IGEM House, Kegworth, Derbyshire DE74 2DA.

3.4 overhead radiant heater
gas-fired appliance intended for overhead installation and designed to heat, mainly by radiation, the space in which it is installed

3.5 overhead radiant tube heater
overhead radiant heater in which a tube or series of connected tubes are heated by the internal passage of combustion products

3.6 overhead luminous radiant heater
overhead radiant heater in which the heat is produced by means of burning the fuel gas at or near the outer surface of a material such as a ceramic plaque or metal gauze

4 Competence

4.1 Non-gas competence

Persons carrying out work that will have an impact on work covered by the scope of this standard shall ensure that they have the competence relevant for the task such as not to compromise the requirements/recommendations of this standard and in particular the safe installation, commissioning and operation of gas equipment.

*COMMENTARY ON **4.1***

Competence requires sufficient knowledge, practical skill and experience to carry out the job in hand safely, with due regard to good working practice. Any installation should also be left in a safe condition for use. Knowledge should be kept up to date with changes in law, technology and safe working practice.

4.2 Gas competence

Persons carrying out any gas installation, commissioning, servicing and/or maintenance work shall be competent to do so.

*COMMENTARY ON **4.2***

It is a statutory requirement that all gas work be carried out by a business or self-employed person(s) that is a member of a "class of persons" registered with a registration body which has been approved by an approval body to operate and maintain such a register.

The statutory regulations, registration bodies and approval bodies applicable to Great Britain, the Isle of Man, Northern Ireland and Guernsey are given in Table 1.

The qualifications which persons need to have to be deemed competent to carry out gas work relevant to this standard are given in Table 2.

Table 1 **Registration and approval bodies by country/territory**

Country/territory	Gas registration body	Approval body	Statutory regulations
Great Britain	Gas Safe Register	Health and Safety Executive (HSE)	The Gas Safety (Installation and Use) Regulations 1998 [2]
Isle of Man	Gas Safe Register	Health and Safety at Work Inspectorate (HSWI)	The Gas Safety (Installation and Use) Regulations 1994, as amended and applied by the Gas Safety (Application) Order 1996 [3]
Northern Ireland	Gas Safe Register	Health and Safety Executive Northern Ireland (HSENI)	The Gas Safety (Installation and Use) Regulations (Northern Ireland) 2004 [4]
Guernsey	Gas Safe Register	Health and Safety Executive for the States of Guernsey [HSE (Guernsey)]	The Health and Safety (Gas) (Guernsey) Ordinance 2006 [5]

Table 2 **Competence requirements by country/territory**

Qualifications	Great Britain and Isle of Man	Northern Ireland	Guernsey
Current certificate(s) of competence in the type of gas work to be conducted, issued by an awarding body accredited by the United Kingdom Accreditation Service (UKAS) (ACS certification)	✓	✓	✓
National/Scottish Vocational Qualification (N/SVQ accredited by Ofqual), which is aligned in matters of gas safety	✓	✓	✓
National/Scottish Vocational Qualification (N/SVQ accredited by Ofqual), which is aligned under the HSC ACoP arrangement [A)] as approved with the registration body	✓	✓	✘
Any other scheme recognized by the gas registration body for registration purposes	✓	✓	✓

[A)] Guidance on the individual competency required for gas work is given in the Health and Safety Commission's *Standards of training in safe gas installation. Approved Code of Practice* (ACoP) (COP 20) [14].

At the time of publication, the body with HSE approval to operate and maintain a register of businesses who are a "member of a class of persons" is the Gas Safe Register.

Persons deemed competent to carry out gas work are those who hold a certificate of gas safety competence acceptable to the Gas Safe Register which includes (without limitation) the National Accredited Certification Scheme for Individual Gas Fitting Operatives' (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.

5 Selection of equipment and pre-installation

5.1 Exchange of information and planning

5.1.1 Design considerations

The design shall be such that the installation is in accordance with the heater or system 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 produce a safe and satisfactory installation.

NOTE 2 In case of doubt contact the manufacturer.

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

a) the heater or system manufacturer's installation instructions; [3)]

b) human resource for installation, clearances to combustible materials, planning for location of supports and provision of access for servicing;

c) type of building and form of construction;

d) sizes, layout and purposes of rooms and working areas;

e) size, height and route of flue (if any);

f) provision of adequate air for combustion and ventilation;

g) correct assessment of heat losses and heat gains to ensure ambient environmental conditions for occupants of building;

h) gas types, pressures and availability of supplies;

i) electricity requirements;

j) liaison between the various trades carrying out the work;

k) liaison with fire insurers;

l) liaison with building owner/operator;

m) transmission of noise and vibration;

n) any hazardous area classification of the location for the heater or system; and

o) the position of any drains for condensate.

Attention is drawn to statutory regulations and local by-laws, e.g. The Building Regulations Approved Document L [15] and Local Air Quality Management.

Designers should make customers aware, by providing them with the following list in writing, that it is the customer's 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 [12], as appropriate, is consulted in respect of fire precautions in accordance with BS 9999;

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 heater, or an addition to it; and

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[3)] The manufacturer of the appliance or system should be contacted if there is any doubt about whether the design conforms to the installation instructions.

5) they comply with The Health and Safety at Work etc. Act 1974 [12].

5.1.2 Environmental considerations

Consideration and planning shall be agreed for the following areas:

a) disposal/recycling of existing appliances and systems materials to be removed;

b) disposal/recycling of new appliances and system components packaging;

c) minimizing energy usage through appliance selection; and

d) minimizing harmful emissions discharge.

5.2 Selection of heater or multi-burner system

5.2.1 General

The operative shall ensure that the heater or multi-burner system for installation carries a CE mark, and is supplied with installation, maintenance and user instructions.

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

The heater or multi-burner system shall only be connected to and supplied with the gas for which it was designed.

Before installation the installer shall ensure that the heater or multi-burner system 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 heater or multi-burner system manufacturer's instructions, using the manufacturer's supplied components.

The heater or multi-burner system shall only be fitted with external control devices approved by the heater or multi-burner system manufacturer.

*COMMENTARY ON **5.2.1***

The HSE publication "L 56, Safety in the installation and use of gas systems and appliances" [16] should be consulted.

In particular the installer should ensure that the heater or multi-burner system and the packaging, if any, are marked with at least the following:

a) the letters "GB"; and

b) the type of gas and the pressure used, indicated as follows:

1) "G20 – natural gas – 17.5 mbar (or 17.5 mbar to 20 mbar)" for a heater or multi-burner system adjusted for natural gas.

2) "G31 – propane – 37 mbar (or 50 mbar)" for a heater or multi-burner system adjusted for propane.

3) "G30 – butane – 29 mbar (or 28 mbar to 30 mbar)" for a heater or multi-burner system adjusted for butane.

The data plate of a CE marked heater or multi-burner system should carry one of the following designations, CAT:I_{2H}, I_{3P}, I_{3B}, I_{3+}, II_{2H3P} or II_{2H3}+ to identify the heater or multi-burner system category.

Full details on the appliance category scheme are given in BS EN 437+A1.

In all, four items of information should be given, which, dependent on the heater or system category and the heater or system adjustment or state of conversion, should be one of the alternatives listed in Table 3.

Table 3 **Heater (system) categories/adjustment for UK gas supply conditions**

Alternatives [A)]	Country code	Type of gas	Gas pressure [B)] mbar	Heater category
a)	GB	G20, natural gas	17.5 or 17.5 to 20	I_{2H}
b)	GB	G20, natural gas	17.5 or 17.5 to 20	II_{2H3P} or II_{2H3+} (when adjusted to use natural gas)
c)	GB	G31, propane	37 or 50	I_{3P} or II_{2H3P} (when adjusted to use propane)
d)	GB	G31, propane	37	I_{3+} or II_{2H3+} (when adjusted to use propane)
e)	GB	G30, butane	29 or 28 to 30 [C)]	I_{3B} or 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 appliance or multi burner system for a particular gas, the manufacturer should be consulted before installation.

[B)] If the gas pressure is not as indicated in Table 3, the gas conveyor should also be consulted before installation.

[C)] Appliances or multi burner systems in categories I_{3+} or II_{2H3+}, when adjusted for butane, may be used without adjustment at the specified supply pressures of 28 mbar to 30 mbar.

If the "Unit Verification" procedure is used, the appropriate information from Table 3 should be affixed to the heater (or multi-burner system) and/or its data plate after commissioning the appliance or system.

The installer should check the data provided with the heater or multi-burner system to confirm that the heater or multi-burner system 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 DD 221/CR 1472.

5.2.2 Flued heaters and systems

5.2.2.1 Where vapours/gases or airborne dusts are present in the air which degrade to components that are potentially damaging to the heater/flue or the multi-burner system/flue when passed through the combustion zone of a flame, heaters or multi-burner systems shall be selected which, when installed in accordance with the manufacturer's instructions, ensure that all air supplied to the burner(s) is outside air that is free from such contaminants (e.g. room-sealed type C heaters).

*NOTE In case of doubt as to whether the vapours/gases or airborne dusts are present in sufficient concentrations to put the heater/flue or the multi-burner system/flue at risk, the heater or multi-burner system manufacturer should be contacted before installation (see **6.1.1.2**).*

5.2.2.2 Where a heater or system is intended to incorporate a means for the disposal of condensate, the means shall be installed in accordance with the manufacturer's installation instructions.

*COMMENTARY ON **5.2.2.2***

When siting the heater or multi-burner system, early consideration should be given to the following.

a) The siting of any flue terminal.

If condensing conditions exist for long periods, 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 also be taken into account.

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

The condensate pipe should run and terminate internally to a soil and vent stack or a waste pipe. Alternatively, the condensate may be discharged into the combined foul storm water 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. 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 run in a 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 heater or multi-burner system manufacturer's instructions. Any external pipework should be kept to a minimum to avoid freezing and should have a diameter of not less than 21.5 mm.

5.2.3 Type A heaters

5.2.3.1 In accordance with the requirements specified in **6.2.2**, the total installation, that is the combination of the heater(s) and the ventilation facilities in the room or space where the heater(s) is installed, shall be designed and operated so 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) or 2 800 ppm.

NOTE V/V is used in chemical measurement of mixed volumes and is the per cent on a volume per volume basis.

5.2.3.2 Where vapours/gases or airborne dusts are present in the air which degrade either:

a) to components that are potentially damaging to the heater; or

b) to concentrations of potentially harmful gases (see the HSE publication EH 40, *Occupational exposure limits 2005 as amended*) [N1];

when passed through the combustion zone of a flame, heaters shall be selected which, when installed in accordance with the manufacturer's instructions, ensure that all air supplied to the burner is outside air that is free from such contaminants.

*COMMENTARY ON **5.2.3.2***

Some plastics dusts and some vapours/gases given off during cleaning or curing processes produce potentially harmful gases when passed through a flame. The quantities given off and the ventilation rate of the building determine whether the limits specified in the HSE publication EH 40, "Occupational exposure limits 2005 as amended" [N1], are exceeded.

*If there is any doubt as to whether the heater is suitable for use in the environment concerned, the installer should contact the manufacturer before installation (see **6.1.1.2**).*

5.3 Heat input requirements for full space heating

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

a) raise the environmental temperature to a level that the purchaser considers is necessary for the type of usage of the building; and

b) ensure the specified heating-up time relative to the lowest design temperature.

NOTE Thermal comfort and design information is contained in "CIBSE Guide A" [17].

5.4 Materials and components

All materials and components used in the installation shall conform to the applicable British Standard if such a standard exists.

Materials containing asbestos shall not be used. High melting point solders incorporating cadmium shall not be used.

NOTE Where no British or European Standard exists, materials and components should be of a suitable quality, and should be designed, constructed and installed to fulfil their intended purpose and so as not to put the safety of persons at risk.

6 Installation

6.1 Installation and siting

6.1.1 General

6.1.1.1 Siting and mounting heights shall be in accordance with the heater or multi-burner system manufacturer's instructions and associated data sheets. The heater or multi-burner system shall be sited so that:

a) persons shall not be subjected to excessive thermal radiation intensity;

b) combustible materials shall not be subject to excessive heat; and

c) the system shall be fully accessible for servicing and maintenance.

NOTE The maximum radiation levels at head height (2 m) should be not more than 240 W/m^2. Minimum clearances as given in the manufacturer's instructions should be observed.

6.1.1.2 Heaters and multi-burner systems shall only be installed in locations where the environmental conditions are suitable.

*COMMENTARY ON **6.1.1.2***

Corrosive or salty atmospheres can cause corrosion and/or failure of metal components, particularly burners and controls.

*In some locations, dusts from plastics forming/handling processes or vapours/gases from cleaning or curing are emitted into the heated space. Such products, when passed through the combustion zone of a flame, or because of contact with radiating surfaces, can produce potentially harmful gases (see the HSE publication "EH 40, Occupational exposure limits" 2005 as amended [N1]) and/or corrosive emissions. It is therefore recommended that precautions are taken to prevent the dusts or vapours/gases from entering the working atmosphere or from entering the combustion zones (see **5.2.2.1** and **5.2.3.2**).*

High wind speeds can adversely affect burner performance.

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

6.1.1.3 Heaters and multi-burner systems shall either be suitably protected from external mechanical damage or situated where the risk of external mechanical damage is minimized.

6.1.1.4 Clearance in accordance with the manufacturer's instructions shall be allowed and means provided to give ready access for installing, operating and servicing the burner(s), fan(s), controls and any other part(s) that require regular attention and which are not liable to accidental disconnection.

6.1.1.5 Clearance in accordance with the manufacturer's instructions shall be allowed between any combustible materials or any material likely to be affected by high temperature, the heater, multi-burner system, heat shield or the flue (see **6.1.1.1** and **6.8**).

6.1.1.6 Where heaters or multi-burner systems are suspended, e.g. from roof trusses, the means of suspension shall be of sufficient number and of adequate strength to support the full weight of the heater or the multi-burner system in accordance with the manufacturer's instructions. Any means of suspension shall be protected against corrosion.

6.1.1.7 Where heaters or multi-burner systems are wall-mounted, they shall be fitted using sufficient brackets of adequate strength to support the full weight of the heater or the multi-burner system. The brackets shall be protected against corrosion.

6.1.1.8 No installation shall be carried out unless the supporting structure is sufficiently strong to withstand the additional loads imposed by pipework, heaters or multi-burner systems and, where fitted, flue systems, see **5.1.1**.

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

6.1.2.1 Heaters or multi-burner systems shall not be installed in spaces classified as hazardous as defined in BS EN 60079-10-1.

*COMMENTARY ON **6.1.2.1***

Correct hazardous areas' classification normally results in the identification of distinct zones at different elevations, i.e. zones 0, 1 or 2. Consequently it may be possible to install heaters or multi-burner systems in safe areas, as defined in BS EN 60079-10-1, above zones exposed to heavier-than-air vapours/gases.

Increasing the ventilation rates within hazardous areas can alter their extent, permitting the use of such heaters or multi-burner systems.

6.1.2.2 In any application where flammable heavier-than-air vapours might be present but where the space to be heated does not constitute a hazardous area, heaters or multi-burner systems shall not be sited within the space unless:

a) the base of the heater is at least 1.8 m above the floor level; and

b) cables and switchgear sited within 1.2 m of the floor level within the space to be heated are appropriately protected as specified in BS EN 60079-10-1.

NOTE Guidance on the installation of heaters in commercial garages is given in "IGEM/IM/28, Appliances in Commercial Garages" [4] *[18].*

6.1.2.3 A heater or multi-burner system for use with 3rd family gases shall not be installed in a room below ground level, e.g. in a basement or a cellar.

[4] In the process of being replaced by IGEM/UP/18, *Guidance on gas safety in vehicle repair and body shops*.

NOTE This does not preclude the installation of such heaters or multi-burner systems into rooms which are basements with respect to one side of the building, but open to ground level on the opposite side.

6.2 Heater/multi-burner system air supply

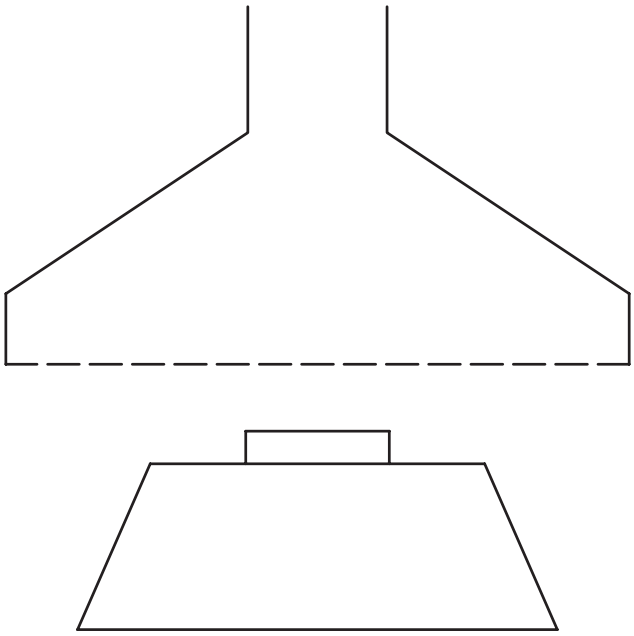
6.2.1 General

6.2.1.1 There shall be provision for a supply of air for combustion and, where relevant, for combustion products dilution. This requirement shall be met by conformity to **6.2.2** or **6.2.4** as appropriate.

*COMMENTARY ON **6.2.1.1***

The applicable requirements are dependent on the means of evacuating the products of combustion dependent upon the heater type. The following requirements are based on the heater type system given in PD CEN/TR 1749, which is generally used in British Standards and European Standards as a means of classifying gas-fired heaters. Descriptions of type B_1, type B_2, type C_1, and type C_3 heaters are given in Figure 1, Figure 2 and Figure 3.

Figure 1 **Type B_{11} overhead luminous radiant heater**



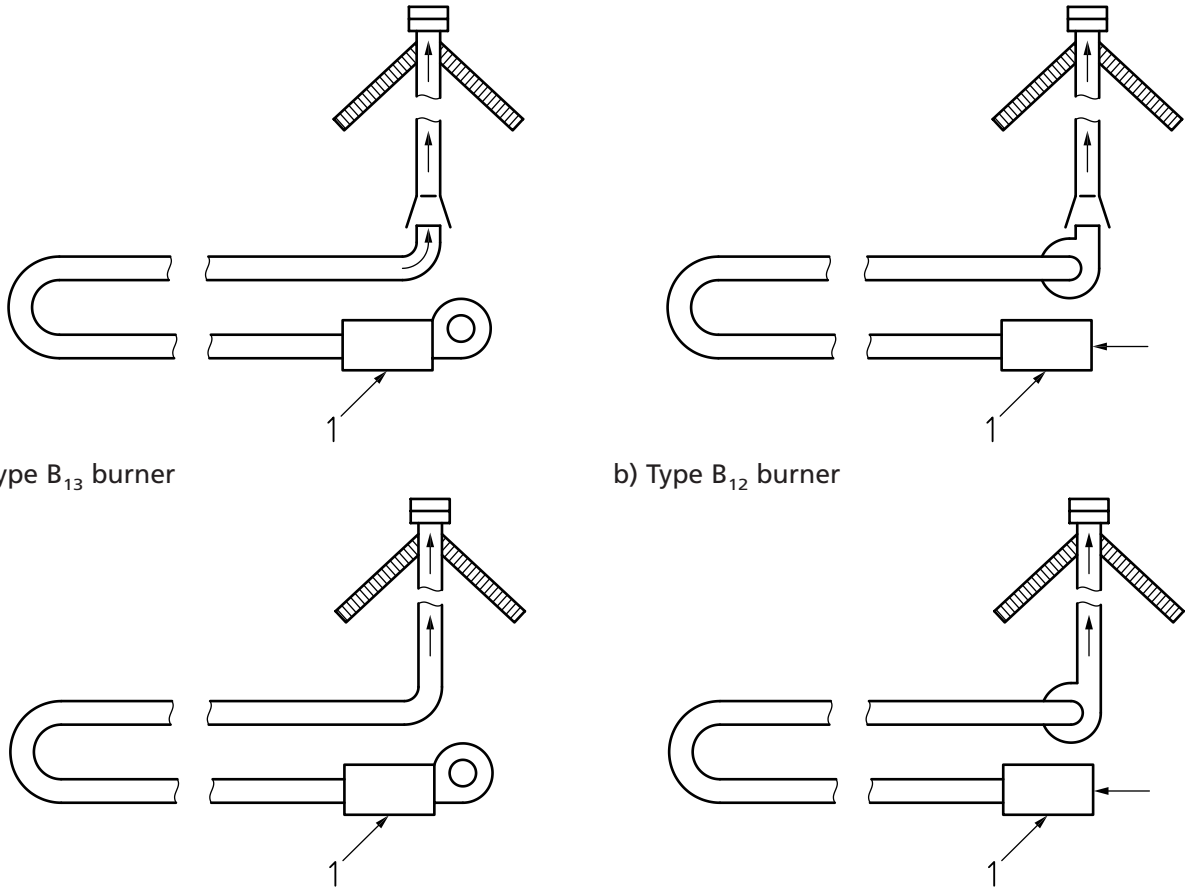
NOTE A type B heater is a heater intended to be connected to a flue that evacuates the products of combustion to the outside of the room containing the appliance.

The combustion air is drawn directly from the room.

A type B_1 heater is a type B heater incorporating a draught diverter.

A type B_{11} heater is a natural draught type B_1 heater.

Figure 2 **Type B_{12}, type B_{13}, type B_{22} and type B_{23} overhead radiant tube heaters**



a) Type B_{13} burner

b) Type B_{12} burner

c) Type B_{23} burner

d) Type B_{22} burner

Key

1 Burner

NOTE A type B_{12} heater is a type B_1 heater designed for a natural draught flue incorporating a fan downstream of the combustion chamber or heat exchanger and fan upstream of the draught diverter.

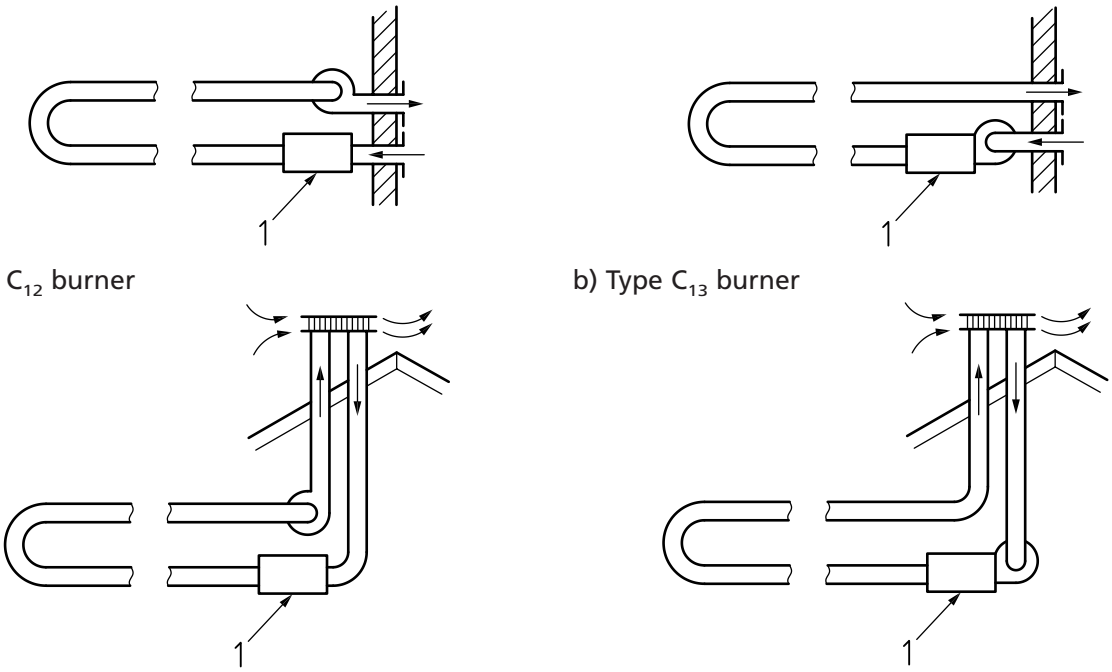
A type B_{13} heater is a type B_1 heater designed for a natural draught flue incorporating a fan upstream of the combustion chamber or heat exchanger.

A type B_2 heater is a type B heater without a draught diverter.

A type B_{22} heater is a type B_2 heater incorporating a fan downstream of the combustion chamber or heat exchanger.

A type B_{23} heater is a type B_2 heater incorporating a fan upstream of the combustion chamber or heat exchanger.

Figure 3 **Type C_{12}, type C_{13}, type C_{32} and type C_{33} overhead radiant tube heaters**



a) Type C_{12} burner

b) Type C_{13} burner

c) Type C_{32} burner

d) Type C_{33} burner

Key

1 Burner

NOTE A type C heater is a heater in which the combustion circuit (air supply, combustion chamber, heat exchanger and evacuation of the products of combustion) is sealed with respect to the room in which the heater is installed.

A type C_1 heater is a type C heater that is designed for connection via its ducts to a horizontal terminal, which at the same time admits fresh air to the burner and discharges the products of combustion to the outside through orifices that are either concentric or close enough to come under similar wind conditions.

A type C_{12} heater is a type C_1 heater incorporating a fan downstream of the combustion chamber or heat exchanger.

A type C_{13} heater is a type C_1 heater incorporating a fan upstream of the combustion chamber or heat exchanger.

A type C_3 heater is a type C heater that is designed for connection via its ducts to a vertical terminal, which at the same time admits fresh air to the burner and discharges the products of combustion to the outside through orifices that are either concentric or close enough to come under similar wind conditions.

A type C_{32} heater is a type C_3 heater incorporating a fan downstream of the combustion chamber or heat exchanger.

A type C_{33} heater is a type C_3 heater incorporating a fan upstream of the combustion chamber or heat exchanger.

6.2.1.2 Means, such as interlocks, shall be provided for installations in which the incorrect operation or blockage of any fan supplying ventilation air, or extracting combustion products, fumes, etc. can lead to an insufficient supply of air or spillage. In the event of such a fan failure, the means provided shall shut down the heater(s) or multi-burner system(s), their associated fans and all other equipment that could be affected.

NOTE The need to take precautions for plant fitted with integral extract fans and systems should be assessed.

6.2.1.3 Where other fuel-fired heaters are installed, the combustion and ventilation requirements of all such plant, particularly if unflued, shall be taken into account.

6.2.1.4 The following requirements shall apply in cases where mechanical ventilation is used.

a) The mechanical ventilation shall be by mechanical inlet and with either natural or mechanical extraction. Systems of ventilation employing mechanical extraction and natural air inlet shall not be used.

b) Where only a mechanical supply of air is used, the inlets shall be at or below the level of fuel-fired heaters. Natural outlet air vents shall be at high level.

c) Where there are any flued heaters in the heated space and where outside air is supplied mechanically and there is mechanical extraction, the design extract rate shall be 5% to 10% less than the design inlet rate so that the room is at a higher pressure than the outside air.

d) An automatic control shall be fitted to cause shutdown of the burner(s) in the event of failure of the airflow in either the mechanical inlet or the mechanical extract systems.

6.2.1.5 Where natural ventilation is used, it shall be by suitable permanent openings of free area. These openings shall communicate directly to outside air and, where practicable, shall be fitted with grilles of low resistance. Low-level inlets shall be below the heater(s) and high-level outlets shall be above the heater(s) or multi-burner system(s). Where high-level and low-level ventilation openings are required the vertical distance between the centre line of the high-level and low-level grilles shall be not less than 3 m.

NOTE To decrease the effect of downdraught in the buildings, high-level roof vents should be of a design to encourage upward airflow under crosswind conditions.

6.2.1.6 The disposition of ventilation openings shall depend on the location of the heaters or multi-burner systems, in so far as is reasonably practicable, and they shall be sited so that they cannot easily be blocked or flooded. They shall be located, where practicable, on at least two sides of the building.

NOTE The use of ventilation near floor level where heavier-than-air gases, e.g. 3rd family gases, are distributed should be assessed.

6.2.1.7 Ventilation air shall be taken from an outside point where it is not likely to be contaminated, e.g. by smells, road vehicle exhausts or dry-cleaner exhausts.

6.2.2 Type A heaters and multi-burner systems

6.2.2.1 The ventilation of unflued heaters shall be designed in accordance with BS EN 13410.

6.2.2.2 When an unflued heater(s) is installed, the total installation, that is the combination of the heater(s) and the ventilation facilities in the room or space where the heater(s) is installed, shall be designed and operated so 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) or 2 800 ppm.

NOTE This includes positions at low level, any mezzanine levels and high levels if appropriate, e.g. for crane operations.

6.2.2.3 In rooms or spaces where products of combustion are present from sources other than from unflued radiant heaters, e.g. releases from small unflued heaters, the maximum concentration of carbon dioxide shall include these local ambient levels for the purposes of conformity to this requirement. If the room or space in which the heater(s) is installed contains any fans which disturb the room atmosphere, e.g. de-stratification fans, these requirements shall apply both with and without these fans in operation.

NOTE Annex A gives guidance on the measurement of carbon dioxide concentrations.

6.2.2.4 Ventilation shall be provided, if necessary, to ensure that the concentrations of any other gases or vapours present within the room or space do not exceed the limits specified in the HSE publication EH 40, *Occupational exposure limits* [N1].

NOTE Table A.1 gives information on the limits applicable in the HSE publication EH 40, "Occupational exposure limits" [N1], for gases present in products of combustion e.g. carbon dioxide, carbon monoxide, nitrogen oxide and nitrogen dioxide.

6.2.3 Type B heaters and multi-burner systems

6.2.3.1 General

In buildings having a design air change rate of less than 0.5 /h, the requirements of **6.2.3.2** or **6.2.3.3** as appropriate shall apply.

NOTE In buildings with a design air change rate of 0.5 /h or greater, additional natural or mechanical ventilation is not necessary.

6.2.3.2 Type B_1 heaters, type B_2 heaters and type B_2 multi-burner systems

6.2.3.2.1 Natural ventilation

Ventilation openings with a free area of at least 2 cm^2/kW of total rated heat input shall be provided at low level (i.e. below the level of the heater flue connection) for both type B_1 heaters (with draught diverters) and type B_2 heaters (without draught diverters).

NOTE High-level ventilation is not generally needed for this type of flued heater.

6.2.3.2.2 Mechanical ventilation

Sufficient ventilation air shall be provided, in accordance with the requirements of **6.2.1.4**, to ensure that the building air change rate is at least 0.5 /h.

6.2.3.3 Type B_1 heaters with ducted combustion air supply

In those special cases where the combustion air is directly ducted to the burner from the outside air, low-level openings shall be provided having a total minimum free area of not less than 50% of the areas given in **6.2.3.2.1**.

6.2.3.4 Type B_2 heaters and multi-burner systems with ducted combustion air supply

For type B_2 heaters and multi-burner systems with ducted combustion air supply, in those special cases where the combustion air is directly ducted to the burner(s) from the outside air, no additional provisions shall be required for the supply of combustion air or for combustion products dilution.

6.2.4 Type C heaters and multi-burner systems – Room-sealed heaters of type C_1 and type C_3

NOTE For room-sealed heaters of type C_1 and type C_3, combustion air is ducted to the heater and the combustion products ducted to the outside air. No additional provisions for the supply of combustion air or for combustion products dilution are necessary.

6.3 Building ventilation

6.3.1 General

6.3.1.1 Internal air quality shall be monitored to ascertain levels of carbon monoxide and carbon dioxide before, during and on completion of maintenance and servicing routines in accordance with guidance given in BS 7967-5.

6.3.1.2 In assessing the ventilation and maximum heat input rates, all equipment, including process equipment and vehicles that release products of combustion into the heated space, shall be taken into account with due consideration of the avoidance of condensation.

NOTE See "CIBSE Guide A" [17]. Condensation can occur on cold steel components, steel structures, windows, poorly ventilated roof spaces or between poorly sealed structural membranes.

6.3.1.3 The quantity of outside air supplied shall be at least equal to the minimum needed for the respiration of the occupants of the building and for the removal of odours and fumes.

NOTE See BS 5720 [5)] and "HS(G) 202, General ventilation in the workplace" [19].

6.3.1.4 Where there are any flued heaters in the room and where outside air is supplied mechanically and there is mechanical extract, the design extract rate shall be 5% to 10% less than the design inlet rate so that the room is not at a lower pressure than the outside air.

6.3.1.5 Air filters, if required for a clean environment, shall be fitted.

NOTE 1 See BS 5720 [5)].

NOTE 2 Air filters are not normally necessary for industrial and commercial applications with this type of installation.

6.3.2 Additional ventilation

6.3.2.1 Unless the air change rate of the building, as specified by the building designer, or other competent person, is sufficient to conform to the requirements of **6.2.2.2**, **6.2.2.3** and **6.2.2.4**, additional ventilation shall be provided in accordance with **6.3.2.2** or **6.3.2.3** as appropriate.

6.3.2.2 Where additional natural ventilation is provided to conform to **6.2.2.2**, **6.2.2.3** and **6.2.2.4**, permanent vents situated at high and low levels shall be used, having the same total free area. The vertical distance between the centre lines of high and low level vents shall be not less than 3 m.

[5)] Withdrawn.

6.3.2.3 Where additional mechanical ventilation is provided to conform to **6.2.2.2**, **6.2.2.3** and **6.2.2.4**, it shall conform to the requirements of **6.2.1.4** and **6.3.1.3**.

6.4 Air vents

All air vents communicating with outside air shall be sited such that there is an adequate separation between the air vent and any part of a heater flue terminal to minimize the risk of re-entry of the products of combustion.

NOTE BS 5440-2 and "The Building Regulations Approved Document J" [9] give information on minimum separation distances.

6.5 Gas supplies and pipework

6.5.1 General

Where it is necessary to connect a heater or the burners of a multi-burner system to the gas supply with a flexible pipe, the pipe shall conform to either:

a) BS 669-2 except that the use of a self-sealing plug and socket is optional and any colour of cover may be used; or

b) BS 6501-1 types B or C of the appropriate pressure class.

Where a self-sealing plug and socket is not used, a union fitting shall be applied at or near to one end of the pipe.

A 90° action manual valve shall be fitted immediately upstream of the flexible pipe assembly.

*COMMENTARY ON **6.5.1***

Flexible pipes should be installed in accordance with the instructions issued by the heater manufacturer or, if not included therein, by the pipe manufacturer. In environments high in halogens, e.g. chlorine from degreasing tanks, it is advisable to use hoses conforming to BS 669-2 incorporating a protective cover.

The manufacturer's instructions relating to the application and fitting of stainless steel flexible pipes should be carefully followed. In particular, the pipe should not twist when tightening unions.

6.5.2 2nd family gases

6.5.2.1 It shall be ensured that the gas pressure in a new or existing service pipe is controlled to supply gas at a pressure suitable for the heater(s) or the burners of the multi-burner system (see Table 3).

6.5.2.2 The installer shall confirm with the gas supplier or public gas transporter that a new or existing service pipe(s) supplying the heater(s) or multi-burner system(s) is of sufficient size for the heater(s)/system(s) and the maximum gas rate of the whole installation.

6.5.2.3 When a meter is fitted by a gas supplier or public gas transporter, the installer shall confirm that the meter is of sufficient capacity for the maximum gas rate of the whole installation.

6.5.2.4 Installation pipework shall be sized and installed in accordance with IGEM/UP/2, *Installation pipework on industrial and commercial premises* [N2].

6.5.2.5 The installation of any gas booster shall be in accordance with BS 8487 and IGEM/UP/2, *Installation pipework on industrial and commercial premises* [N2].

6.5.3 3rd family gases

6.5.3.1 Where a heater or multi-burner system is supplied with 3rd family gas, it shall be ensured that the gas pressure is controlled to supply gas at a pressure suitable for the heater or multi-burner system (see Table 3).

NOTE 1 LPG gas containers having up to a total capacity exceeding 100 kg may be installed or stored inside premises. Capacities exceeding 100 kg should not be installed inside premises unless a fully documented risk analysis has been carried out.

NOTE 2 "UKLPG Code of Practice 24: Part 6 – The use of Propane in Cylinders at Commercial and Industrial Premises" [20] gives guidance on safe practice.

6.5.3.2 The 3rd family gas pipework system shall be in accordance with BS 5482 (all parts) and IGEM/UP/2, *Installation pipework on industrial and commercial premises* [N2].

6.6 Electrical controls and connections

6.6.1 All wiring external to the heater shall be carried out and checked in accordance with BS 7671.

NOTE Attention is drawn to the Electricity at Work Regulations [13].

6.6.2 Components shall also be checked to ensure that they are suitable for the voltage range and frequency available.

6.6.3 The electrical supply to the heater shall be provided with a suitably rated high-rupturing capacity (hrc) fuse or circuit breaker as specified in the manufacturer's instructions.

6.6.4 Where there is an electrical supply controlling the heating system it shall be provided with a double- or multi-pole isolating switch located in a position readily accessible to the user and service engineer.

6.6.5 Where any heater has an electrical supply it shall be provided with, in an adjacent position, a double- or multi-pole isolating switch.

NOTE Where flexible means of suspension are used for installation, consideration should be given to the use of heat-resistant insulated and sheathed cable or flexible electrical conduit conforming to BS EN 61386-1 for the electrical supply.

6.7 Other controls

6.7.1 Means for controlling the environmental temperature and the duration of the operation shall be provided, except where the intermittency of use makes it practicable to use manual control.

*COMMENTARY ON **6.7.1***

This is usually achieved by an air or black bulb sensor and time switch. Frost protection control may be required if necessary.

"GPG 303, The designer's guide to energy-efficient buildings for industry" [21], provides guidance on the application of radiant heating systems.

6.7.2 Ancillary controls shall be connected to the heater in accordance with the heater manufacturer's installation instructions.

NOTE Space heater controls are addressed in "The Building Regulations Approved Document L2" [10].

6.8 Flues

*COMMENTARY ON **6.8***

The applicable requirements are dependent on the means of evacuating the products of combustion from the heater (and multi-burner system type). The following requirements are based on the heater-type system given in PD CEN/TR 1749 which is generally used in British Standards or European Standards as a means of classifying gas-fired heaters (see Figure 1, Figure 2 and Figure 3).

6.8.1 Heater and multi-burner system types

Unless otherwise stated in the heater or multi-burner system manufacturer's installation instructions, the flue shall be supported independently of the heater or multi-burner system.

6.8.2 Condensation

6.8.2.1 The flue system shall be so designed and constructed as to provide satisfactory control of water condensation (see **6.8.2.2** and **6.8.2.3**).

6.8.2.2 If condensation within the flue is conceivable at times other than during first start-up of the burner, an insulated flue, e.g. a double-walled flue, shall be used and/or the requirements given in **6.8.2.3** shall apply.

6.8.2.3 The flue lining components shall be impervious to condensates and shall be suitably resistant to corrosion. Appropriate provisions shall be made for draining and disposal of the condensate (see **5.2.2.2**). Condensate drain pipes from the flue to the disposal point shall be suitably resistant to corrosion [see **5.2.2.2**c)], preferably not less than 21.5 mm internal diameter.

6.8.2.4 Flue dampers shall not be installed unless this is specifically allowed in the manufacturer's installation instructions. If flue dampers are permitted, their installation, together with that of the necessary safety devices and interlocks, shall be carried out in accordance with the manufacturer's installation instructions.

6.8.3 Room sealed heaters of type C_1 and type C_3

6.8.3.1 The flue system shall be assembled and installed in accordance with the manufacturer's installation instructions using the components supplied with the heater.

6.8.3.2 The terminal shall be so positioned externally as to allow the dispersal of products of combustion and the intake of air. In particular, there shall be an adequate separation between the flue terminal and other openings in the building to minimize the risk of re-entry of the products of combustion.

NOTE BS 5440-1 and "The Building Regulations Approved Document J" [9] give information on flue locations and minimum separation distances.

6.8.3.3 The terminal shall be fitted with a guard if it is less than two metres above ground level to prevent blockage or injury to persons. The guard shall not have any sharp edges, which might cause injury, nor shall any opening permit the entry of a ball of 16 mm diameter when applied with a force of 5 N. The guard shall be suitably resistant to corrosion from condensate within the flue gases.

6.8.4 Type B heaters and multi-burner systems

6.8.4.1 General

6.8.4.1.1 If it is intended to install a type B heater or multi-burner system on an existing flue (or chimney) for which a notice plate is displayed, the installer shall ensure that the heater or multi-burner system is suitable for use on that chimney or flue. The installer shall also ensure that the existing flue is able to last the expected life of the new appliance and that the appliance manufacturer approves the use of an existing flue system.

*COMMENTARY ON **6.8.4.1.1***

The notice plate may include a designation which identifies various performance characteristics. The installer should find the appropriate information in the heater or multi-burner system manufacturer's instructions to determine whether the heater or system is suitable for use on that flue, but in case of doubt the heater or multi-burner system manufacturer should be contacted before installation.

The need to post information on the correct application and use of chimneys in buildings is a matter addressed by The Building Regulations [6], [7] and [8].

Useful information on these matters is given in "The Building Regulations Approved Document J" [9] and "Approved Document J: Guidance and Supplementary Information on the UK Implementation of European Standards for Chimneys and Flues" [22].

6.8.4.1.2 The flue system shall be in accordance with the heater or multi-burner system manufacturer's installation instructions.

*COMMENTARY ON **6.8.4.1.2***

The manufacturer's installation instructions may refer to standards and other publications giving guidance on flue systems e.g. BS 5440-1, BS 5854. "Chimney Heights, third edition of the 1956 Clean Air Act Memorandum" [23] gives information on flue locations. The installing engineer should ensure that the existing flue system is fit for purpose.

Attention is drawn to "Approved Code of Practice and Guidance L 56" [16], which gives guidance on conformity to the Gas Safety (Installation and Use) Regulations [2]. Appendix 4 of this publication gives a more comprehensive list of standards and other useful publications to which reference may be made.

6.8.4.1.3 Unless otherwise specified in the appliance or multi-burner system manufacturer's installation instructions, flue components and their materials of construction shall be in accordance with the appropriate British Standards.

NOTE A range of European chimney standards which replace existing purely British Standards are in preparation. "Approved Document J: Guidance and Supplementary Information on the UK Implementation of European Standards for Chimneys and Flues" [22] gives details of the European Standards in the course of preparation.

6.8.4.2 Flue termination

6.8.4.2.1 For heaters or multi-burner systems with a rated heat input not exceeding 70 kW net (77 kW gross), the flue termination shall be in accordance with BS 5440-1.

6.8.4.2.2 The terminal shall be so positioned externally as to allow the dispersal of products of combustion and the intake of air.

NOTE BS 5440-1 and "The Building Regulations Approved Document J" [9] give information on flue locations.

6.8.4.2.3 Where a type B_2 heater or multi-burner system has a wall termination, there shall be an adequate separation between the flue terminal and other openings in the building to minimize the risk of re-entry of the products of combustion.

NOTE BS 5440-1 and "The Building Regulations Approved Document J" [9] give information on minimum separation distances.

6.8.4.2.4 The wall terminal for a type B_2 heater or multi-burner system shall be fitted with a guard (as specified in BS 5440-1) if it is less than 2 m above ground level to prevent blockage or injury to persons.

6.8.4.3 Fans in flues

The installer shall not fit a fan in the flue system serving the heater or the multi-burner system unless this is specifically allowed by the heater manufacturer's installation instructions. Such a fan shall only be installed as specified in these instructions. Appropriate exhaust fans shall be interlocked with the operation of the heating equipment.

6.8.4.4 Common flues

Heaters and multi-burner systems shall not be installed on a common flue system unless this is specifically allowed by the manufacturer's installation instructions. Where such installation is permitted it shall be carried out in accordance with the manufacturer's instructions.

7 Post installation

7.1 Inspection, commissioning and servicing

Before it is commissioned, the installation shall be thoroughly checked to ensure the work has been carried out in accordance with the requirements of this standard and the heater or system manufacturer's installation instructions. It shall be ensured that the heater(s) or multi-burner system(s), as well as any other associated systems, operate safely and correctly. In addition it shall be ensured that:

a) the provision of combustion air and ventilation air conforms to **6.2** and **6.3**;

b) the heater supports are adequate for the duty required, see Clause **6**;

c) pipework is properly supported, correctly installed, pressure tested, and purged;

d) any flue is correctly constructed;

e) the general condition of the heater(s) or multi-burner system(s) and their installation is adequate; and

f) the electrical fittings and other works for the supply of electricity conform to **6.6**.

NOTE To conform to requirements a) and b) it may be necessary to consult the installation designer to verify his calculations.

7.2 Commissioning

7.2.1 Commissioning shall be carried out in accordance with the heater manufacturer's instructions to check the operation of all controls, motors and valves before the admission of gas to the burner.

NOTE A typical list of heater checks to be carried out before commissioning the heater is given in Annex B.

7.2.2 A live run shall be carried out in accordance with the heater manufacturer's instructions to check that the controls are operating correctly.

NOTE The verification of ventilation requirements may be met by applying Annex A where considered necessary.

7.2.3 Efficiency and emissions checks shall be carried out and the outputs recorded and left with the system operator/end user.

7.3 Operating instructions

During commissioning, the commissioning engineer shall ensure that the end user or his representative is instructed in the safe operating and lighting procedures for the heater or multi-burner system. In addition, the commissioning engineer shall ensure that all instructions provided with the heater or multi-burner system by the manufacturer are left with the end user or his representative.

7.4 Maintenance

7.4.1 After installation the commissioning engineer shall advise the end user in writing that for continued efficient and safe operation of the heater or multi-burner system, it is essential that regular inspection and servicing is carried out in accordance with the heater or multi-burner system manufacturer's instructions. In addition, recommendations shall be made in writing that arrangements are made for servicing to be carried out at least once per year.

NOTE The commissioning engineer should recommend that a list of spare parts be kept by the end user particularly where the heater or multi-burner system is an essential part of any system and where its being out of operation might cause problems, e.g. by frost damage to stock, water services.

7.4.2 The installer shall draw the end user's attention to the servicing instructions provided by the manufacturer and in particular shall stress that any servicing procedure shall incorporate determination of the following:

a) the effectiveness of the flue;

b) the effectiveness of ventilation and combustion air supply;

c) the efficiency of the system;

d) the heat input and operating pressure; and

e) the safe and efficient operation of the heater.

Attention shall also be drawn to the necessity for notifying the person responsible for the premises in which the heater is situated of any defect found during the servicing procedure.

NOTE For unflued heaters, it is important to check at regular intervals that the provisions for ventilation are working correctly to ensure that the design carbon dioxide levels are not exceeded. The end user should be made aware that this is important.

Annex A (informative) Testing for carbon dioxide in the environment

Where it is considered necessary to check that the ventilation system is providing adequate dilution of products of combustion in unflued systems, the following information provides guidance.

Carbon dioxide concentrations should not exceed 0.28% (V/V) or 2 800 ppm at any point where persons can normally be expected to work. This includes low levels, mezzanine levels and high levels for crane operations, etc.

Instrumentation to check the concentration of carbon dioxide should conform to BS 8494 or BS EN 50543. When carrying out the tests it is necessary to ensure that the building is operating under full heat input and is approaching an equilibrium condition with respect to the build-up of carbon dioxide. This often takes more than one hour.

In assessing the results it may be necessary to ensure either that other unflued equipment is operating or that a design allowance is calculated and subtracted from 2.8×10^{-3}.

Where only partial or spot heating is provided, it is normally only necessary to test the environment near to that part of the heating system.

In some industrial premises where other process emissions can occur it may be necessary to check for gases in addition to carbon dioxide. In these cases the maximum levels are stated in EH 40, *Occupational exposure limits* [N1].

The exposure limits given in Table A.1 are taken from EH 40, *Occupational exposure limits* [N1].

NOTE Further guidance on measuring atmospheric concentrations of carbon dioxide and carbon monoxide may be found in BS 7967-5.

Table A.1 **Occupational exposure limits**

Gas or vapour	EH 40 limits	
	parts per million	$mg \cdot m^3$
Carbon dioxide (CO_2)	5 000	9 150
Carbon monoxide (CO)	30	35
Nitric oxide (NO)	25	31
Nitrogen dioxide (NO_2)	53	5.7

Annex B (informative) Checks to be carried out before commissioning

A typical list of checks to be carried out before commissioning the burner(s) is as follows:

a) check that the manual gas valves are in the closed position;

b) check that all electrical supplies are isolated and that suitable warning notices are attached to accessible means of isolation and labelled, where appropriate, to prevent other trades on site causing inadvertent restoration of the supply;

c) check electrical earth continuity between the heater, gas pipework and mains electricity supply;

d) check to ensure that the electrical components are of the correct voltage range, particularly low-voltage ancillary controls;

e) check that the rotation of any fan is in the right direction and that it is moving freely;

f) check the operation and interlocking of extract and fresh air supply fans where appropriate;

g) check for correct connection and operation of all external components, e.g. thermostats and time switches;

h) check for gas tightness of the connections and pipework on the heater using leak detection fluid;

i) check that the gas installation pipework to the heater or multi-burner system is installed and supported correctly, that it has been tested for gas tightness and that the gas installation has been purged correctly;

NOTE Guidance is given in IGEM/UP/1, "Strength testing, tightness testing and direct purging of industrial and commercial gas installations" [24], and IGEM/UP/1A, "Strength testing, tightness testing and direct purging of small, low pressure industrial and commercial natural gas installations" [25].

j) check with the gas supplier that the meter installation is operational.

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Standards publications

BS 5440-2, *Flueing and ventilation for gas appliances of rated input not exceeding 70 kW net (1st, 2nd and 3rd family gases) – Part 2: Specification for the installation and maintenance of ventilation provision for gas appliances*

BS 5720, *Code of practice for mechanical ventilation and air conditioning in buildings* [6)]

BS 5854, *Code of practice for flues and flue structures in buildings*

BS 8494, *Electronic portable and transportable apparatus designed to detect and measure carbon dioxide in indoor ambient air – Requirements and test methods*

BS 9999, *Code of practice for fire safety in the design, management and use of buildings*

BS EN 437+A1, *Test gases – Test pressures – Appliance categories*

BS EN 50543, *Electronic portable and transportable apparatus designed to detect and measure carbon dioxide and/or carbon monoxide in indoor ambient air – Requirements and test methods*

BS EN 61386-1, *Conduit systems for cable management – Part 1: General requirements*

DD 221/CR 1472, *General guidance for the marking of gas appliances*

PD CEN/TR 1749, *European scheme for the classification of gas appliances according to the method of evacuation of the products of combustion (types)*

Other publications

[1] GREAT BRITAIN. The Gas Appliances (Safety) Regulations 1995. London: The Stationery Office. [SI 1995, No. 1629].

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