

BS 5410-2:2018



BSI Standards Publication

**Code of practice for liquid fuel firing
– Part 2: Installations providing space
heating, hot water and steam supply
services to non-domestic buildings**



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Foreword

Publishing information

This part of BS 5410 is published by BSI Standards Limited under licence from The British Standards Institution and came into effect on 30 April 2018. It was prepared by Technical Committee RHE/13, *Oil burning equipment*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This part of BS 5410 supersedes [BS 5410-2:2013](#), which is withdrawn.

Relationship with other publications

BS 5410 is published in three parts as follows:

- *Part 1: Installations for space heating and hot water supply purposes for domestic buildings¹*
- *Part 2: Installations providing space heating, hot water and steam supply services to non-domestic buildings*
- *Part 3: Installations for furnaces, kilns, ovens, oil-fuelled standby generators and other industrial purposes.*

Hazard warnings

WARNING. Decommissioning and disposal of liquid fuel storage tanks

The decommissioning and disposal of liquid fuel storage tanks can become necessary as part of the maintenance cycle of a liquid fuelled system. This is not covered in this British Standard. It is a very hazardous procedure, and it is imperative that it is only undertaken by specialist operatives who have the right equipment, expertise and insurance. Building owners should never attempt to cut up old liquid fuel storage tanks themselves.

NOTE 1 Attention is drawn to the Construction (Design and Management) Regulations 2007 [1], which class such work as a "demolition project".

NOTE 2 Detailed guidance on decommissioning and disposal of liquid fuel storage tanks is given in OFTEC Technical Book 3 [2].

NOTE 3 Attention is drawn to The Dangerous Substances and Explosive Atmospheres Regulations 2002 [3] and the need to risk assess the selection of equipment to ensure safety in use and maintenance operations.

Use of this document

As a code of practice, this part of BS 5410 takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

Any user claiming compliance with this part of BS 5410 is expected to be able to justify any course of action that deviates from its recommendations.

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

¹ BS 5410-1 is currently being revised and is due to be published before the end of 2018.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is “should”.

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

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. “organization” rather than “organisation”).

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 specific regulations:

- The Dangerous Substances and Explosive Atmospheres Regulations 2002 [3];
- The Boiler (Efficiency) Regulations 1993 as amended by the Boiler (Efficiency) (Amendment) Regulations 1994 and the Boiler (Efficiency) (Amendment) Regulations 2006 [4];
- The Building Regulations [5], [6], [7];
- The Environmental Protection Act 1990 [8];
- The Control of Pollution (Special Waste) (Amendment) Regulations 1988 [9];
- The Control of Pollution (Oil Storage) (England) Regulations 2001 [10];
- The Control of Pollution (Oil Storage) (Amendment) Regulations (Northern Ireland) 2011 [11];
- The Water Environment (Oil Storage) (Scotland) Regulations 2006 [12];
- The Water Resources (Control of Pollution) (Silage, Slurry and Agricultural Fuel Oil) Regulations 2010 (as amended) [13];
- The Water Resources (Control of Pollution) (Oil Storage) (Wales) Regulations 2016 [38];
- The Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) (Scotland) Regulations 2001 (as amended) [14];
- The Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) Regulations (Northern Ireland) 2003 [15];
- The Hazardous Waste (England and Wales) Regulations 2005 (as amended) [16];
- The Hazardous Waste Regulations (Northern Ireland) 2005 [17];
- The Special Waste (Amendment) (England and Wales) Regulations 2001 [18];
- The Special Waste Amendment (Scotland) Amendment Regulations 2004 [19];
- The Building (Approved Inspectors etc.) Regulations 2010 [20];
- The Building (Forms) (Scotland) Regulations 2005 (as amended) [21].
- The Ecodesign for Energy-Related Products and Energy Information (Amendment) Regulations 2015 [22].

1 Scope

This part of BS 5410 gives recommendations and guidance on the design, installation, commissioning and maintenance of liquid fuel firing installations for heating, hot water and steam supply services in non-domestic buildings. This also includes buildings containing multiple separate dwellings which are all served by a single heating and hot water system and buildings where public assembly, entertainment or hospitality take place.

This part of BS 5410 is applicable to installations burning liquid fuel conforming to BS 2869, and other equivalent fuels, including biofuels, for example, those containing fatty acid methyl esters (FAME) conforming to BS EN 14214, and blends thereof.

This British Standard covers the provision of new installations and also gives guidance on the modernizing of existing installations. This British Standard also gives recommendations and guidance on the selection and installation of liquid fuel storage tanks associated with these installations.

This part of BS 5410 is applicable to the liquid fuel firing equipment forming part of a multi-fuel installation in which liquid fuel is not burnt simultaneously with any other fuel. It is not applicable to liquid fuelled systems for marine installations.

This British Standard is intended for use by designers, specifiers, installers and building owners.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes provisions 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 476-21](#), *Fire tests on building materials and structures – Part 21: Methods for determination of the fire resistance of loadbearing elements of construction*

[BS 476-22](#), *Fire tests on building materials and structures – Part 22: Methods for determination of the fire resistance of non-loadbearing elements of construction*

[BS 799-4:1991](#), *Oil burning equipment – Part 4: Specification for atomizing burners (other than monobloc type) together with associated equipment for single burner and multi burner installations*

[BS 799-5](#), *Oil burning equipment — Part 5: Carbon steel oil storage tanks — Specification*

[BS 845-1](#), *Methods for assessing thermal performance of boilers for steam, hot water and high temperature heat transfer fluids — Part 1: Concise procedure*

[BS 845-2](#), *Methods for assessing thermal performance of boilers for steam, hot water and high temperature heat transfer fluids — Part 2: Comprehensive procedure*

[BS 1212-1](#), *Float operated valves — Part 1: Specification for piston type float operated valves (copper alloy body) (excluding floats)*

[BS 1212-2](#), *Float operated valves — Part 2: Specification for diaphragm type float operated valves (copper alloy body) (excluding floats)*

[BS 1212-3](#), *Float operated valves — Part 3: Specification for diaphragm type float operated valves (plastics bodied) for cold water services only (excluding floats)*

[BS 1710](#), *Specification for identification of pipelines and services*

[BS 2869](#), *Fuel oils for agricultural, domestic and industrial engines and boilers — Specification*

BS 5306 (all parts), *Fire extinguishing installations and equipment on premises*

[BS 5410-1](#), *Code of practice for liquid fuel firing — Part 1: Installations for space heating and hot water supply purposes for domestic buildings*²

[BS 5422](#), *Method for specifying thermal insulating materials for pipes, tanks, vessels ductwork and equipment operating within the temperature range -40 °C and +700 °C*

[BS 5970](#), *Thermal insulation of pipework, ductwork, associated equipment and other industrial installations in the temperature range of -100 °C to +870 °C — Code of practice*

[BS 6700](#), *Design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages — Specification*

[BS 7430](#), *Code of practice for protective earthing of electrical installations*

[BS 7671](#), *Requirements for electrical installations – IET Wiring Regulations — Seventeenth edition*

[BS 7860](#), *Specification for carbon monoxide detectors (electrical) for domestic use (now withdrawn)*

[BS 9999](#), *Fire safety in the design, management and use of buildings — Code of practice*

BS EN 267, *Automatic forced draught burners for liquid fuels*

BS EN 303-1, *Heating boilers – Part 1: Heating boilers with forced draught burners – Terminology, general requirements, testing and marking*

BS EN 303-2, *Heating boilers – Part 2: Heating boilers with forced draught burners – Special requirements for boilers with atomizing oil burners*

BS EN 303-4, *Heating boilers – Part 4: Heating boilers with forced draught burners – Special requirements for boilers with forced draught oil burners with outputs up to 70 kW and a maximum operating pressure of 3 bar – Terminology, special requirements, testing and marking*

BS EN 1254-2:1998, *Copper and copper alloys — Plumbing fittings — Part 2: Fittings with compression ends for use with copper tubes*

BS EN 1457-1, *Chimneys — Clay/ceramic flue liners — Flue liners operating under dry conditions — Requirements and test methods*

BS EN 1457-2, *Chimneys — Clay/ceramic flue liners — Flue liners operating under wet conditions — Requirements and test methods*

BS EN 1567, *Building valves — Water pressure reducing valves and combination water reducing valves — Requirements and tests*

BS EN 1856-1, *Chimneys — Requirements for metal chimneys — Part 1: System chimney products*

BS EN 1856-2, *Chimneys — Requirements for metal chimneys — Part 2: Metal flue liners and connecting flue pipes*

BS EN 1857, *Chimneys — Components — Concrete flue liners*

BS EN 1859, *Chimneys — Metal chimneys — Test methods*

BS EN 12285-1, *Workshop fabricated steel tanks — Part 1: Horizontal cylindrical single skin and double skin tanks for the underground storage of flammable and non-flammable water polluting liquids*

BS EN 12285-2, *Workshop fabricated steel tanks — Part 2: Horizontal cylindrical single skin and double skin tanks for the aboveground storage of flammable and non-flammable water polluting liquids*

BS EN 12446, *Chimneys — Components — Concrete outer wall elements*

² BS 5410-1 is currently being revised and is due to be published before the end of 2018.

BS EN 12514-2, *Installations for oil supply systems for oil burners – Part 2: Safety requirements and tests — Parts, valves, pipes, filters, oil de-aerators, meters*

BS EN 13063 (all parts), *Chimneys — System chimneys with clay/ceramic flue liners*

BS EN 13069, *Chimneys — Clay/ ceramic outer walls for system chimneys — Requirements and test methods*

BS EN 13076, *Devices to prevent pollution by backflow of potable water — Unrestricted air gap — Family A — Type A*

BS EN 13077, *Devices to prevent pollution by backflow of potable water — Air gap with non-circular overflow (unrestricted) — Family A — Type B*

[BS EN 13216](#), *Chimneys — Test methods for system chimneys*

BS EN 13341, *Static thermoplastic tanks for the above ground storage of domestic heating oils, kerosene and diesel fuels — Blow moulded and rotationally moulded polyethylene tanks and rotationally moulded tanks made of anionically polymerized polyamide 6 — Requirements and test methods*

BS EN 13831, *Closed expansion vessels with built-in diaphragm for installation in water*

BS EN 13959, *Anti-pollution check valves — DN 6 to DN 250 inclusive Family E, type A, B, C and D*

BS EN 14125, *Thermoplastic and flexible metal pipework for underground installation at petrol filling stations*

BS EN 14214, *Liquid petroleum products — Fatty acid methyl esters (FAME) for use in diesel engines and heating applications — Requirements and test methods*

BS EN 14622, *Devices to prevent pollution by backflow of potable water — Air gap with circular overflow (restricted) — Family A, type F*

BS EN 15940, *Automotive fuels — Paraffinic diesel fuel from synthesis or hydrotreatment — Requirements and test methods*

BS EN 50291, *Electrical apparatus for the detection of carbon monoxide in domestic premises — Test methods and performance requirements*

BS EN 60079-14, *Explosive atmospheres — Part 14: Electrical installations design, selection and erection*

BS EN 60079-15, *Explosive atmospheres — Part 15: Equipment protection by type of protection “n”*

BS EN 60079-30-1, *Explosive atmospheres — Part 30-1: Electrical resistance trace heating — General and testing requirements*

BS EN 60079-30-2, *Explosive atmospheres — Part 30-2: Electrical resistance trace heating — Application guide for design, installation and maintenance*

BS EN 60947-4-1, *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*

BS EN 62271-106, *High voltage switchgear and controlgear — Part 106: Alternating current contactors, contactor-based controllers and motor-starters*

BS EN 62395-1, *Electrical resistance trace heating systems for industrial and commercial applications — Part 1: General and testing requirements*

BS EN 62395-2, *Electrical resistance trace heating systems for industrial and commercial applications – Part 2: Application guide for system design, installation and maintenance*

BS EN ISO 4126-1, *Safety devices for protection against excessive pressure — Part 1: Safety valves*

Other publications

- [N1] ICOM Energy Association/CEA guide to Water treatment for industrial boiler plant.
- [N2] ICOM Energy Association guide to Water treatment and conditioning of commercial heating systems.
- [N3] OIL FIRING TECHNICAL ASSOCIATION. *OFS T200 Steel oil storage tanks and tank bunds for use with distillate fuels, bio-fuels, lubrication oils and waste oils. Construction standards and test procedures. Issue 10.* OFTEC, Ipswich, 2012.
- [N4] OIL FIRING TECHNICAL ASSOCIATION. *OFS T100 Polyethylene oil storage tanks and tank bunds for distillate fuels. Construction standards and test procedures. Issue 8.* OFTEC, Ipswich, 2012.
- [N5] INTERNATIONAL COUNCIL ON COMBUSTION ENGINES. *CIMAC Guideline The Interpretation of Marine Fuel Oil Analysis Test Results with Particular Reference to Sulphur Content.* 2014.
- [N6] MASON, P.A., AMIES, H.J. and G. SANGARAPILLAI, et al. *Construction of bunds for oil storage tanks.* CIRIA report 163, 1997.
- [N7] HEALTH AND SAFETY EXECUTIVE. *HSG176 Storage of flammable liquids in tanks.* HSE Books, Sudbury, 1998.

3 Terms and definitions

For the purposes of this part of BS 5410 the following terms and definitions apply.

3.1 bund

containment vessel to hold spillage from a primary tank, or tanks, caused by leakage or overfilling

NOTE 1 A bund provides secondary containment to a primary tank and is sometimes referred to as “secondary containment”.

NOTE 2 A bund is designed to contain any leakage from the primary tank or any liquid escaping in an overfill situation and so prevent pollution and the risk of fire.

NOTE 3 A bund may be provided as an integral part of a liquid fuel storage tank.

3.2 chimney

construction to carry the products of combustion to the atmosphere having one or more passages

NOTE The passages are known as “flues”.

3.3 fire screen wall

imperforate wall, of fire-rated construction, provided between a fuel storage system and a building or a boundary to act as a heat radiation barrier

3.4 flue duct

connection to carry the products of combustion from a boiler or air-heater outlet to the entry of a chimney

3.5 non-domestic buildings

places of work, public assembly, entertainment or hospitality, communal areas and shared services therein associated with buildings which contain multiple separate dwelling units

NOTE The term domestic building is defined in [BS 5410-1](#) as single buildings used primarily as dwellings.

3.6 liquid fuel

fuel intended for combustion in boilers, air or radiant heaters based on mineral, vegetable or synthetic liquids or blends thereof

3.7 liquid fuel storage system

system for the storage of liquid fuel consisting of a manufactured, or site-built, unit comprising a primary container with its fill, venting, draw off, gauging and alarm equipment and any secondary containment provided

3.8 primary tank

vessel used for the containment of liquid fuel

NOTE This can be located within a bund.

3.9 service tank

tank that isolates the main storage tank or tanks from the burner installation

3.10 tank chamber

enclosure of a tank consisting of structural walls, floor and ceiling or roof

NOTE The main purpose of a tank chamber is to protect the contents of the tank from a fire originating outside the tank chamber.

4 Work undertaken in connection with liquid fuelled installations

NOTE 1 The installation, commissioning and replacement of liquid fuelled appliances and liquid fuel storage and supply installations is work covered by the Building Regulations [5], [6], [7] and the Control of Pollution (Oil Storage) Regulations [10] [11] [12] [38].

This type of work should be undertaken by competent technicians, subject to supervision by a registration body.

NOTE 2 Where an approved competent person scheme is in operation, and a person registered with an approved scheme is used for such work then it is not required that application is made to the local authority building control department prior to the work commencing and such firms can self-certify compliance of their work at completion.

NOTE 3 Attention is drawn to the Dangerous Substances and Explosive Atmospheres Regulations 2002 [3] and the need to risk assess the selection of the equipment used and of the installation, commissioning and maintenance operations covered in this British Standard.

NOTE 4 Where documentation is required by the local authority to confirm competent installation work, OFTEC form CD/10 [23] or equivalent may be used.

NOTE 5 Attention is drawn to the Building Regulations [5], [6], [7] with respect to structural alterations to buildings.

5 Classification of fuels

For information on flashpoints, auto ignition temperatures, etc. reference should be made to BS 2869, BS EN 15940, BS EN 14214 and the manufacturer's material safety data sheet.

Liquid fuels intended for use in fixed combustion appliances should have defined and industry agreed limits for density and specific energy (maximums and minimums). Producers and/or suppliers of such fuels should declare the typical density and specific energy of the fuels to be supplied to enable safe and efficient combustion to be achieved.

Fuels with unknown density and/or specific energy values should not be used in fixed combustion appliances.

6 Application of liquid fuel firing burners

6.1 General

The type of liquid fuel burner to be used and the mode of control of the burner should be selected to be suitable for:

- a) the type of plant unit, e.g. shell combustion equipment, water-tube;
- b) combustion equipment, warm air heater;
- c) the class of liquid fuel to be used, see [Clause 5](#) and [Annex A](#);
- d) the utilization pattern of plant, e.g. constant output, variable output such as variations in heating load.

NOTE 1 Attention is drawn to the Clean Air Act 1993 [24] and the Clean Air (Northern Ireland) Order 1981 [25].

NOTE 2 Attention is drawn to BS EN 267.

There are a large range of burners available (see [Annex A](#)) and guidance on burner selection should be obtained from the burner manufacturer and from [Annex B](#).

6.2 Choosing liquid fuel burning equipment

The maximum output of the burner(s) should be sufficient to meet the maximum rating of the combustion equipment or warm air heater. Depending upon the type of burner employed, the method of operation of the burner should be chosen from one of the following types to meet the varying load requirements:

- a) on/off;
- b) on/off, with transitional low-flame start;
- c) high/low/off;
- d) fully modulating over the turn-down range; or
- e) O₂ trim.

The flame size and shape should be such as to be confined within the combustion space of the unit under the conditions specified by the combustion equipment or heater designer.

NOTE 1 It is often difficult to visually judge if a flame is impinging on the surface within the combustion space or if it appears to be impinging, whether it might cause damage. If flame impingement is occurring due to chilling of the flame, carbon builds up on the surface or it becomes impossible to reduce the carbon monoxide level below a level of 0.01%, or the smoke number (Bacharach scale) of the exhaust gases might be higher than for normal operation.

NOTE 2 Attention is drawn to the Clean Air Act 1993 [24] and the Clean Air (Northern Ireland) Order 1981 [25]. Many types of liquid fuel burners have been developed commercially to meet individual requirements for heating and steam raising (see [Annex A](#)).

6.3 Appliances

6.3.1 General

COMMENTARY ON 6.3.1

Reliable and efficient operation of a boiler installation depends upon satisfactory coordination of the designs of the boiler, the liquid fuel firing equipment and the system. New boilers are frequently supplied as packaged units in which the boiler, burner and certain ancillary equipment are supplied to site

pre-assembled. This practice, which can be applied to all but very large units, facilitates pre-matching and pre-testing the boiler-burner assembly as a standardized design.

When specifying liquid fuel burners, whether for use with new appliances or with existing boilers that have previously been fired by other fuels or by other liquid fuel burners, the suitability of the proposed burner for the conditions and intended duty should be taken into account.

NOTE 1 The classification of boilers used in this British Standard has been adopted to serve as a basis for consideration of factors relating to liquid fuel firing equipment and is not intended to be a general or exhaustive classification of all boiler types.

Boiler units conforming to BS EN 303-1, BS EN 303-2 and BS EN 303-4, as appropriate, should be used.

NOTE 2 Attention is drawn to the Boiler (Efficiency) Regulations 1993 as amended by the Boiler (Efficiency) (Amendment) Regulations 1994 and by the Boiler (Efficiency) (Amendment) Regulations 2006 [4].

NOTE 3 Attention is drawn to the Ecodesign for Energy-Related Products and Energy Information (Amendment) Regulations 2015 [22].

6.3.2 Boiler sizes in relation to load requirements

Boiler sizes should be selected to match the actual load requirements; where boilers are oversized in relation to the load, the liquid fuel burners are subjected to frequent on/off operation and long off periods that produce the following undesirable effects:

- a) a reduction in overall “seasonal” efficiency of the boiler plant;
- b) increased fouling of boiler gas-side heating surfaces;
- c) increased danger of corrosion of boiler heating surfaces, flue ducts and chimneys;
- d) increased wear and tear on control gear, contactors, motors, etc.;
- e) fluctuations in steam pressure or in temperature of water flow from the boiler plant;
- f) difficulties with feed-water treatment and continuous blow-down control of steam boilers.

A curve showing anticipated loadings should be produced and the boiler sizes selected such that under normal load conditions the liquid fuel burners are working within their high/low or modulating range.

A boiler should be selected which has a range of outputs, with a turn-down ratio of the burner, i.e. the ratio between high and low levels of output, as given in [Table 1](#).

Table 1 — Recommended maximum turn-down ratios for different types of boilers

Type of boiler	Maximum turn-down ratio
Condensing boilers	3+:1
Cast iron sectional boilers	2:1
Small shell and other steel boilers (up to 2 000 kW)	2:1
Large hot water shell and other steel boilers (over 2 000 kW)	3:1
Large steam shell boilers (over 2 000 kW)	4:1

With large water-tube boilers fitted with multiple liquid fuel burners the turn-down ratio may be extended beyond the range given in [Table 1](#) depending upon the particular boiler and system design under consideration, but the risk of acidic corrosion at low output should be taken into account.

Annual variations in anticipated loadings should be taken into account. Special attention should be given to the summer load, which might be much less than winter demand where no process heat is required, and to schemes with a phased development, where the ultimate load might not be reached for several years.

Standby capacity should be provided either by means of a separate standby boiler or by selecting boiler units with extra capacity where this can be done in accordance with the load matching principles in [6.3.2](#).

Where a plant consists of a mixture of condensing and non-condensing boilers, the condensing boilers should cover the base load and the non-condensing boilers should be used for peak and standby purposes.

6.3.3 Quality of boiler water

6.3.3.1 Water treatment for industrial boilers

The water content of an industrial heating system should be flushed, filled and treated as part of the commissioning process of the system, in accordance with boiler plant installation and maintenance instructions.

Feed water for steam boilers should be pre-treated to ensure that it meets the quality limits set by the boiler manufacturer. In order to protect the boiler, the quality of the boiler feed water should be subject to continuous monitoring and control to ensure it remains within the limits specified by the boiler manufacturer. Advice should be obtained from a water treatment specialist which should be followed at all times.

Industrial boiler water treatments should follow ICOM Energy Association/CEA guide to Water treatment for industrial boiler plant [N1].

6.3.3.2 Water for hot water boilers

The water for the initial fill, and the make-up water, should be pre-treated to ensure it meets the limits set by the boiler manufacturer to protect the boiler, taking into account the intended operating temperature of the system.

It should be noted that although hot water systems are regarded essentially as “closed circuits”, make-up water is necessary, the quantity depending upon the amount of leakage from such items as pump glands and from draining down for maintenance purposes, etc.

NOTE This treatment can range from simple chemical dosing to full demineralization with the application of oxygen scavenging and pH corrective chemicals.

Frequent checks on internal water conditions as in [6.3.3.1](#) should also be carried out.

Commercial boiler water treatment should follow the ICOM Energy Association guide to Water treatment and conditioning of commercial heating systems [N2].

6.3.4 Condensing boilers

A condensing boiler utilizes the latent heat remaining in the flue gases by causing the condensation of the water vapour in these gases. Therefore these boilers are fitted with a condensate drain. Condensing operation can only be achieved when the return water temperature is low, typically around 55 °C. The lower the return water temperature, the greater the condensation and the higher the efficiency. The relatively cool flue gases lack buoyancy and therefore fans are needed to drive them out of the flue systems. Fuels with very low levels of sulfur should be used for these boilers to minimize acid corrosion from the condensate.

6.3.5 Cast iron sectional boilers

6.3.5.1 General

COMMENTARY ON 6.3.5.1

This subclause covers boilers of cast iron construction in which the rating of the boiler can be selected, within limits, by the number of assembled sections. The usual configuration covers a horizontal combustion space, but subsequent travel of the flue gas can be via a multiplicity of passes in series and/or in parallel and arranged horizontally or vertically.

With all cast iron boilers, the associated system should be designed to maintain the water return temperature at a high enough value to minimize condensation and sulfur corrosion.

6.3.5.2 Purpose-made boilers

Purpose-made boilers use combustion spaces at a positive pressure so inter-section sealing is very important. These boilers are less sensitive to flue conditions, but the boiler manufacturer's recommendations regarding flue conditions should be followed. In these boilers, all flue-way doors and observation windows should be gastight, and any excess-pressure relief door should be sufficiently loaded to withstand the normal operating pressure without leakage.

Owing to the higher rates of heat release from purpose-made boilers, correct circulation of the water is very important and pumps and associated equipment should be of sizes that ensure adequate circulation at all times.

6.3.6 Shell boilers**6.3.6.1 General**

The term "shell boilers" is applied to a group of boilers in which the flue gases usually traverse the boiler horizontally between the burner and the off-take. One or more furnace tubes, usually of circular cross-section, are fitted and these may be arranged for through or reversed flow of the combustion gases. After leaving the furnace tube the products of combustion pass through one or more longitudinal externally water-cooled return passages before reaching the chimney gas off-take. The gas passages may consist of nests of externally water-cooled tubes or of annular spaces. This group includes:

- a) economic boilers, in which the rear chambers, known as "combustion chambers", may be refractory lined (dry-back) or water-cooled (wet-back); and
- b) reverse flame furnace tube boilers.

6.3.6.2 Installation design — Relevant factors

The specification of burners should be undertaken in collaboration with the burner manufacturer, or burners should be chosen from the appliance manufacturer's approved listing for the equipment concerned and the liquid fuel being used.

NOTE Attention is drawn to the Clean Air Act 1993 [24] and the Clean Air (Northern Ireland) Order 1981 [25]. Chimney and flue gas ducts are to be designed and matched to the requirements of the appliance manufacturer's specification.

6.3.6.3 Replacement of liquid fuel firing equipment — Burner to appliance matching

6.3.6.3.1 The specification of burners should be undertaken in collaboration with the burner manufacturer, or burners should be chosen from the appliance manufacturer's approved listing for the equipment concerned and the liquid fuel being used. When the boiler plant is supplied by the manufacturer complete with the liquid fuel firing equipment, the specifier should inform the equipment manufacturer of the fuel specification to be used.

6.3.6.3.2 In the older types of shell boilers the gas passages were so proportioned that the pressure drop experienced by the gases in passing from furnace to chimney was small, usually a gauge pressure of

less than 60 mm of water. Such boilers were intended for operation under zero or negative draught pressure, and the design of smoke boxes, excess-pressure relief devices, access doors and other fittings is unlikely to be suitable for use with newer forced-draught liquid fuel burners without modification.

6.3.6.3.3 When modifying these older types of boiler, special attention should be given, particularly in the case of dry-back boilers, to the following:

- a) tightness of gas joints between front and rear smoke boxes and the boiler shell;
- b) sealing between brickwork or insulation and shell of smoke boxes;
- c) seals of access doors;
- d) suitability of excess-pressure relief devices for resisting gas leakage under forced-draught conditions including those on start-up of burners;
- e) suitability of existing refractory linings covering non-water-cooled surfaces for the increased surface temperature likely with liquid fuel firing.

6.3.6.3.4 The quality of the refractory brick should be such as to withstand a temperature of not less than 1 100 °C. However, where the brick surfaces cannot reradiate heat to any nearby water-cooled surfaces a quality of refractory brick capable of operating at temperatures up to 1 400 °C should be used.

6.3.6.3.5 The use of hot-face insulating bricks for the construction of the combustion space is sometimes desirable and the boiler manufacturer should be consulted. Where the burner design makes use of a brick quarl to ensure flame stability, care should be taken to follow exactly the quarl shape specified. The burner maker's advice should be sought on the design of the burner quarl. If necessary, refractory material should be fitted to exclude heat from the burner plate, and from those parts of the furnace tube not water-cooled, particularly the weld between the furnace tube and the head plate.

6.3.6.3.6 The suitability of tube attachment at the entry end of the first tube pass to withstand the changed conditions should be considered. The ends of welded stay tubes and of seal-welded plain tubes should be dressed flush with the weld, and plain tubes that are not welded should be no more than 1.5 mm proud of the tube plate.

6.3.6.3.7 The suitability of water-side circulation in tubed hot water boilers to sustain the higher rates of heat transfer in the region of the first tube pass entry when changing from solid fuel to liquid fuel firing should also be examined.

6.3.6.3.8 The combustion space should be such that combustion at the maximum required output is completed within the available length of furnace tube so that the flame does not make contact with the water-cooled surface of the furnace tube. The combustion space should also be such that the fuel can burn efficiently within the volume available.

6.3.6.3.9 Special problems might arise when converting boilers of riveted construction since the changed heat distribution within the boiler might cause old riveted joints to work loose and leak. If the boiler is old, this problem can be difficult to overcome.

6.3.6.4 New equipment

Where the boiler is supplied separately from the firing equipment the recommendations given in [6.3.6.3](#) should be followed. When a matched boiler-burner unit is supplied, details of the

requirements for the temperature and pressure of the fuel supply and draught arrangements at the boiler outlet should be obtained from the manufacturer.

6.3.7 Water-tube boilers

- 6.3.7.1** The liquid fuel firing of water-tube boilers requires special consideration by the specifier in collaboration with the boiler and burner makers in respect of furnace volume, rate of heat release, the number of burners and their location, their proximity to the combustion space boundaries and the length of flame. Attention should be paid to the necessity for a low rate of firing when starting the boiler from cold. This is particularly important when superheaters are fitted.
- 6.3.7.2** When the bottom of the combustion space is not water-cooled, arrangements should be made to limit the heat flow into the boiler room floor. This can be achieved by the provision of an air gap below the hearth, which should be adequately cooled by natural convection or by induced or forced ventilation.
- 6.3.7.3** The specification of burners should be undertaken in collaboration with the burner manufacturer, or burners should be chosen from the appliance manufacturer's approved listing for the equipment concerned.
- 6.3.7.4** Adequate standards for water treatment should be determined to meet the new conditions, see [6.3.3](#).
- 6.3.7.5** Air leaks into the combustion chamber, gas passes and flue ducts should be reduced to a minimum.
- 6.3.7.6** When it is intended to use the existing fans, the suitability of their performance should be checked.
- 6.3.7.7** The sulfur content of liquid fuels can cause low-temperature acidic corrosion problems and steps should be taken to reduce the resulting effects. In the case of boilers fitted with economizers, corrosion can be reduced by the following methods:
- a) removal of sections of the economizer;
 - b) recirculating feed water through the economizers;
 - c) increasing the feed water inlet temperature of the economizer by external means;
 - d) selection of burners suitable for operation at near stoichiometric conditions over the required turn-down range.
- 6.3.7.8** Flue ducts should be adequately insulated to prevent low metal temperatures.
- 6.3.7.9** Where the replacement of a burner has necessitated the reconstruction of a combustion chamber incorporating large quantities of refractory material, it should be ensured that the boiler operators bring the plant slowly up to maximum working load.

NOTE This is so that the refractory material is dried out slowly so as not to affect its structural integrity. When heated too quickly the surface can harden before the moisture in the deeper parts has dried. This can later boil and affect the adhesion of the refractory material onto the supporting structure and to itself.

The advice of the installer or a specialist refractory engineer should be sought.

6.3.8 Instantaneous steam and instantaneous hot water generators

NOTE Instantaneous steam generators are a group of appliances characterized by pressure parts consisting of a continuous coil of pipe that provides the convected heat transfer zone and can also completely or partly surround the combustion space. Water is fed into the coil under pressure and is largely or entirely converted into steam before reaching the other end of the coil. Instantaneous hot water generators are similar but designed so that the water is heated during passage through the coil to the required outlet temperature.

Units of this type are usually supplied as fully packaged appliances. This type of equipment necessitates a degree of interlock between the water pumping rate and the firing rate; the combustion chambers are often of compact size and shape. For these reasons the appliances should be fired only by the burner supplied by the appliance manufacturer.

In certain cases it is possible to convert the appliance to use a fuel different from that for which it was originally designed but in view of the considerations outlined above such a conversion should be carried out only by the original equipment manufacturer.

The manufacturers' instructions in respect of chimney and fuel supply conditions should be precisely followed.

6.4 Warm air heaters

6.4.1 General

For the purposes of this standard, a warm air heater is defined as a self-contained appliance for supplying warm air for heating non-domestic buildings.

NOTE The requirements for warm air heaters are specified in BS EN 13842.

The appliance is generally an enclosed unit containing a burner and a heat exchanger system. The air to be heated is circulated by a fan across the heat exchanger and the warm air is then distributed directly into the heated space or via ductwork to the space to be heated.

The heat exchanger consists generally of a metal-walled combustion chamber where the combustion of the fuel is completed and a secondary section in which further heat is transferred from the products of combustion prior to their discharge into the flue system.

Warm air heaters are designed with the heat exchanger system operating under either a negative or a positive pressure. To enable the correct condition to be achieved the chimney and flue duct should be of such size as to provide the draught specified by the manufacturer, which might involve the fitting of an induced-draught exhaust fan. This fan may be built into the heater unit or supplied as an additional item of equipment, but in either case interlocking with the burner control is essential to ensure that the burner cannot operate unless the fan is running.

6.4.2 Conversion of gas fired heaters to liquid fuel firing

When conversion of gas fired equipment to liquid fuel firing is required, the manufacturer of the heater should be consulted.

NOTE It is possible that the heater was originally designed for either of these fuels and a simple substitution of burner and controls might be adequate to bring about the conversion.

Many manufacturers of warm air heaters use packaged gas burners supplied by independent burner manufacturers. In these cases the burner manufacturer can usually supply a suitable liquid fuel burner. If not, a suitable burner should be obtained from an independent burner supplier.

When a substitute liquid fuel burner is not available from the heater manufacturer, consideration should be given to the gas firing characteristics so that a suitable type of liquid fuel burner can be selected.

Where the gas burner has been incorporated as a special part of the heater design, physical difficulties can arise when attempting to fit an alternative liquid fuel burner. It is then advisable that the manufacturers of both the heater and the liquid fuel burner should be consulted. It is unlikely that heaters fitted with atmospheric gas burners can be converted to liquid fuel firing.

With pre-mix units, advice should be obtained from the burner manufacturer as to the suitability for conversion.

The specification of burners should be undertaken in collaboration with the burner manufacturer, or burners should be chosen from the appliance manufacturer's approved listing for the equipment concerned.

A check should be made on the heater to ensure that there is sufficient airflow across the heat exchanger to limit the air temperature rise to that recommended by the heater manufacturer.

All joints in the combustion system should be sealed to avoid any leakage of combustion gases into the warm air flow or the heater surroundings. For the same reason, the correct fitting of excess-pressure relief devices should be ensured.

The heat exchange system should be checked. Particular attention should be paid to inspection of the combustion chamber for any cracking or broken welds due to excessive thermal stressing, and checking of the secondary section for leakage caused by corrosion. Faulty parts should be repaired or, if necessary, replaced.

6.4.3 Installation of new warm air heaters

The specifier and/or the designer should ensure that the size or number of heaters to be installed is sufficient to meet the maximum load requirements of the space to be heated.

NOTE Over-sizing of heaters causes frequent shut-downs and long periods of inactivity, resulting in inefficient operation.

Where high/low/off heaters are to be installed, they should be selected so that the maximum designed heating load falls between the high and low flame outputs.

6.4.4 Installation design

Warm air heaters should be sited to ensure that air inlets are not restricted in any way and that there is sufficient clearance for maintenance of burner, controls, heater, and exhaust flue. Heaters should be isolated from any combustible materials or flammable vapours, see [7.6.2](#).

Flue-gas ducts and chimneys should be designed to satisfy the draught requirements specified by the heater manufacturer and to ensure that the products of combustion cannot be re-circulated to the air inlets.

7 Design and construction of accommodation for liquid fuelled installations

7.1 General

The recommendations in this clause apply to liquid fuelled installations, both new and conversions of installations from use with other fuels, in both new and existing buildings; the recommendations are for the purposes of safety and good engineering practice.

7.2 Classification of buildings

For the purposes of this clause, buildings are divided into two groups as follows.

- a) “Large buildings” and places of public entertainment or assembly, where a “large building” is one which:
- exceeds 30 m in height; or
 - exceeds 24 m in height and has an area exceeding 930 m² on any floor; or
 - is used for purposes of trade or manufacture and has a total volume exceeding 7 000 m³.
- b) All buildings other than those referred to in a).

7.3 Accommodation for boilers

7.3.1 Location of boilers

Where liquid fuelled boilers and any associated equipment are installed in a non-domestic building they should preferably be sited in a suitably constructed boiler room. Alternatively, where smaller,

cased boilers are used these may be sited in another suitable position within the building in accordance with the appliance manufacturer's installation instructions and/or [BS 5410-1](#).

7.3.2 Use of boiler room

The boiler room should be used for housing only the boiler plant and such other apparatus as is necessary for its operation and that of the associated steam or hot water system. In no circumstances should refrigeration plant be accommodated in a boiler room.

7.3.3 Construction and fire resistance of boiler rooms

NOTE Attention is drawn to the Building Regulations [\[5\]](#), [\[6\]](#), [\[7\]](#).

Construction and fire resistance of boiler rooms, including the doors and windows, should be as given in [Table 2](#) or [Table 3](#), as applicable. Detailed examples of suitable types of construction are given in [Table 4](#).

The doors should be in accordance with [BS 9999](#).

Where a boiler room is within a building but projects partly therefrom so that its ceiling is partly the underside of a separating floor and partly the underside of a roof, the floor portion should have at least 1 h fire resistance and the roof should be of concrete having not less than 1 h fire resistance.

Table 2 — Construction, and fire resistance (in hours), of boiler room enclosures, doors and windows in “large buildings” and places of public entertainment or assembly

Location of boiler room	External wall construction	Roof construction	Doors and windows in external walls	Internal walls and floor separating boiler room from rest of building	Doors in internal walls separating boiler room from rest of building	Other recommendations
Detached from main building	Bricks, non-combustible blocks, concrete or masonry	Non-combustible materials	Where room is within 6 m of main building 0.5 h self-closing doors and 0.5 h glazing in frames fixed shut	—	—	Any doors, windows and vent openings in external walls and roofs should be positioned so as to present minimum risk to main building
External to, but adjoining, main building	Bricks, non-combustible blocks, concrete or masonry	Non-combustible materials, not less than 1 h	0.5 h self-closing doors and 0.5 h glazing in frames fixed shut	1 h	Single 1 h self-closing door (see Note)	Any doors, windows and vent openings in external walls and roofs should be positioned so as to present minimum risk to main building
Within the main building	Bricks, non-combustible blocks, concrete or masonry	(See 7.3.3)	0.5 h self-closing doors and 0.5 h glazing in frames fixed shut	1 h (see 7.3.3)	Single 1 h self-closing door (see Note)	Boiler room should be situated against an external wall. Any doors, windows and vent openings in external walls and roofs should be positioned so as to present minimum risk to main building. If not situated in lowest storey, 1 h structural supports to boiler room throughout building down to foundation should be fitted
On roof or within top-most storey of building	Bricks, non-combustible blocks, concrete or masonry	Non-combustible materials	0.5 h self-closing doors and 0.5 h glazing in frames fixed shut	1 h	Single 1 h self-closing door (see Note)	1 h structural supports to boiler room throughout building down to foundation should be fitted

NOTE Doors that are bolted into place and are designed and intended only for means of access for the installation, removal, repair or overhaul of the appliance or its ancillary equipment need not be self-closing.

Table 3 — Construction, and fire resistance (in hours), of boiler room enclosures, doors and windows in all buildings other than “large buildings” and places of public entertainment or assembly

Total rated heating capacity of boiler (see Note 1) kW	Roof construction	Walls and floors separating boiler rooms from rest of building	Internal access doors
Exceeding 45 and up to and including 110	Non-combustible materials (see Note 2)	1 h (see 7.3.3)	0.5 h self-closing (see Note 3)
Exceeding 110 and up to and including 220	Non-combustible materials (see Note 2)	1 h (see 7.3.3)	1 h self-closing (see Note 3)
Exceeding 220	Non-combustible materials (see Note 2)	1 h (see 7.3.3)	One 1 h self-closing (see Note 3) or one inner and one outer 1 h self-closing (see Note 3)

NOTE 1 Total rated heating capacity means either the rated heating capacity of the boiler or the rated heating capacity per hour calculated at the rate of 30 W for each cubic metre of the building or that part of the building served by the boiler installation, whichever is the greater.

NOTE 2 A combustible roof is acceptable in existing buildings if protected to give at least 1 h of fire resistance, provided that where the roof is within 450 mm of the boiler the whole roof is protected to give at least 1 h fire resistance.

NOTE 3 Doors that are bolted into place and are designed and intended only for means of access for the installation, removal, repair or overhaul of the appliance or its ancillary equipment need not be self-closing.

Table 4 — Examples of types of construction for the recommended periods of fire resistance given in [Table 2](#) and [Table 3](#)

Period of fire resistance	Examples of types of construction	
	Load-bearing walls (see BS 476-21)	Floors and roofs (see BS 476-21)
1 h	90 mm concrete block, class 1 aggregate	100 mm reinforced concrete slab
2 h	100 mm solid brickwork	125 mm reinforced concrete slab
4 h	170 mm solid brickwork	150 mm reinforced concrete slab
	Doors	Glazing
0.5 h	Doors constructed in solid timber not less than 44 mm finished thickness or door assemblies capable of resisting the action of fire for 0.5 h when tested in accordance with BS 476-22	Wired glass or electro-copper glazing
1 h	Door assemblies capable of resisting the action of fire for 1 h when tested in accordance with BS 476-22	—
2 h	Door assemblies capable of resisting the action of fire for 2 h when tested in accordance with BS 476-22	—

7.3.4 Boiler room floors

Boilers should be installed on a suitable base so that no part of the structural floor, foundations or ground exceeds a temperature of 65 °C. With this type of construction it is necessary to take account of transmitted heat, depending on the type and number of boilers and their distance apart. For small boilers, a layer of insulating brick of good quality might be sufficient to protect the floor. For larger boilers, insulation alone would be excessive in thickness and cost; hence it is usually more practicable to use water or air cooling.

Where a waterproof membrane is incorporated in the foundations special attention should be given to its protection from excessive downward heat transmission.

Where air cooling is used, it is possible with some designs of liquid fuel firing plant to improve the thermal efficiency by drawing the air for combustion through the air passages, so achieving some degree of preheating.

Whatever type of insulating base is used, it should be adequate to carry the gross weight of the boiler, including its weight when filled with a full quantity of operating fluid.

The floor of the boiler room should be of non-combustible material constructed or treated to prevent liquid fuel reaching any other parts of the building. Non-combustible thresholds at least 75 mm high should be provided.

7.3.5 Access and means of escape from buildings in which there is a boiler room

7.3.5.1 Means of escape

Care should be taken in the location of a boiler room within a building so as not to prejudice the means of escape for the occupants should there be an outbreak of fire involving the building or the boiler room. Locating the boiler room in a situation where the entrance door is accessed from a staircase in a single staircase building or from a cul-de-sac corridor should be avoided. Where consideration is being given to locating a boiler room within a building, the local fire and rescue service should be consulted. According to the circumstances, impermeable separation from a main

staircase might be required by the fire and rescue service; alternatively, protection of such a staircase might be required by means of fire-resisting approach lobbies or corridors that might be required to be ventilated.

7.3.5.2 Ventilation openings

Any ventilation openings serving the boiler room should not be sited within 1 m of any means of egress from the building.

7.3.5.3 Means of escape from the boiler room itself

The means of escape from boiler rooms should be designed to take account of the fire hazard presented by the equipment or contents of the room and any hindrance to the movement of the occupants; for example low headroom.

Where only one exit is provided, the maximum travel distance should not exceed 12 m.

Where only one exit is provided, or where there is danger of people being trapped, alternative means of escape such as ceiling hatches and ladders should be provided.

Where two or more exits are provided, the maximum travel distance from any point within the boiler room to the nearest exit should not exceed 25 m. Of this 25 m, the maximum travel distance in a single direction should not exceed 12 m.

Any upward means of escape from a boiler room whether by means of stairs or a ladder should be separated from the boiler room by means of a full height enclosure of 0.5 h fire-resisting construction and entered by a 0.5 h fire-resisting, self-closing door.

7.3.5.4 Plant access

There should be adequate access for the installation, removal, repair and overhaul of relevant plant. In all buildings other than “large buildings” or places of public entertainment or assembly, the plant access doors should be of the self-closing type. Alternatively, purpose-built bolted access panels should be used.

7.3.5.5 Direction of opening and fastening for doors

All doors affording means of escape from a boiler room should open in the direction of the escape route, be clear of steps other than the threshold recommended in [7.3.4](#), and be readily openable from inside the room without the aid of a key.

7.3.6 Smoke outlets

In boiler rooms below ground level in “large buildings” and places of public entertainment or assembly, pavement or stallboard lights should be provided to serve as smoke outlets, in addition to the ventilation openings recommended in [7.4](#). They should terminate at ground level in positions accessible to the Fire and Rescue Service but not sited in positions which could interfere with the means of escape (see [7.3.5.1](#)). Outlets should be as large as possible and arranged to provide cross ventilation when the covers thereto (which should be of suitable breakable construction) are broken. Any necessary outlet shafts should be separated from the rest of the building, including other outlet shafts, by construction having the same period of fire resistance as that required for the enclosure of the boiler room or for the remainder of the building through which they pass, whichever is longer. The outlets should be clearly identified at ground level by notices, e.g. SMOKE OUTLET FROM BASEMENT BOILER ROOM.

In large boiler rooms below ground level in buildings other than “large buildings” and places of public entertainment or assembly, smoke outlets as described above should be provided whenever the design permits.

7.3.7 Automatic fire extinguishing installations and foam inlets

In the case of the upgrading or conversion of an old installation, where the boiler room is not satisfactorily fire separated from the rest of the building, or is difficult to access, or where the ventilation is not in accordance with 7.4, a fixed automatic fire extinguishing installation or foam inlet might be required by the Fire and Rescue Service. The local Fire and Rescue Service and insurers should be consulted.

7.3.8 Lighting

The boiler room should be well lit by permanent electric lighting. Socket outlets should be provided for inspection lamps.

7.4 Ventilation and supply of combustion air

7.4.1 General

7.4.1.1 There should be provision for a supply of air for combustion, for combustion products dilution, where relevant, and for ventilation in accordance with 7.4.2 or 7.4.3 as applicable.

7.4.1.2 The air supplied for boiler room ventilation should be such that the maximum temperatures within the boiler house are:

- 25 °C at floor level (or 100 mm above floor level);
- 32 °C at mid-level (1.5 m above floor level); and
- 40 °C at ceiling level (or 100 mm below ceiling level).

NOTE Where the plant is likely to be used at or near maximum capacity during the summer months, additional ventilation might be required.

7.4.1.3 Combustion and ventilation air should be provided by one of the following four methods, as appropriate.

- a) Air should be supplied via one or more low-level openings and discharged via one or more high-level openings, the motive force being provided by thermal effects.
- b) Air should be supplied by a fan via one or more low-level openings, and discharged naturally via one or more high-level openings.
- c) Air should be supplied by a fan via one or more low-level openings and discharged by means of a second fan at a high-level opening. The fans should be selected and controlled so as not to cause a negative pressure (relative to the outside atmosphere) developing in the boiler room.
- d) In the case of balanced compartment installation, air should be supplied and discharged by means of a purpose-designed (or proprietary) flueing/ventilation system based solely on high-level permanent openings situated immediately adjacent to the flue outlet.

The apertures of an air opening should allow entry of a 5 mm diameter ball. No gauze or flyscreen (i.e. mesh having apertures of less than 5 mm) should be incorporated or subsequently fitted to an air vent, as such practices might compromise the free area.

For a balanced compartment installation, specialist advice should be sought from the system manufacturer.

7.4.1.4 All air inlet and extract fans should be fitted with automatic controls causing at least safety shutdown of the boiler(s) in the event of the air inlet or extract fan failing.

7.4.2 Open flued boilers

7.4.2.1 General

- 7.4.2.1.1** The boiler room should be provided with means of ventilation to ensure a supply of air sufficient for both combustion and general ventilation when all doors and windows are closed.
- 7.4.2.1.2** Where the boiler room is ventilated by natural means the air necessary for combustion and ventilation should be admitted by permanent openings at low level from the open air having a free area of not less than 6.7 cm² for each 1 kW of installed boiler capacity. In addition, permanent openings to the open air having a total free area of not less than 3.3 cm² per 1 kW of installed boiler capacity should be provided at high level to effect general ventilation. These openings should have a minimum area of 120 cm². If a mechanical system of ventilation is necessary it should be independent of any system serving other parts of the premises.
- 7.4.2.1.3** In boiler rooms below ground level special ducts might be necessary to admit the air. Such ducts should be enclosed and separated from the rest of the building by non-combustible construction having the same period of fire resistance as that required for the enclosure of the boiler room or for the remainder of the building through which the ducts pass, whichever is longer.
- 7.4.2.1.4** A ventilation system in which air is supplied naturally via a simple opening, and extracted using a fan, should not be used since this could depressurize the boiler room/house/enclosure and cause reverse flow in the flue.
- 7.4.2.1.5** For the purposes of determining air supply requirements, gas and solid fuel burning appliances installed in the same room or space as liquid fuelled boilers should be treated as liquid fuelled appliances of a similar type and rating when specific information is not available.
- 7.4.2.1.6** High-level ventilation openings should be located as high as is reasonably practicable, preferably within 15% of the building height from the ceiling.

7.4.2.2 Mechanical ventilation

When the supply of combustion and ventilation air is by mechanical means it should be ensured that the air flow is that specified by the boiler manufacturer.

7.4.2.3 Draught control

7.4.2.3.1 Individual draught

Combustion air should be supplied to the burner at a positive pressure by means of a forced-draught fan (or fans), which may be integral with the liquid fuel burner or separate from it, supplying air to one or more burners. The choice of fan is dependent on the conditions in the combustion space. It should be verified that the fan is capable of supplying the required quantity of air at a pressure high enough to overcome the pressure loss through the burner together with the maximum back pressure that can occur in the combustion space.

In addition to an adequate margin on the duty of the forced-draught fan, the fan should be specified to take into account the fouling of the boiler or heater gas passages likely to occur after prolonged periods of operation.

7.4.2.3.2 Balanced draught

Under all conditions of load, the combustion space should be maintained at a slightly sub-atmospheric pressure, normally by means of an induced-draught fan fitted with a control device, and the necessary combustion air should be supplied to the burners in accordance with [7.4.2.3.1](#).

7.4.2.3.3 Induced draught and forced draught

The characteristics of induced-draught fans should be carefully examined in relation to the total resistance of the boiler or heater flue and chimney systems at all rates of firing, and allowances made for excess air.

In addition, allowance should be made for added resistance due to fouling of gas passages and for loss of fan performance due to build-up on the impeller during periods between cleaning. The fan manufacturer should be informed of the flue gas temperature at which the fan will operate and their advice should be obtained on the correct choice of fan.

The output of forced-draught and induced-draught fans can be controlled by:

- a) fan speed control;
- b) flue damper control;
- c) inlet damper or vane control.

These controls can be manual or automatic. Electrical interlocking of the fan(s) with the burner is essential for safety and where both forced-draught and induced-draught fans are installed on a unit the forced-draught fan should not be allowed to continue running unless the associated induced-draught fan is operating correctly. A device should be incorporated (e.g. an air flow switch) to prevent burner operation in the event of failure of the induced-draught fan; this is particularly important where belt-driven fans are employed.

7.4.3 Room sealed boilers

7.4.3.1 Installation in a boiler room

The ventilation provided should be adequate to ensure that the boiler room temperature is in accordance with [7.4.1.2](#), and should be not less than 2 cm² free-area per kilowatt of heat output both at high and at low level.

NOTE In the case of room-sealed boilers where combustion air is ducted to the appliance from outside 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. Where a boiler is to operate in summer months, the above allowance can be expected to be sufficient, provided that it does not operate for more than 50% of the time. If the boiler is to operate for a higher percentage of the time, increased ventilation will be necessary, e.g. at 75%, 3 cm²/kW will be needed and at 100%, 4 cm²/kW will be needed at high and at low level.

7.4.3.2 Installation in an enclosure

Air vents should be provided in an enclosure containing a room-sealed boiler, and should be sized in accordance with [Table 5](#), at both high and low levels.

Both high and low level vents should communicate either with the same room or internal space, or with the outside air at the same wall. The vertical distance between the high and low vents should be as great as is possible to encourage a convective air flow.

NOTE Room sealed appliances in ventilated heated spaces, normally above 0.5 air changes per hour, do not require additional ventilation.