Incorporating Corrigendum No. 1

Specification for safety and rational use of energy of domestic gas appliances —

Part 2: Combined appliances: Gas fire/back boiler

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Foreword

This standard has been prepared under the direction of the Engineering Section Board, E/-, and is a revision of BS 5258-8:1989 and BS 6332-3:1984, all of which will be withdrawn, on publication of this standard.

Matters related to quality assurance systems, tests during production and to certificates of conformity of auxiliary devices are not dealt with.

The test gases, test pressures and appliance categories specified in this standard are in accordance with those specified in BS EN 437.

A Guide to the clauses of this British Standard addressing the Essential Requirements of the Gas Appliance Directive (GAD) is given in Annex C.

In particular attention is drawn to the following:

The Gas Appliances (Safety) Regulations 1995 SI No. 1629[1].

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 does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 74, an inside back cover and a back cover.

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1 Scope

This standard specifies the requirements and methods of test for the construction, safety, performance, classification and marking of gas-fired appliances consisting of a back boiler and a gas fire. These appliances are intended for installation with a governed or regulated gas supply.

This standard applies to open flued appliances using 2nd and/or 3rd family gases only.

This standard does not apply to:

- back circulators;
- catalytic combustion appliances;
- appliances in which the supply of combustion air, or the movement of convected air, is achieved by mechanical means;
- appliances intended for direct heating of sanitary water;
- gas fires with a range-rating capability.

This standard only covers type testing.

2 Normative references

The following referenced documents are indispensible for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 1179:1967, Glossary of terms used in the gas industry.

BS 5258-8:1980, Safety of domestic gas appliances — Combined appliances: Gas fire/back boiler.

BS EN 88:1991, Pressure governors for gas appliances.

BS EN 125:1991, Specification for flame supervision devices for gas-burning appliances — Thermoelectric types.

BS EN 126:1995, Multifunctional controls for gas burning appliances.

BS EN 161:1991, Automatic shut-off valves for gas burners and gas appliances.

BS EN 257:1995, Mechanical thermostats for gas burning appliances.

BS EN 298:1994, Automatic gas burner control systems for gas burners and gas-burning appliances with or without fans.

BS EN 437:1997, Specification for test gases, test pressures and categories of appliances, for gas appliances.

BS EN 484:1998, Specification for dedicated liquified petroleum gas appliances — Independent hotplates, including those incorporating a grill for outdoor use.

BS EN 50165:1997, Electrical equipment of non-electric appliances for household and similar proposes — Safety requirements.

BS EN 60730-2-9:2002, Specification for automatic electrical controls for household and similar use— Particular requirements— Particular requirements for temperature sensing controls.

IEC 817:1984, Spring operated impact test apparatus and its calibration.

ISO 7-1:1995, Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation.

ISO 228-1:2000, Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation.

ISO 228-2:1987, Pipe threads where pressure-tight joints are not made on the threads — Part 2: Verification by means of limit gauges.

ISO 274:1975, Copper tubes of circulation section — Dimensions.

ISO 7005-1:1992, Metallic flanges — Part 1: Steel flanges.

ISO 7005-2:1998, Metallic flanges — Part 2: Cast iron flanges

ISO 7005-3:1998, Metallic flanges — Part 3: Copper alloy and composite flanges.

3 Terms and Definitions

For the purposes of this standard the following definitions together with those of BS 1179, apply.

3.1 Appliance and parts

3.1.1

appliance

a combination of a back boiler and a gas fire

3.1.2

back boiler

a water heating unit designed to fit into a builders opening to provide central heating or central heating and domestic hot water

3.1.3

gas fire

that part of the appliance that has a function similar to those within the scope of BS EN 509:2000 or BS 7977-1:2002

3.1.4

closed fronted gas fire

a gas fire which does not have exposed flames or exposed incandescent areas

3.1.5

live fuel effect fire (LFE)

gas fired appliance designed to heat a room mainly by the emission of air heated by convection. Such an appliance also contains radiant elements designed to simulate a solid fuel fire bed. It is designed to be mounted on a hearth, floor or wall

3.1.6

back circulator1)

a water heater unit designed to fit into a fireplace recess intended primarily for the supply of domestic hot water in conjunction with a separate storage vessel and for operation by gravity circulation with a rated heat input not exceeding $7.2~\mathrm{kW}$ net

3.2 Parts of the appliance conveying gas to the burners

3.2.1

gas circuit

the parts of the appliance conveying gas to the burners

3.2.2

inlet connection

the part of the appliance intended to be connected to the gas supply

3.2.3

mechanical joint (mechanical means of obtaining soundness)

a means of assuring the soundness of an assembly of several (generally metallic) parts without the use of liquids, pastes, tapes, etc. There are, for example:

- metal to metal joints;
- conical joints;
- toroidal sealing rings;
- flat joints

3.2.4

restrictor

device with an orifice, which is placed in the gas circuit so as to create a pressure drop and thus reduce the gas pressure at the burner to a predetermined value for a given supply pressure and rate

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 $^{^{1)}}$ Back circulators are not covered by this standard.

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3.2.5

sgas rate adjuster

component allowing the gas rate of the burner to be brought to a predetermined value according to the supply conditions.

the adjustment may be progressive (screw adjuster) or discontinuous (changing restrictors).

the adjuster of an adjustable governor is regarded as a gas rate adjuster.

if, after the manufacturer or installer has adjusted an adjuster it is immobilized in this position by some means such as a screw, etc., it is said that the adjuster is "set" in this position

3.2.6

sealing an adjuster

procedure by which after setting an adjuster, material is added such that any attempt to alter the setting is apparent

factory sealed preset adjuster, other than the adjuster of a pressure governor, is considered to be non-existent.

a pressure governor is considered to be non-existent if it has been factory sealed such that it cannot function as a pressure governor.

3.2.7

putting an adjuster or a control out of service

adjuster or a control (of temperature, pressure, etc.) is said to be "put out of action" if it is sealed in a position such that the appliance then functions as if the device had been removed

3.2.8

gas rate control²⁾

component allowing the user to open, close or adjust the gas supply to one or more burners

3.2.9

range-rating device

component on the appliance intended to be used by the installer to adjust the nominal heat input of the appliance, within the range of maximum and minimum heat inputs stated by the manufacturer, to suit the actual heat requirements of the installation

3.2.10

injector

component that admits the gas into a burner

3.3 The burner

3.3.1

main burner

burner that is intended to assure the thermal function of the appliance and is generally called the burner

3.3.2

fuel effect burner

burner that simulates a solid fuel flame. The flames pass through a simulated solid fuel bed

3.3.3

ignition device

any means (flame, electrical ignition device or other device) used to ignite the gas at an ignition burner or main burner

3.3.4

ignition burner

a small burner whose flame is intended to ignite a main burner

²⁾ This device may be a "Tap".

3.3.5

ignition safety time

time that elapses between the order to open the gas supply to the burner and the gas supply being shut off in the event that no flame has been detected

3.3.6

extinction safety time

time that elapses between extinction of the supervised flame and the order to shut off the gas supply to the burner

3.3.7

fixed primary aeration restrictor

device containing a restriction of fixed cross-section which limits the supply of air to a burner

3.3.8

non-volatile lockout

shutdown condition such that a start can only be accomplished by a manual reset

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volatile lockout

shutdown condition such that a start can only be accomplished by restoration of the electrical supply after its loss

3.3.10

de-energized to trip principle

principle according to which neither auxiliary energy nor external action is required to activate a safety device

3.4 Burner control systems

3.4.1

manually operated burner control system

control system for an appliance in which manual intervention by the user is necessary to turn on the appliance; to ignite the ignition burner, if any, and the main burner; to vary the heat input of the main burner and to shut off the appliance

3.4.2

semi-automatic burner control system

control system for an appliance in which manual intervention by the user is necessary to turn and ignite a permanent ignition burner. Ignition, from this ignition burner, control and extinction of the main burner is carried out automatically without the need for manual intervention

3.4.3

automatic control system

system comprising at least a programming unit and all the elements of a flame detector device. The various functions of an automatic burner control system may be in one or more housings

3.4.4

programming unit

device which reacts to signals from control and safety devices; gives control commands; controls the start-up sequence, and supervises the burner shut-down and lock-out. It follows a predetermined sequence of actions and always operates in conjunction with a flame detector device

3.5 Construction

3.5.1

builders opening

enclosure constructed by the builder to accommodate fireplace components

3.5.2

draught diverter

device placed in the combustion products circuit to reduce the influence of flue-pull and down-draught on the burner performance and combustion

3.5.3

working surfaces

those parts of an appliance whose main function is to contribute to the heating of the room and which are therefore at a high temperature, for example refractories and radiants. Also those parts which due to their function or position are at high temperature, for example dress guards and outlet grilles

NOTE 1 Any point within 15 mm of a working surface should be considered part of that working surface.

NOTE 2 Surfaces within 15 mm of parts that have to be manipulated during normal operation of the appliance cannot be considered as working surfaces.

3.6 Auxiliary equipment

3.6.1

pressure governor

device which maintains the downstream pressure constant to within fixed limits independent of variations, within a given range, of the upstream pressure and the gas rate

3.6.2

flame supervision device

device that, in response to a signal from the flame detector, keeps the gas supply open and closes it in the absence of the supervised flame

3.6.3

control knob

component designed to be moved by hand to operate an appliance control (tap, thermostat, etc.)

3.6.4

control thermostat

device enabling a temperature to be kept automatically, within a range, at a predetermined value

3.6.5

adjustable control thermostat

control thermostat that permits the user to obtain setting temperatures between a minimum and a maximum value

3.6.6

safety temperature limiter

device that causes safety shutdown and non-volatile lockout so as to prevent the water temperature exceeding a preset limit

3.6.7

temperature sensing element

component that detects the temperature of the environment to be supervised or controlled

3.6.8

overheat cut-off device

device that causes safety shutdown and non-volatile lockout before the appliance is damaged and/or before safety is compromised

3.7 Gases

3.7.1

net calorific value (net C.V.)

quantity of heat produced by the complete combustion, at a constant pressure of 1 013.25 mbar³), of unit volume or mass of gas, the constituents of the combustible mixture being initially at 15 $^{\circ}$ C, 1 013.25 mbar, the products of combustion being brought back to the same conditions and the water produced by combustion being assumed to be retained in the vapour state

Practical units: MJ/m^3 , MJ/kg Symbol: H_i

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³⁾ $1 \text{ bar} = 10^5 \text{ Pa}$

3.7.2

gross calorific value (gross C.V.)

quantity of heat produced by the combustion, at a constant pressure, of unit volume or mass of the gas considered, the combustion water being condensed, under standard reference conditions of 15 °C, 1,013 bar

Practical units: MJ/m 3 , MJ/kg Symbol: H_8

3.7.3

relative density

ratio of the masses of equal volumes of dry gas and dry air at the same conditions of temperature and pressure

Symbol: d

3.7.4 Wobbe index

3.7.4.1

net wobbe index

ratio of the net calorific value of a gas per unit volume and the square root of its relative density under the same reference conditions

 $\frac{H_{\rm i}}{\sqrt{d}}$

Unit: MJ/m^3 Symbol: W_i

3.7.4.2

gross wobbe index

ratio of the gross calorific value of a gas per unit volume and the square root of its relative density under the same reference conditions

 $\frac{H_{\rm s}}{\sqrt{d}}$

Unit: MJ/m^3 Symbol: W_s

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gas pressures

all the pressures are static pressures of the moving gas, relative to the atmospheric pressure, measured at right angles to the direction of flow of the gas

Units: millibar (mbar)

3.7.6

3.7.5

test pressures

gas pressures used to check the operational characteristics of appliances using combustible gases. They comprise normal and limit pressures

Units: millibar (mbar)

3.7.7

normal pressure

pressure under which appliances operate under nominal conditions when supplied with the corresponding reference gas (see Table 6)

Symbol p_n

3.7.8

limit pressures

pressures representative of the extreme variations in the appliance supply condition

3.7.9

setting pressure

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

7

3.8 Appliance performance

3.8.1 Gas rates

3.8.1.1

volumetric flow rate

volume of gas consumed by the appliance in unit time during continuous operation

Unit: m³/h

3.8.1.2

mass flow rate

mass of gas consumed by the appliance in unit time during continuous operation

Units: kg/h and, if necessary, g/h

3.8.1.3

thermal equilibrium

state of thermal equilibrium is the operating state of the appliance corresponding to a particular setting of the input, in which the measured value of the flue gas temperature remains steady within a tolerance of ± 2 % over a period of 10 minutes

3.8.2 Input

3.8.2.1

heat input

quantity of energy used in unit time corresponding to the volumetric rate or the mass rates, the calorific value used being net and expressed in kilowatts⁴⁾

Unit: kW

3.8.2.2

nominal heat input⁵⁾

the value of the net heat input stated by the manufacturer (see 8.1)

Unit: kW

3.8.2.3

minimum operational rate

3.8.2.3.1

boiler

lowest heat input at which the boiler is intended to operate

3.8.2.3.2

gas fire

- a) for any burner or section of a burner which is controlled by a thermostat, the bypass rate;
- b) for any burner which is manually controlled and which is subdivided into sections under control of a tap (e.g. duplex burners), 30 % of the full-on rate of each individual section;
- c) for any burner which is manually controlled but which is not subdivided into sections (i.e. simplex burners), 20 % of the full-on rate;
- d) for any burner where it is only possible to obtain certain predetermined fixed settings, the lowest fixed setting.

⁴⁾ The heat input on gross calorific value is related to the net value for the reference gases as follows:

G 20 gross value = $1.111 \times$ net value

G 31 gross value = $1.087 \times$ net value.

⁵⁾ Appliances fitted with a range-rating device operate at a nominal heat input between the maximum and minimum adjustable heat inputs. Modulating appliances operate between the nominal heat input and the minimum controlled heat input.

3.8.3

nominal output

heat output obtained with the reference gas at nominal heat input. This output is declared by the manufacturer for both the back boiler and the gas fire

Unit: kW

3.8.4 Efficiency

3.8.4.1

boiler efficiency

ratio of the useful boiler output to the heat input measured with the boiler only alight, expressed as a percentage

3.8.4.2

fire efficiency

ratio of the useful fire output to the heat input measured with the fire only alight, expressed as a percentage

3.9 Gas combustion

3.9.1

flame stability

the state of the flames resting in a stable manner, on the burner ports or the flame contact area provided by the design, with no flame lift or light-back

3.9.2

flame lift

phenomenon characterized by the total or partial lifting of the base of the flame from the burner port or the flame contact area provided by the design

3.9.3

light-back

phenomenon characterized by the entry of a flame into the body of a burner

3.9.4

light-back at the injector

phenomenon characterized by ignition of the gas at the injector either, as a result of the flame entering the burner or, by the propagation of a flame around the outside of the burner

3.9.5

sooting

phenomenon characterized by deposits of soot on the surfaces of parts of the appliance in contact with the products of combustion or with the flame

3.9.6

yellow tipping

phenomenon characterized by the appearance of yellow colouring at the tip of a blue flame

3.9.7

start gas rate

fixed, restricted gas flow rate admitted either to a separate ignition burner or to the main burner during safety time

3.9.8

start gas flame

flame established at the start-gas rate either at the main burner or a separate ignition burner

3.9.9

main gas rate

gas flow obtained with the burner controls in their fully open position

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3.10 lint assessment

for the purposes of lint assessment the following definitions apply:

- a) aerated burner. A burner in which the gas flowing through a gas injector induces the primary air for subsequent combustion;
- b) non-aerated burner. A burner in which the gas is burned without previous mixture with air;
- c) air inlet. Any opening(s) in the boiler casing for the supply of air.

4 Classification of appliances

4.1 Classification according to the nature of the gases used (categories)

4.1.1 General

For the purposes of this standard, gases shall be classified in accordance with BS EN 437:1999.

4.1.2 Families of gases

Gases are classified into families, possibly divided into groups according to the value of the Wobbe index. Table 1 specifies the families and groups of gas used in this standard.

Table 1 — Classification of gases

Gas families and groups	Gross Wobbe index at 15 °C and 1 013.25 mbar (dry)		
	Minimum	Maximum	
Second family			
Group H	45.7	54.7	
Third family			
Group P	72.9	76.8	

4.1.3 Categories of appliance

NOTE Appliances are classified in categories according to the gases that they are designed to use.

4.1.3.1 Categories I

These categories relate to appliances designed exclusively to use gases of a single family and possibly only gases of a single group:

- a) appliances designed for use with second family gases,
 - category I_{2H}. An appliance for use with gases in group H of the 2nd family only;
- b) appliances designed for use with third family gases,
 - category I_{3P}. An appliance for use with gases in group P of the 3nd family only (propane).

4.1.3.2 Categories II

This category relates to appliances designed for use with 2nd and 3rd family gases.

— Category II_{2H3P}. An appliance capable of using gases of group H of the second family and gases of group P of the third family. The second family gases are used under the same conditions as for category I_{2H}. The third family gases are used under the same conditions as for category I_{3P}.

4.2 Conversion to different gases

When converting from one gas to another, the manufacturer's instructions shall be followed.

5 Construction

5.1 Materials and method of construction

5.1.1 General

The quality and thickness of the materials used in the construction of the appliances, and the method of assembling the various parts, shall be such that the constructional and performance characteristic are not significantly altered during a reasonable life and under normal conditions of installation and use.

In particular, all the appliance components shall withstand the mechanical, chemical and thermal conditions to which they may be subjected when the appliance is normally used.

Materials downstream of the heat exchanger shall be corrosion-resistant or be protected against corrosion.

5.1.2 Materials

Asbestos or asbestos containing materials shall not be used.

Cadmium shall not be used in high melting point solders.

Copper shall not be used for those parts of the gas circuit which exceed 100 $^{\circ}\mathrm{C}$ when the appliance is in normal use.

Thermal or acoustic insulation shall be non-combustible, securely located and protected against mechanical damage and condensate.

5.2 Accessibility for maintenance and use

Any control placed in the gas circuit shall be so arranged that any adjustment, maintenance or exchange is easy.

User removable parts shall be so designed or marked that they are easy to reassemble correctly and difficult to reassemble incorrectly.

In particular, it shall be possible to complete all the operations of removal and reassembly of parts which the user has to carry out in the course of routine maintenance, as explained in the user instructions, without the aid of a tool.

Removable parts shall be dismountable for maintenance by a service engineer using ordinary tools.

Parts that are not intended to be removed or adjusted by the user and that on removal, or adjustment, may result in a hazard, e.g. injector jets, shall require the use of tools for their removal.

5.3 Connections to the gas and water pipes

5.3.1 General

The appliance connections shall be easily accessible. They shall be clearly identified in the installation instructions and possibly on the appliance.

The clearance around the connections, after removing the case if necessary, shall be adequate to allow easy use of the tools required to make the connection. It shall be possible to make all the connections without special tools.

5.3.2 Connection to the gas pipe

It shall be possible to connect the appliance by rigid metallic means to the gas supply pipe.

If the appliance has a threaded connection, this thread shall conform to ISO 228-1:1995 or ISO 7:1995. In the first case, the end of the appliance inlet connection shall offer a sufficiently flat annular surface to allow the use of a sealing washer.

If flanges are used, they shall conform to ISO 7005:1988 and the manufacturer shall provide the counterflanges and sealing gaskets.

5.3.3 Water connections

Threaded connections shall conform to ISO 228-1:2000 or ISO 7-1:1995.

If tubular copper connections are used, the connecting end of the tube shall conform to ISO 274:1975.

Non-metallic materials shall only be used if it is evident that such materials are fit for purpose.

5.3.4 Drainage

If it is not possible to drain the boiler by means of the water connections, the boiler shall have a device to enable it to be drained, which can be operated by means of a tool such as a spanner or screwdriver.

Directions for drainage shall be included in the instructions.

5.3.5 Pressure test points

Pressure test points shall be provided on the appliance for measurement of the manufacturer's stated operating pressures. The pressure test nipples shall have an external diameter of $9_{-0.5}^{\ 0}$ mm, and a useful length of at least 10 mm for connection to tubing. The diameter of the hole in the test point shall be not greater than 1 mm at its narrowest point.

If either the fire or back boiler is fitted with a governor or continuous action gas rate adjuster which, in accordance with the manufacturer's instructions, may require adjustment, upon installation of the appliance, or during its conversion, then the fire or boiler concerned shall be fitted with two pressure test points. One to measure the pressure upstream of any governor or adjuster⁶⁾ and the other to measure the pressure after the governor or adjuster, upstream of the burner.

5.4 Flue system

The appliance shall be capable of:

- a) direct connection to a round flue pipe or to a flexible metallic liner; and/or
- b) connection to a specified design of pre-cast flue system.

The appliance shall be provided with a flue outlet socket form having a minimum depth of 25 mm. It shall be easily possible, during installation in accordance with the manufacturer's instructions, to make and seal the flue connection from the front of, and inside, the fireplace recess.

5.5 Soundness

5.5.1 Soundness of the gas circuit

Holes for screws, studs, etc., intended for the assembly of components shall not open into the gasways⁷⁾. The residual wall thickness shall be at least 1 mm.

Brackets for supporting components shall not interpose into any gas-carrying joints.

The soundness of components and assemblies connected to the gas circuit and likely to be dismantled for routine maintenance at the consumer's premises with the exception of gas taps and cocks, shall be assured by means of mechanical joints, e.g. metal to metal joints, O-ring joints or packing, i.e. excluding the use of any sealing compound such as tape, mastic or paste. The soundness shall be maintained after dismantling and reassembly.

Sealing compounds may be used for permanently threaded assemblies and grease may be used for taps and cocks. The sealing material shall remain effective under normal conditions of appliance use.

Where parts of the gas circuit are assembled without threads, soundness shall not be achieved by means of soft solder for which the lowest temperature of the melting range, after application, is less than 450 °C neither shall adhesives be used.

⁶⁾ This pressure test point may serve both the fire and the boiler.

⁷⁾ A niting plate is not considered to be a gas-carrying joint.

$5.5.2\ Soundness\ of\ the\ combustion\ circuit$

The appliance shall be constructed so that it conforms to **7.1.2**.

Any means used to achieve soundness of the combustion circuit shall be such that it remains effective under normal conditions of use and servicing.

In particular, the soundness of parts likely to be removed during routine servicing shall be achieved by mechanical means, excluding pastes, liquids and tapes. The replacement of seals in accordance with the manufacturer's instructions is permitted.

5.6 Supply of combustion air and evacuation of the combustion products

All appliances shall be designed so that there is an adequate supply of combustion air during ignition and over the whole range of possible heat inputs stated by the manufacturer.

Connection to the flue shall be made by means of a flue outlet preceded by a draught diverter. This device is part of the appliance.

5.7 Assembly

Mechanical means shall be provided to secure the boiler base firmly to the fireplace heath.

Where screws are used for the assembly of any part of the appliance casing which is removable for routine servicing, they shall be fitted with spring steel fasteners or have at least 2½ threads engagement.

5.8 Electrical equipment

The electrical equipment of the appliance shall conform to the relevant requirements of BS EN 50165:1999.

5.9 Operational safety in the event of fluctuation, interruption and restoration of the auxiliary energy

Interruption and subsequent restoration of the mains voltage supply to the appliance at any time during the start up or operation of the appliance shall result in continued safe operation, or:

- a) for appliances not fitted with an automatic burner control system, shut down of the burner such that manual re-ignition of the burner is required, or
- b) for appliances with an automatic burner control system, at least safety shut down.

Interruption and subsequent restoration of the mains voltage supply shall not override any non-volatile lockout condition.

Requirements and methods of test covering the safety and continued operation of the appliance in the event of normal and abnormal fluctuation of the auxiliary energy are specified in **7.7.1.1** and **7.7.1.2.5**.

5.10 Confirmation of operation

The ignition and operation of the burners and also the length of the flame(s) of any ignition burner(s) shall be visible to the installer.

 NOTE This may entail the opening of a door or the removal of a case.

Mirrors, sight glasses, etc., shall continue to retain their optical properties.

An indirect means of indication (e.g. an indicator light) may be used, provided that the indicator checks only for flame presence or a fault in the means of checking the flame itself which results in an indication that there is no flame.

It shall be possible for the user, perhaps after opening a door, to check at any time that the boiler is operating.

5.11 Requirements for adjusting, control and safety devices

5.11.1 General

Safety systems shall be so designed that de-energization does not create a hazard.

The operation of safety devices shall not be overruled by adjusting and control devices.

All of the devices and/or any multifunctional control shall be removable or exchangeable if necessary for cleaning or replacement of the device. Adjusters for devices shall not be interchangeable if this could result in confusion.

When there are several control knobs (taps, thermostats, etc.), their function shall be clearly indicated and they shall not be interchangeable if this could lead to confusion.

5.11.2 Gas rate adjusters and range-rating devices (boiler only)

5.11.2.1 *General*

Any parts which are not intended to be altered by the user or the installer shall be sealed such that any unauthorized interference is evident. Paint may be used for this purpose provided that it withstands the temperature to which it is subjected during normal operation of the boiler.

Adjusting screws shall be designed in such a way that they cannot fall into the gasways.

Adjustment of the adjuster and/or of the range-rating device may be continuous (e.g. use of an adjusting screw) or discrete (e.g. change of restrictors).

5.11.2.2 *Adjuster*

Any adjuster(s) shall be adjusted and sealed by the manufacturer or the installer.

5.11.2.3 Range-rating devices

If this device and the gas rate adjuster are one and the same, the manufacturer shall give instructions for the use of the adjuster in installation instructions.

5.11.3 Aeration adjusters

Aeration shall not be adjustable on the boiler.

If the fire is provided with aeration adjustment, this adjustment shall be limited in accordance with 7.7.3.1.

5.11.4 Manual controls

The appliance shall be provided with gas taps, thermostats or electric switches essential for normal operation of the appliance by the user.

Any gas tap shall conform to the parameters specified by the tap manufacturer.

Any gas cock or tap shall be designed, identified or positioned to avoid inadvertent operation but shall be easy to operate when required. It shall be so designed that the "OFF" and "ON" positions are readily distinguishable.

Any gas cock or tap shall be provided with positive stops at the "OFF" and full "ON" positions. The gas shall not be shut off in any position of the tap except between the "OFF" stop and the end of the circumferential seal. For the purpose of this standard any operating mechanism between the control and the tap handle shall be deemed part of the control.

A multi-position tap shall be clearly marked at the ignition position. A halt at the ignition position shall be provided unless the control incorporates another device, to avoid a hazard arising, e.g. flame supervision device or ignition cut out.

5.11.5 Gas governors

The use of a gas governor is optional. Gas governors shall conform to BS EN 88:1991.

The design and accessibility of any governor shall be such that it can be easily adjusted and put out of operation when another gas is supplied, but precautions shall be taken to make unauthorized interference with the adjuster difficult.

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5.11.6 Flame supervision devices

5.11.6.1 General

The backboiler and fire shall each be protected by a flame supervision device conforming to BS EN 125:1996 or BS EN 298:1998 as appropriate.

5.11.6.2 Flame detection

The presence of a flame shall be detected as follows:

- either by a thermoelectric flame supervision device; or
- by the flame detector of an automatic burner control system.

Where the main burner is ignited by an ignition burner, the presence of the ignition burner flame shall be detected before gas is admitted to the main burner.

5.11.6.3 Thermoelectric flame supervision device

The device shall cause non-volatile lockout of the unit of the appliance in the event of flame failure and in the event of damage to the sensing element or to the connection between the sensing element and the shut-off valve.

5.11.7 Multifunctional controls

Multifunctional controls shall conform to BS EN 126:1995.

5.11.8 Automatic shut-off valves

Any electrically operated automatic shut-off valve shall conform to the requirements of EN 161:1998.

The valve classes specified in this standard are the minimum requirements and do not prevent the use of valves of a superior performance. The valve classes are A, B, C and J with A having the greatest closing force and J the lowest. Examples of gas valve arrangements for automatic controls are given in Annex B (see Figure B.1, Figure B.2 and Figure B.3).

No markings are required where a single push button operates a safety device that controls both the burner and the ignition burner, provided that incorrect operation is not possible.

5.11.9 Burner control systems

5.11.9.1 General

The fire control system shall be so designed that ignition is possible only when the user is in sight of the fire. Further, it shall not incorporate any means of facilitating ignition under other circumstances.

The fire shall have:

- either a manually operated burner control system;
- or a semi-automatic control system;
- or an automatic burner control system providing that this system is so designed that ignition is only possible when the user is in sight of the appliance.

The back boiler shall have:

- either a semi-automatic burner control system;
- or an automatic control system.

5.11.9.2 Manually operated burner control system

The control system shall have one or more manually operated controls (e.g. tap or cock) enabling the user:

- to turn on and ignite the ignition burner, if any, and the main burner
- to control the heat input of the main burner, and
- to shut off the main burner and any pilot.

The control system shall incorporate a flame supervision device conforming to BS EN 125:1996. In the event of flame failure, this device shall shut off the gas supply to the main burner. Re-ignition of the appliance shall only be possible after manual intervention.

5.11.9.3 Semi-automatic burner control systems

5.11.9.3.1 *General*

The control system shall be provided with a user control enabling the user to turn on and ignite the ignition

The control system shall incorporate a means of preventing the supply of gas to the main burner until the ignition burner flame has been detected.

The control system shall incorporate a flame supervision device conforming to BS EN 125:1996. In the event of flame failure, this device shall shut off the gas supply to the main burner and any ignition burner. Re-ignition of the appliance shall only be possible after manual intervention.

In addition, where the boiler incorporates such a control system, it shall conform to either of the following requirements.

- a) The control system shall incorporate a re-start interlock; or
- b) The manufacturer shall include a statement in the user's instructions, warning the user to wait a specific period of time before attempting to light the appliance in any circumstances where this could be hazardous.

5.11.9.3.2 Gas circuit valves

The gas circuit shall be fitted with at least the following automatic shut off valves

Specified in Table 2, or their given alternatives. Where two gas valves are required these shall be in series.

Table 2 — Gas valves for semi-automatic control systems

Main gas circuit		Ignition circuit		
1 st valve	2 nd valve	1 st valve	2 nd valve	
Ca	J	Cab	J^{c}	

- ^a A flame supervision device may be fitted as an alternative to this valve.
- b This valve may be the 1st valve in the main burner circuit.
- This valve is not required if the heat input of the ignition burner is less than 0.250 kW.

5.11.9.4 Fully automatic burner control systems

5.11.9.4.1 General

Automatic burner control systems shall conform to the appropriate requirements of EN 298:1994 Systems not within the scope of EN 298:1994 shall conform to an appropriate standard for their application.

Operation push buttons, switches, etc. incorrectly set or out of sequence shall not adversely affect the safety of the automatic burner control system. In particular, when tested in accordance with 7.13.2.1.2.1, the rapid (on and off) operation of any start switch shall not set up a hazardous condition.

5.11.9.4.2 Particular conditions for the gas fire

Extinction of the main burner or start gas flame (where incorporated) due to operation of user controls, safety controls, or failure of gas or electricity supply shall result in non-volatile lock out.

5.11.9.4.3 Start-gas flame ignition

5.11.9.4.3.1 Design

For burners with this control system, a start-gas flame shall be established, either at the main burner or at a separate ignition burner. If the start-gas flame is established at the main burner, it shall be supplied at a fixed start-gas rate.

The manufacturer shall declare the maximum safety time (see 7.13.1.2.2).

If the start-gas flame has not been detected by the end of the safety time, volatile or non-volatile lockout shall result.

The control system shall be so designed and arranged that the signal to supply the main burner with gas at the main gas rate cannot be given until after the start-gas flame has been detected.

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Where the start-gas supply is taken from between the two main gas valves or is supplied by the first stage of a two stage valve in the main system, the gas line shall conform to **7.4.6**.

Flame failure in the running condition shall result in the following:

- non-volatile lockout;
- volatile lockout; or
- spark restoration.

Where spark restoration is used, the re-ignition attempt shall begin within 1 second of loss of flame and end no later than the safety time. If the flame is not detected by the end of the safety time, non-volatile or volatile lockout shall result.

5.11.9.4.3.2 *Gas circuit valves*

The gas circuit shall be fitted with at least the automatic shut off valves shown in Table 3. Where two gas valves are required these shall be in series.

Table 3 — Gas valves for automatic control systems with start-gas ignition

Main gas circuit	Start -gas circuit ^a		
1 class C and	1 class C ^b and		
1 class J ^c	1 class J ^d		

- ^a Where the start-gas rate is controlled by a two stage valve in the main gas circuit, these valves are the same as the main gas valves.
- b This valve may be the class C valve in the main gas circuit.
- ^c If a class J valve is used, a strainer that does not pass a 0.2 mm pin gauge shall be fitted upstream of the valve.
- d This valve is not required if the start gas rate ≤0.250 kW.

5.11.9.4.4 Direct main flame ignition

5.11.9.4.4.1 Design

For burners with this control system, the main burner is ignited directly at the main gas rate or, for control systems incorporating a slow opening valve, at a lower rate, depending on when ignition occurs.

The ignition source shall not be energized before the flame simulation check has been carried out by the automatic burner control system and shall be de-energized at, or before, the end of the safety time. Where a hot surface ignition system is used, the ignition system shall be so energized that the ignition source is capable of igniting incoming gas before the main gas valves are opened.

The manufacturer shall declare the maximum safety time (see 7.13.1.2.2).

If the flame has not been detected by the end of the safety time, non-volatile lockout shall result.

Flame failure in the running condition shall result in the following:

- non-volatile lockout;
- volatile lockout; or
- spark restoration.

Where spark restoration is used, the re-ignition attempt shall begin within 1 second of loss of flame and end no later than the safety time. If the flame is not detected by the end of the safety time, non-volatile or volatile lockout shall result.

5.11.9.4.4.2 *Gas circuit valves*

The main gas circuit shall be fitted with at least two gas valves in series. One of these shall be of at least class C and the other shall be at least class J.

Where a class J valve is used, a strainer shall be used such that it does not pass a 0.2 mm pin gauge. This strainer shall be fitted upstream of the valve.

5.11.10 Thermostats and water temperature limiting devices (boiler only)

5.11.10.1 *General*

Boilers shall be fitted with a control thermostat conforming to **5.11.9.4**.

In normal operation, the maximum water flow temperature shall not exceed 95 °C.

Temperature limiting devices are not required when the boiler is designed to be installed exclusively with an open expansion vessel and a failure of the control thermostat does not cause a dangerous situation for the user or damage to the appliance. In all other situations a safety temperature limiter shall be fitted to prevent the water flow temperature exceeding 110 °C following failure of the control thermostat.

To avoid the water flow temperature exceeding 110 °C, following failure of the control thermostat, boilers shall be fitted with the additional temperature limiting devices specified as follows.

5.11.10.2 Boilers only intended for central heating systems with open expansion vessels

Appropriate information shall be given in the technical instructions.

Where an overheat device is required on an open vented system then it shall conform to the same control requirements as if it were fitted to a sealed expansion vessel.

5.11.10.3 Boilers intended for central heating systems with sealed expansion vessels

Boilers intended for central heating systems with sealed expansion vessels shall have a safety temperature limiter conforming to the requirements of **5.11.10.5**.

5.11.10.4 Control thermostat

The control thermostat shall conform to BS EN 60730-2-9:1995 for type 1 devices

If the control thermostat is adjustable, the manufacturer shall state the maximum temperature in the instructions. The positions of the temperature selector shall be easy to establish and it shall be possible to ascertain in which direction the water temperature rises or falls. If numbers are used for this purpose, the highest number shall correspond to the highest temperature.

The thermostat shall have a position allowing the temperature of domestic hot water to be raised above 60 °C.

At its maximum setting, the thermostat shall cause at least controlled shut-down before the water flow temperature exceeds 95°C.

5.11.10.5 Safety temperature limiter

A safety temperature limiter shall conform to BS EN 60730-2-9:1995 for type 2 devices.

The safety temperature limiter shall cause non-volatile lockout before the water flow temperature exceeds 110 °C.

This device shall cause non-volatile lockout before the boiler is damaged and/or a dangerous situation for the user occurs.

This device shall not be adjustable and normal operation of the boiler shall not give rise to a change in its set-point temperature.

Interruption of the link between the sensor and the device responding to its signal shall cause at least safety shutdown.

5.11.10.6 Mechanical thermostat

Mechanical thermostats shall conform to BS EN 257:1995.

5.11.10.7 Thermostat sensors

The failure of any sensor shall not give rise to a dangerous situation for the user, or damage to the appliance.

The sensors shall withstand the thermal overload resulting from any overheat condition specified in this document without the predetermined set point being affected.

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5.11.10.8 Remote control

The boiler shall be designed so that it can be controlled remotely (for example by a room thermostat or a clock), except when the boiler operates without using electrical energy.

Connection of any remote controls recommended by the manufacturer shall be possible without disturbing the internal electrical connections except for purpose-designed removable links.

5.11.10.9 Expansion vessel and pressure gauge

For appliances specified for use with a sealed system, an expansion vessel shall be supplied or specified by the manufacturer.

The instructions shall give full details of the maximum permissible water capacities of the system and the maximum water-side operating pressure for expansion vessels supplied or specified and the water content of the appliance.

Such a boiler shall also be fitted with a pressure relief valve conforming to **5.11.10**.

5.11.11 Pressure relief valve (Boilers only)

A pressure relief valve shall include the following features:

- spring loading;
- a preset, non-adjustable lift pressure of 3 bar;
- a seating or valve face of non-resilient material;
- a test device:
- provision for connection to a drain pipe.

5.11.12 Spillage monitoring system

The appliance system shall be so constructed that in abnormal conditions there is no release of combustion products in a dangerous quantity into the room concerned.

Any safety device used for this purpose shall be as follows:

- not have any adjustment other than that made and sealed by the manufacturer;
- be so designed that it cannot be removed or dismantled without the use of a tool;
- have electrical insulation that will withstand the thermal and chemical stresses resulting from spillage of the combustion products;
- be so designed such that interruption of any link between the sensor and the device shall cause safety shut down, if necessary, after a waiting time.

5.11.13 Ignition devices

Ignition of the ignition burner(s) (or main burner for a fire without an ignition burner) shall be from a safe and easily accessible position.

Ignition burners, ignition devices and their mountings shall be so designed that they can only be located rigidly and correctly in relation to every component and burner with which they are to operate.

5.12 Burners

All burner and injectors shall be positively located and so arranged that misalignment is difficult and obvious.

The cross-section of the flame ports and also the terminal cross-section of burner and ignition burner injectors shall not be adjustable.

Every injector and removable restrictors shall carry an indelible means of identification prevent any confusion.

6 Test conditions

6.1 Test gases

6.1.1 Characteristics of test gases (reference and limit gases)

Appliances are intended for use with gases of various qualities.

In each family or group:

- a) the gas which in general corresponds to that most frequently distributed and for which the appliance is designed is called the reference gas;
- b) the gases which correspond to the extremes of a particular gas family or gas group are called "limit gases".

Table 4 and Table 5 gives the characteristics of the reference and limit gases.

6.1.2 Synthesis of test gases

Within the following tolerances, the composition of gases used for the tests are those specified in Table 4. For the constitution of the gases the following rules are observed:

- a) the Wobbe index of the gas used shall be within ± 2 % of the value in the Table 4 (this tolerance includes the errors of the measuring equipment);
- b) the gases used to constitute the mixtures shall have the following minimum degrees of purity:

nitrogen	N_2	99%	
hydrogen	H_2	99%	
methane	CH_4	95%	
propene	C_3H_6	95%	With a total content of H_2 , CO and O_2 below 1 %
propane	C_3H_8	95%	
butane	$\mathrm{C_4H_{10}}$	95%	and a total content of N_2 and CO_2 below 2 %.

Table 4 — Characteristics of the test gases gas dry at 15 °C and 1,013.25 mbar

Gas family and group	Test gases	Designation	Composition By volume	W_{i}	$H_{ m i}$	$W_{ m s}$	$H_{ m s}$	d
			%	MJ/m³	MJ/m³	MJ/m³	MJ/m³	
Gases of the	second family							
	Reference gas	G 20	$CH_4 = 100$	45.67	34.02	50.72	37.78	0.555
	Incomplete combustion	G 21	$CH_4 = 87$	49.60	41.01	54.76	45.28	0.684
	Sooting limit gas		$C_3H_8 = 13$					
Group H	Light back limit gas	G 222	$CH_4 = 77$	42.87	28.53	47.87	31.86	0.443
			$H_2 = 23$					
	Flame lift limit gas	G 23	$CH_4 = 92,5$	41.11	31.46	45.66	34.95	0.86
			$N_2 = 7.5$					
Gases of the	third family	l						
	Reference gas			70.69	88.00	76.84	95.65	1.50
C 2D	Incomplete combustion	G 31	$C_3H_8 = 100$					
Group 3P	Sooting and flame lift limit gas							
	Light back and sooting limit gas	G 32	$C_3H_6 = 100$	68.4	82.78	72.86	88.52	1.476

Table 5 — The calorific values of the third family test gases

Designation	$\mathrm{H_{i}}$	$\mathrm{H_{s}}$	
	$\mathrm{MJ/kg}$	$\mathrm{MJ/kg}$	
G 31	46.34	50.37	
G 32	45.77	48.94	

These requirements are not mandatory for each of the constituent gases provided that the final mixture has a composition identical to that of a mixture that would have resulted from using the above constituents. To make up a mixture, a gas may be used which already contains, in convenient proportions, several constituents of the final mixture. Moreover, for 2^{nd} family reference gas G 20, a natural gas of group H may be used even if its composition does not conform to the foregoing requirements provided that, after a possible addition of either propane or nitrogen, as appropriate, the final mixture has a Wobbe index within ± 2 % of the value specified in Table 4 for the corresponding reference gas.

To make up the limit gases G 21, G 222 and G 23, it is permissible to take, instead of methane, a natural gas in group H as the base gas. The gas to be added to obtain a mixture corresponding to the limit gas in question is that shown for each gas in Table 4, but for the gases G 21 and G 23 the quantity of this constituent may be different from the value specified in Table 4, provided that the final mixture has a Wobbe index within ± 2 % of the value shown in Table 4 for the corresponding limit gas. However, for gas G 222, in addition to the ± 2 % of the Wobbe index requirement, the final mixture contains 23% hydrogen.

6.1.3 Practical application of test gases

6.1.3.1 Choice of test gases

Gases for the following tests, shall conform to **6.1.1** and shall be made up in accordance with **6.1.2**:

- 7.2 Heat input rates
- 7.4 Ignition, cross-lighting and flame stability
- 7.7 Combustion

For the tests described in other clauses, to facilitate testing the reference gas may be replaced by a gas actually distributed, provided that its Wobbe index is within ± 5 % of that of the reference gas. In case of dispute however, the specified test gas shall be used.

6.1.3.2 Conditions of supply and adjustment of the burners

6.1.3.2.1 Initial adjustment of appliance

Fit the appliance with the appropriate equipment corresponding to the gas family or gas group to which the specified test gas belongs (see Table 4). Any gas rate adjusters shall be set in accordance with the manufacturer's instructions using the appropriate reference gas(es) (see 6.1.2) and the corresponding normal pressure(s) specified in 6.1.4.

6.1.3.2.2 Supply pressures

Except where an adjustment of the supply pressure is necessary (as specified in 6.1.3.2.3 and 6.1.3.2.4) the normal, minimum and maximum supply pressures to be used for testing purposes shall conform to 6.1.4.

Unless otherwise specified, the initial adjustment of the appliance shall not be altered.

6.1.3.2.3 Adjustment of heat inputs

Except where otherwise specified, the following steps shall be taken before all the tests to be carried out at the nominal heat input with the reference gas at the normal supply pressure:

— the appliance shall be fitted with the injectors for the reference gas used.

For tests requiring adjustment of the burner to the nominal or another specified heat input, ensure that the pressure upstream of the injectors is such that the heat input obtained is within $\pm 2\%$ of that specified (by altering the preset adjusters or the appliance governor, if adjustable, or the appliance supply pressure).

The specified heat input shall be determined, with the appliance installed in accordance with 6.2.3 and supplied with the appropriate reference gas(es).

6.1.3.2.4 Corrected pressures

Where, to obtain the nominal heat input within ± 2 %, it is necessary to use a supply pressure, p, different from the normal pressure p_n , then those tests normally carried out at the minimum or maximum pressures p_{\min} and p_{\max} shall be carried out at the corrected pressures p' and p'' where:

$$\frac{p'}{p_{\min}} = \frac{p''}{p_{\max}} = \frac{p}{p_{\text{n}}}$$

6.1.4 Test pressures

The test pressure, i.e. the pressures required at the gas inlet connection of the appliance, are specified in Table 6.

Table 6 — Test pressure (mbar)

Type of gas		Normal	Minimum	Maximum	
Second family	Group H	20	17	25	
Third family	3+	28	20	35	
	3P	37	25	45	

6.2 Conditions of test

6.2.1 General

The following conditions shall be applied unless otherwise specified in particular clauses.

6.2.2 Test room

The appliance shall be installed in a well-ventilated, draught-free room which has an ambient temperature of (20 ± 5) °C.

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6.2.3 Test installation

The appliance shall be installed in the test box specified in **6.2.4** in accordance with the manufacturer's instructions, taking account of the minimum declared clearances around the appliance.

For the convenience of carrying out tests, the appliance may be installed at a height above the floor which is other than that specified in the manufacturer's instructions, provided that this does not affect the performance of the appliance.

Due note shall be taken of the manufacturer's instructions regarding the positioning of gas fire refractories. If it is obvious that any particular arrangement is not in accordance with the manufacturer's instructions then that arrangement shall not be used for testing purposes.

During testing, the initial adjustment of the gas fire shall not be altered.

6.2.4 Test box

The test box and surround shall simulate the type of construction specified in the manufacturer's installation instructions. The test box shall represent the minimum size of fireplace recess into or against which the appliance is to be fitted, i.e., the test box shall have the minimum dimensions for the fireplace depth, width and height and the maximum dimension for the associated lintel, which is assumed to be of rectangular section.

The box shall be provided with a wall face extension of 13 mm thick, rigid heat resistant builders board 1.3 m high and 1.33 m wide and with a removable fireplace surround 37 mm thick having the same dimensions as the wall face extension and provided with an opening of the appropriate minimum dimensions specified in the instructions.

There shall be adequate provision for the fitting of test probes and for access to the appliance during testing.

A test box of typical dimensions is illustrated in Figure 1. Where the test box is other than to the typical dimensions shown, it shall be supplied to the test authority by the manufacturer. There shall be no significant leakage from the test box.

6.2.5 Test flue

The test box is fitted with a vertical flue of 125 mm nominal diameter and of such a length that the height from the floor of the test box to the top of the flue is 3 m.

6.2.6 Test rig: water side

The appliance is connected to a test rig and operated at the rated heat input(s) and at the flow and return temperatures specified. Means shall be provided for measuring the flow and return temperatures and the inlet water temperature to within $0.5\,^{\circ}\text{C}$.

Test rigs are shown in Figure 2a) and Figure 2b), but any other arrangement having the same capability may be used.

The flow and return of the appliance shall be short circuited via a connecting pipe containing a circulating pump and control valve I. Cold water at a temperature t_3 is fed into the return pipe after the control valve from a constant head tank which ensures a static head on the system⁸⁾. An equivalent amount of water at the flow temperature t_2 flows out of the system via a ventilated off-take.

The water flow rate corresponding to the required flow temperature at the preset output is regulated by control valve II. The specified temperature difference $(t_2 - t_1)$ °C is set by means of control valve I.

6.2.7 Test procedure

Examine the test rig and appliance for gas and water soundness both before and after the tests; the results are deemed invalid unless the system is sound.

Ensure that the appliance is at room temperature at the start of each test unless otherwise stated in the test method.

⁸⁾ It is advisable to fit a water flow meter into the cold feed to the boiler for preliminary setting of water flow rate and to allow spot checks to be made during tests.

During testing, do not alter the initial adjustment of the appliance unless specifically required by the test method⁹⁾.

Unless otherwise specified, the boiler and test rig shall be set up to give a water flow temperature of 80 ± 2 °C and a return water temperature of (60 ± 2) °C.

Test pressures shall be measured to 0.2 mbar and shall not vary by more than ± 0.2 mbar for each test.

7 Requirements and test methods

7.1 Soundness

7.1.1 Soundness of the gas circuit

7.1.1.1 Requirement

Leakage shall not exceed 100 cm³/h irrespective of the number of components, whether mounted in series or parallel on the appliance.

7.1.1.2 Test method

These tests are carried out at ambient temperature using air.

The soundness of the first closure member is checked with all the downstream closure members being open and the pressure upstream of the appliance set at 150 mbar.

The upstream pressure is then set to 50 mbar for appliances which do not use 3rd family gas and 150 mbar for appliances which do use 3rd family gas.

The soundness is then checked with all the valves open and the injectors blocked.

7.1.2 Soundness of the combustion circuit

7.1.2.1 Requirement

The leakage of products shall be less than $0.28 \text{ m}^3\text{/h}$ when the boiler and fire are operated separately and together.

7.1.2.2 Test conditions

The appliance shall be installed, in accordance with the manufacturer's instructions, with the test box, water test rig and flue specified in **6.2**. Adjust the water flow so that conditions are constant and any thermostat does not operate.

The appliance is then operated as described in a), b), c) and d) as follows, the spillage being measured after each operation.

- a) The gas fire only shall be operated at adjustment pressure for 1 h.
- b) The boiler only shall be operated at adjustment pressure for 15 min.
- c) Both units shall be operated simultaneously at adjustment pressure for 1 h.
- d) Operations a) and b) shall be repeated with any appliance flue restrictors fitted in accordance with the manufacturer's instructions and with the test box fitted with vertical flue of such a length that the height from the floor of the test box to the top of the flue is 4.25 m.

7.1.2.3 Apparatus

The method for measuring the amount of leakage involves collecting, in a hood placed over the appliance, the convected air output from the appliance together with any escaping products. An injection of a known volume of CO_2 to the hood is used to calculate the total volume passing through the hood.

Figure 2a) specifies a hood for the majority of appliances. A particular appliance may require a special hood which shall be constructed by the appliance manufacturer and supplied to the testing authority.

⁹⁾ In general, except for tests involving governor performance, the appliance governor, if any, may be put out of operation and the specified test pressure obtained by adjusting the gas pressure at the inlet to the appliance.

The positioning of the hood is specified in Figure 2b). The back panel may be adapted to fit around the flue spigot and should be sealed to the face of the test box. The front lower edge of the hood shall be positioned above the likely source of leakage so that:

- a) the hood is positioned as low as possible without affecting the performance of the fire under test;
- b) there is no spillage from the bottom of the hood.

Instrumentation for measuring the CO₂ content of gas shall be accurate to 0.02 % CO₂.

7.1.2.4 Preliminary adjustment

An advantage of this method is that it minimizes the flow through the collecting hood thus increasing the CO_2 fraction of the sample. This is done by adjusting the hood damper. Care should be taken to ensure that the hood does not spill. This is checked by sampling from the tube along the front bottom edge of the hood and comparing the CO_2 content with that of ambient air in the same plane as the horizontal edge of the hood. [See Figure 2a)]. The hood should be left to stabilize, after its adjustment is completed, for at least 30 min. before starting the test.

7.1.2.5 Test procedure

Samples shall be taken from the following:

- a) The hood without injection of CO₂.
- b) The hood with injection of CO_2 .
- c) The laboratory air when CO₂ is not injected into the hood.
- d) The laboratory air when CO₂ is injected into the hood.

During any one test the CO_2 content of the air passing into the appliance shall not exceed 0.1 % and shall not vary by more than 0.02 $\%^{10}$.

7.1.2.6 Calculation of results

The leakage of undiluted products of combustion is calculated by the following equation:

$$V = \frac{r(b - a_1)}{(c - a_2) - (b - a_1)} \times K$$

where

- *V* is the leakage of undiluted products of combustion (m³/h);
- a_1 is the CO_2 content of the laboratory air when CO_2 is not injected (%);
- a_2 is the CO_2 content of laboratory air when CO_2 is injected (%);
- b is the CO₂ content in hood when CO₂ is not injected (%);
- c is the CO_2 content in hood when CO_2 is injected (%);
- r is the injection rate (m^3/h)
- K is the ratio of the volume of undiluted products to the volume of CO_2 per unit volume of $\mathrm{gas}^{11)}$.

Two pairs of results are used to calculate the average value for the rate of leakage.

 $^{^{10)}}$ Rates of injection of 0.02 m3/h are suitable for the majority of appliances. Laboratory air can fluctuate quite rapidly and therefore a fast response analyser or simultaneous sampling is recommended

 $^{^{11)}\} K$ is equal to 8.57 and 7.31 for reference test gases G 20 and G 31 respectively.

7.1.3 Soundness of the water circuit

7.1.3.1 Requirement

The manufacturer shall state the maximum pressure to which the boiler can be subjected, together with the recommended range of working pressures.

The boiler shall not show any sign of visible leakage or permanent distortion when tested at 150 % of the manufacturer's stated maximum pressure. An appliance intended for use in a sealed water system shall conform to this requirement at a pressure of 4.5 bar.

7.1.3.2 Test method

The boiler is sealed and pressurized.

7.2 Heat input

7.2.1 General

The appliance heat input is measured when supplied with each reference gas appropriate to its category, at the normal supply pressure for each reference gas, under the general installation conditions specified in **6.2**.

7.2.2 Calculation of heat input rates under reference conditions

The nominal gas rate is the volumetric rate V_N or mass rate M_N of the gas corresponding to the nominal heat input obtained with reference gas under reference test conditions (dry gas, 15 °C, 1 013.25 mbar).

The nominal heat input Q_N in kilowatts (kW) is given by one of the following expressions:

$$Q_{\rm n} = 0.278 \ M_{\rm N} \times H_{\rm i}$$

$$Q_{\rm n} = 0.278 \ V_{\rm N} \times H_{\rm i}$$

where

 $M_{\rm N}$ is the nominal mass rate in kilograms per hour (kg/h) obtained under reference conditions (dry gas, 15 °C, 1 013.25 mbar);

V_N is the nominal volumetric rate in cubic metres per hour (m³/h) obtained under reference conditions (dry gas, 15 °C, 1 013.25 mbar);

 $H_{\rm i}$ is the net calorific value of the reference gas in megajoules per kilogram (MJ/kg) (1st expression) or in megajoules per cubic metre (MJ/m³) (dry gas, 15 °C, 1 013.25 mbar) (2nd expression).

These mass and volume rates correspond to a measurement and to a flow of reference gas under reference conditions, i.e. assuming the gas to be dry, at 15 °C and under 1 013.25 mbar pressure. In practice the values of mass and volumetric rates obtained during the tests do not correspond to these reference conditions, and have therefore to be corrected to bring them to the values that would be been obtained had the reference conditions existed during the tests, at the outlet of the injector.

When the determination is made by mass, (3rd family gas), the corrected mass rate is calculated from the following equation:

$$M_{\rm o} = M \sqrt{\frac{(1\ 013.25 + p)}{(p_{\rm a} + p)} \times \frac{(273 + t_{\rm g})}{288} \times \frac{d_{\rm r}}{d}}$$

When the determination is made from the volumetric rate the following correction equation is used:

$$V_{\rm o} = V \sqrt{\frac{(1\ 013.25 + p)}{1\ 013.25} \times \frac{(p_{\rm a} + p)}{1\ 013.25} \times \frac{288}{273 + t_g} + \frac{d}{d_{\rm r}}}$$

The corrected mass rate is calculated from the following equation:

$$M_0 = 1.226 \times V_0 \times d$$

where

 M_0 is the mass rate under reference conditions;

M is the mass rate obtained under test conditions:

 $V_{\rm o}$ is the volumetric rate under reference conditions at the appliance inlet;

V is the volumetric rate obtained under test conditions (measured at, or corrected to pressure p and temperature t_g);

 $p_{\rm a}$ is the atmospheric pressure in mbar;

p is the gas supply pressure in mbar;

 t_{σ} is the temperature of the gas at the appliance inlet in ${}^{\circ}$ C;

d is the density of dry test gas relative to that of dry air;

 $d_{\rm r}$ is the density of reference gas relative to that of dry air.

These are the equations that are used to calculate from the mass (M) or volumetric (V) rates, measured under test conditions, the corresponding $M_{\rm o}$ or $V_{\rm o}$ rates that would have been obtained under reference conditions, and it is these values, $M_{\rm o}$ and $V_{\rm o}$, that are compared with the values $M_{\rm N}$ and $V_{\rm N}$, calculated from the nominal heat input, using the equations given earlier in this clause.

These equations are applicable if the test gas used, is dry.

If a wet (water filled) meter is used or if the gas used is saturated, the value d (density of dry gas in relation to dry air) is replaced by the value of the density of the wet gas d_h given by the following equation:

$$d_{\rm h} = \frac{d(p_{\rm a} + p - W) + 0.622 \times W}{p_{\rm a} + p}$$

where

 $d_{\rm h}$ is the corrected relative density;

W is the saturation vapour pressure at the dew point of the test gas, which, in the case of a wet meter is taken to be equal to $t_{\rm g}$.

7.2.3 Adjustment of heat input

7.2.3.1 Requirement

The manufacturer's quoted setting pressures shall be obtained.

7.2.3.2 *Test method*

The main burners of both the gas fire and back boiler are operated at the same time. Using any gas rate adjuster, if necessary, all recommended setting pressures are inspected for each burner, while the other main burner is operating at its maximum setting pressure.

7.2.4 Confirmation of rated heat input

7.2.4.1 Requirement

When tested in accordance with 7.2.4.2, the heat input of the fire and of the boiler if it is not range-rated, shall be within ± 5 % of the heat inputs quoted by the manufacturer.

7.2.4.2 Test method

The fire and boiler, if it is not range-rated, are operated separately at their rated burner pressures. For stability, the fire is operated for one hour and the boiler thirty minutes in each case before readings are made. The heat inputs are measured using the appropriate procedures of **7.2.2**.

7.2.5 Confirmation of range-rating

7.2.5.1 Requirement

When tested in accordance with **7.2.5.2** the heat inputs of range-rated boilers shall be within ± 5 % of the heat inputs quoted by the manufacturer.

7.2.5.2 Test method

The boiler is operated on its own, being adjusted successively to the maximum and minimum setting pressures recommended by the manufacturer for each reference gas. At each setting pressure operate the burner for 30 min. in each case before taking readings. The heat inputs shall be measured in accordance with **7.2.1**.

7.2.6 Ignition burner

7.2.6.1 Requirement

The heat input of any permanent ignition burner, when the main burner is extinguished, shall not exceed $0.250~\mathrm{kW}$.

7.2.6.2 Test method

The heat input is determined by supplying the ignition burner with the appropriate reference gas(es) at the normal pressure specified in **6.1.4**. If the ignition burner has a gas rate adjuster, adjust it in accordance with the manufacturer's instructions.

7.3 Limiting temperatures

7.3.1 Floor temperatures

7.3.1.1 Requirement

The appliance shall not cause the temperature of combustible floors outside the front face of the test box to rise more than 60 K.

7.3.1.2 Apparatus

The apparatus, shown in Figure 3, comprises a test floor mounted in front of the standard box (see Figure 1).

The test floor and wall [see Figure 3b) and Figure 3c)] shall be made of 25 mm thick hardwood or a material with a similar thermal conductivity and incorporate thermocouples spaced at 100 mm centres. The thermocouples shall enter the panels from behind and have their junctions located 3 mm from the front surface. The floor panel shall be supported on battens 50 mm thick and the wall panel shall be spaced away from the front of the test box by battens 12 mm thick. The test shelf [see Figure 3d)] shall be of similar construction, but have thermocouples at 50 mm centres. The upper surface shall be covered with sheet aluminium, separated from the 25 mm thick panel by 12 mm thick battens. The surfaces of the floor, wall and shelf shall be finished with matt black paint.

The test wall incorporates an opening. The gap around this opening, between the wall and the front of the test box shall be sealed with a gasket of insulating material

NOTE 1 For tests of wall temperature, the opening in the test wall may be reduced to the minimum size specified in the manufacturer's instructions by means of pieces having the same construction as the test wall.

NOTE 2 It is necessary to arrange for successive readings to be made at each junction. A convenient method of doing this is to connect all terminals of one sign to a single terminal and each terminal of the opposite sign to a separate terminal of a switchboard. The e.m.f. generated at a thermojunction is measured by a suitable instrument.

The woodwork is thoroughly dried, either by previous test or by heating for 24 h with an appliance in position and operating at a gas rate specified in accordance with the manufacturer's instructions

7.3.1.3 Test

Fit the appliance in the standard test box, in accordance with the manufacturer's installation instructions, with that part of the appliance outside the front face of the test box at the minimum height above the test floor permitted by the instructions. When the instructions permit substitution of a proprietary hearth for the normal incombustible hearth in front of the fireplace recess, or installation without the incombustible hearth when the appliance is wall mounted, carry out additional tests simulating this method of installation.

Operate both units of the appliance in combination at their maximum heat inputs, with the thermostat(s) out of action, using the appropriate reference gas at adjustment pressure. Adjust the water rate on the boiler to give the manufacturer's stated maximum flow temperature with the manufacturer's recommended flow through the appliance.

After 4 h, measure the wall temperatures and take temperature readings over the area of the test floor outside the hearth area and, according to the method of installation simulated, including the hearth area. The latter is a defined area related to the appliance and is bounded by the intersection with the floor of the back plane of the appliance, a plane 300 mm forward from the wall face and planes 150 mm on each side of the appliance.

7.3.2 Wall protection

If the appliance is intended to be fitted against a wall of combustible material, it shall not cause the temperature of the combustible material to rise by more than 60 K when fitted in accordance with the manufacturer's installation instructions and tested in accordance with **7.3.1.2**.

7.3.3 Shelf temperatures

If the appliance is intended to be fitted below a shelf of combustible material, the shelf temperature shall not exceed ambient temperature by more than 60 K when installed in accordance with the manufacturer's installation instructions and tested by the method described in **7.3.1.2**.

$7.3.4\ Temperature\ of\ components\ and\ external\ parts\ of\ the\ appliance$

When tested in accordance with **7.3.1.2**. the temperature of any components (including taps) shall not exceed that specified by the component manufacturer.

The surface temperature of the control handles and of all the parts that have to be manipulated during normal operation of the appliance, measured only in the areas intended to be touched and when tested in accordance with **7.3.1.2** shall not exceed the ambient temperature by more than the following:

- 35 K for metals and equivalent materials;
- 45 K for porcelain and equivalent materials;
- 60 K for plastics and equivalent materials.

When tested in accordance with **7.3.1.2** the temperature of those parts of the appliance likely to be touched accidentally, with the exception of working surfaces, shall not exceed the ambient temperature by more than:

- 80 K for bare metal:
- 95 K for enamelled steel and equivalent materials;
- 100 K for plastics, rubber or wood.

7.3.5 Simulated fuel elements

7.3.5.1 Requirement

The materials used for simulated fuel elements, shall not sustain combustion.

7.3.5.2 *Test method*

Fit the appliance in accordance with the manufacturer's instructions in the apparatus specified in **7.3.1.2**. Using the appropriate reference test gas at adjustment pressure and with the appliance in the hot condition, place a safety match which is well alight on the fuel effect in the most vulnerable position.

7.4 Ignition-cross lighting and flame-stability

7.4.1 General

7.4.1.1 Requirement

Ignition shall be smooth, complete and even. There shall be no prolonged light-back or flame lift. Brief lift or light-back on extinction is acceptable if the safe operation of the appliance is not affected. Flames shall not issue from the case.

7.4.1.2 Test method

Carry the tests out on the fire and boiler in still air at ambient temperature and after the fire or boiler has been alight for at least 30 min.

Ignition of the burners shall occur at all gas rates which can be given by the controls. Brief light-back during ignition or extinction of the burner may be accepted if this does not affect correct operation. Nevertheless flames shall not issue from the case.

Boilers fitted with a range-rating device, shall conform to these requirements when adjusted to the maximum and minimum heat inputs specified by the manufacturer.

7.4.1.3 Normal condition

The burners and ignition burner(s), if any, fitted with the appropriate injectors, are first adjusted with reference gas for the appliance category so as to obtain the nominal heat input to within ± 2 %.

The following three tests shall be carried out with the appliance adjusted to these pre-determined settings.

Test no.1

— The pressure at the inlet shall be reduced to 70 % of the normal pressure for 2^{nd} family gases and to the minimum pressure for 3^{rd} family gases 12).

Under these conditions check the ignition, cross-lighting and flame stability for all of the appliance burners.

The tests are repeated at the minimum heat input permitted by the controls, if ignition is possible under these conditions.

Test no.2

- Replace the reference gas by the corresponding light-back limit gas and reduce the pressure at the appliance inlet to the minimum pressure specified in **6.1.4**.
- Check that ignition of the burners by the ignition burner(s) or ignition device(s) is satisfactory.

Repeat this test at the minimum heat input given by the controls, if ignition is possible under these conditions during normal use in accordance with the manufacturer' instructions for use.

Test no.3

- Supply the burner(s) with the flame lift limit gas at the maximum pressure specified in **6.1.4** and check for the absence of lift.
- Where the fire or boiler has an indirect means of seeing the flame, on completion of the tests check that this indirect means functions correctly.

7.4.2 Resistance to draught

7.4.2.1 Requirement

There shall be no hazard to the user or damage to the appliance likely to cause a hazard.

¹²⁾ Test pressures are specified in Table 6.

7.4.2.2 Test method

With only the fire alight, supply the appliance with reference gas, or a distributed gas at normal pressure and subject it at burner level to a wind stream of 1.2 m/s. The wind stream shall cover at least the width of the burner and be made up of essentially parallel components (speed uniform to within ± 20 %).

The axis of the wind stream shall be in a horizontal plane and shall be moved through one or more angles of incidence within a semi-circle in front of the appliance, the centre of the semi-circle being at an intersection of the plane of symmetry of the appliance and the plane of the test.

Repeat the test at all fire control settings stated by the manufacturer.

7.4.3 Abnormal draught conditions

7.4.3.1 Requirement

The burner flames shall be stable and no extinction of the burner shall occur even through operation of the flame supervision device.

7.4.3.2 *Test method*¹³⁾

The appliance is supplied with reference gas, or a distributed gas, at the nominal heat input.

Test the appliance with each unit of the appliance alight and also with both units alight.

A draught is applied to the flue such that the appliance is subjected to a range of conditions between 3 m/s downdraught and 3 m/s updraught. A further test is carried out with the flue blocked.

7.4.4 High updraught

7.4.4.1 Requirement

The flames of the gas fire shall not be drawn out from the bottom of the radiants or fuel effect.

7.4.4.2 Test method

Apply an updraught of 6 m/s with both units of the appliance operating together at their nominal heat inputs.

Repeat the test with the fire set at its minimum operating rate.

7.4.5 Reduction of the gas rate of the ignition burner

7.4.5.1 Requirement

The main burners shall ignite without damage to the appliance and without flame roll-out, outside the

7.4.5.2 Test method

Fit the main burners and ignition burner(s) with the appropriate injectors and supply the appliance with the reference gases for the category at nominal heat input.

Where a governor is fitted, reduce the pressure downstream of the governor, if necessary, to the value corresponding to 92.5 % of the nominal heat input for 2nd family gases (for the reference gases) or 95 % of the nominal heat input for 3rd family gases.

Reduce the rate by means of an appropriate adjuster in the gas supply line to the ignition burner(s) to give the minimum energy necessary to keep the gasway to the burners open. Then check that ignition of the burners by the ignition burner(s) conforms to **7.4.5**.

For ignition burners having several separate ports, the ports of the ignition burners are sealed except for that of the flame heating the sensor element.

Repeat the test at the minimum heat input given by the controls, if ignition is possible under these conditions.

 $^{^{\}rm 13)}$ For this test it may be necessary to disable any spillage monitoring device.

7.4.6 Defective closure of the downstream main burner gas valve

7.4.6.1 Requirement

Where the gas line is designed so that the gas supply to the ignition burner is taken from between the two main burner gas valves, it shall not be possible for a hazardous situation to arise in the event of defective closure of the downstream main burner valve when the ignition burner is lit.

7.4.6.2 Test method

If the gas supply to an ignition burner is taken from between two automatic valves of a main burner, the downstream main burner automatic valve shall be kept open artificially.

Supply the appliance with reference gas or distributed gas at normal pressure.

7.4.7 Reduction of the gas pressure

7.4.7.1 Requirement

When tested in accordance with **7.4.7.2**, ignition of the main burner(s) shall be assured and there shall be no hazard to the user or damage to the appliance.

7.4.7.2 *Test method*

Test the appliance in accordance with **7.4.1.2**. The supply pressure to the appliance shall be reduced from 70 % of the normal pressure to 0 mbar in stages of 1 mbar.

At each stage it is checked that the requirement of **7.4.7.1** is met.

7.5 Delayed ignition

7.5.1 Requirement

There shall be no hazard to the user or damage to the appliance likely to cause a hazard.

$7.5.2\ Test\ method-All\ fires$

Supply the appliance using the appropriate gas at the pressure required to give the nominal heat input and then test the appliance in the following conditions:

- a) from the cold condition;
- b) after the fire has been lit for 30 minutes.

Allow gas to pass to the fire burner at the nominal heat input¹⁴⁾ and ignite the fire. Repeat this test progressively increasing the delay before ignition, up to a delay time of 60 s.

7.5.3 Test method (Boilers and fires with an automatic control system)

Using the appropriate reference gas at normal pressure and starting from the cold condition, ignition is attempted with the delay time between opening the gas supply and ignition being increased in appropriate intervals to a maximum of 50 % longer than the ignition safety time specified by the manufacturer. ¹⁵⁾

This test shall not be applicable to a fire if the maximum safety time, increased by 50 % is less than 60 s.

7.6 Control devices

7.6.1 Rotary knob

7.6.1.1 Requirement

The operating torque of a knob shall neither exceed 0.6 Nm or 0.017 Nm/mm of knob diameter.

7.6.1.2 Test method

Use a torque meter to rotate the knob at a speed of 5 rpm over the whole range between the open and closed positions.

¹⁴⁾ It may be necessary to bypass the manufacturers ignition system to carry out this test.

¹⁵⁾ NOTE It may be necessary to override some controls.

7.6.2 Push-button

7.6.2.1 Requirement

The force necessary to open and/or to keep open the closure element shall not exceed 45 N nor 0.5 N/mm^2 of the area of the button.

7.6.2.2 *Test method*

Measure the force necessary to operate the button using an appropriate instrument.

7.7 Combustion

7.7.1 Carbon monoxide

7.7.1.1 Requirement

The CO concentration of the dry air-free combustion products shall not exceed the following:

- a) 0.10 % by volume when the appliance is supplied with the reference gas(es), specified in **6.1.2**, when tested in accordance with **7.7.1.2.2**;
- b) 0.20 % by volume when the appliance is supplied with the incomplete combustion limit gas, specified in **6.1.2**, under the conditions specified in **7.7.1.2.3**;
- c) 0.20 % by volume when the appliance is operated under the abnormal flue draught conditions specified in **7.7.1.2.4**. Further, it shall be verified that the appliance operates under these conditions:
- d) 0.20 % by volume when, for an appliance having a mains electrical supply it is supplied with reference gas(es), specified in **6.1.2**, under the normal and abnormal voltage fluctuation conditions specified in **7.7.1.2.5**.

7.7.1.2 *Test method*

7.7.1.2.1 General

The tests specified in **7.7.1.2.2** and **7.7.1.2.4** shall be carried out on each unit of the appliance and also in combination.

The tests specified in **7.7.1.2.3** and **7.7.1.2.5** shall be carried out on the appliance operating in combination with both units at the maximum heat input.

The products of combustion from each unit of the appliance shall be collected in such a manner as to ensure a representative sample.

Take samples of the combustion products, at thermal equilibrium, from each unit of the appliance.

Test range-rated boilers, at the maximum and minimum rated heat inputs. Test modulating boilers at the nominal and minimum outputs of the control.

The CO concentration of the dry, air-free combustion products is specified by the equation:

$$\mathrm{CO} = \frac{(\mathrm{CO})_{\mathrm{M}}}{(\mathrm{CO}_2)_M} \times (\mathrm{CO}_2)_{\mathrm{N}}$$

where

 $\begin{array}{ll} CO & \text{is the carbon monoxide percentage concentration of the dry air-free combustion products.} \\ (CO_2)_N & \text{is the maximum carbon dioxide percentage concentration of the dry, air-free combustion products obtained by calculation from the analysis of the test gas.} \\ \end{array}$

 $\frac{(CO)_M}{(CO_2)_M} \ \ \, \\ \ \ \, \text{are measured concentrations in the samples taken during the combustion test, both} \\ \ \ \, \text{expressed in percent.}$

The concentrations, in percent of $(CO_2)_N$ for the test gases are shown in Table 7.

Table 7 — $(CO_2)_N$ for test gases

Gas	G 20	G 21	G 30	G 31
$(CO_2)_N$	11.7	12.2	14.0	13.7

Place the appliance in a well ventilated room, install and adjust it in accordance with Clause 6.2.

7.7.1.2.2 Reference gas

First, test the appliance with the reference gas or gases for the appliance category.

- For ungoverned appliance units without a gas rate adjuster, test the appliance by supplying the unit at the maximum supply pressure specified in **6.1.4**.
- For ungoverned appliance units with a gas rate adjuster, test the appliance by adjusting the burner to a rate of 1.10 times the nominal heat input.
- For governed appliance units, test the appliance by raising the burner rate to 1.05 times the nominal heat input.

Appliance units with a gas rate adjuster or governor that is put out of action for one or more gas families are tested successively in accordance with the various supply situations specified earlier.

7.7.1.2.3 Incomplete combustion gas

After the test with the reference gas or gases, test the appliance with the incomplete combustion limit gas for the appliance category.

When tested in accordance with **7.7.1.2.1**, **7.7.1.2.2** and **7.7.1.2.3** the appliance shall first be supplied with the reference gas and adjusted to the nominal heat input.

With the same gas supply pressure and without changing the adjustment of the appliance, replace the reference gas by the corresponding incomplete combustion gas.

7.7.1.2.4 Abnormal flue draught

Operate each unit of the appliance on its own and in combination, with each appropriate reference test gas at the nominal heat input, over the range of flue draught conditions from blocked flue to downdraught of 3 m/s mean axial velocity provided by a fan attached to the test flue.¹⁶⁾

 $^{^{16)}}$ For this test it may be necessary to disable any spillage monitoring device.

7.7.1.2.5 Normal and abnormal voltage fluctuation

With the mains electrical supply reduced to 85 % of the minimum rated voltage, using the appropriate reference gas(es) and at the normal gas supply pressure, ignite each unit of the appliance. With the appliance adjusted to give its maximum normal heat output and, after a running period of at least 30 minutes, measure the CO concentration of the dry air-free products of combustion.

Turn the appliance off and then on. Repeat the above test with the mains electrical supply increased to 110 % of the maximum rated voltage.

7.7.2 Sooting

7.7.2.1 Fire

7.7.2.1.1 *Requirement*

The fire shall not show an accumulation of soot that interferes with the safe operation of the fire. If there is a doubt about the accumulation of soot, then test long operation in accordance with **7.7.2.1.3**.

7.7.2.1.2 *Test method*

Operate the fire at nominal heat input on reference gas. Then change to the sooting limit gas (see Table 4) without changing the appliance adjustment. Switch off the appliance and allow it to cool down. Light the fire and let it burn for 30 minutes using the sooting limit gas. After this period, check for any accumulation of soot¹⁷). Perform the test three times, allowing the fire to cool for 1 h after each test.

Repeat this test at all positions of all aeration adjuster (see 7.7.3.1) and all predetermined tap settings.

7.7.2.1.3 Test method — Long operation test

Operate the fire, at nominal heat input, on reference gas. Cycle the fire 16 h on and 8 h off for seven days with the fuel bed, if any, of the fire made up in accordance with the manufacturer's instructions. Check for any accumulation of soot^{15} .

7.7.2.2 *Boiler*

7.7.2.2.1 *Requirement*

No soot deposition shall be observed although yellow tipping is acceptable.

7.7.2.2.2 *Test method*

The boiler shall be installed in accordance with **6.2** and operated at nominal heat input for 30 minutes. Without making any adjustment to the appliance, exchange the reference gas for the sooting limit gas.

7.7.3 Aeration adjustment (Fire only)

7.7.3.1 Requirement

The aeration adjuster shall not be liable to inadvertent movement, shall not be capable of closing the air inlet completely and shall not be capable of being set in such a manner as to cause gas to spill from the burner venturi throat.

When tested in accordance with 7.7.3.2 the appliance shall conform to the following:

- The soundness requirement of **7.1.2**.
- The ignition, cross-lighting and flame stability requirements of **7.4**.
- The combustion requirements of **7.7.1**.

7.7.3.2 Test Method

Test the appliance with the aeration adjuster set the position giving the minimum opening. The tests are repeated with the aeration adjuster set to its maximum opening.

¹⁷⁾ Ignore minor powdery deposits of soot.

7.8 Lint assessment

7.8.1 Heading

Lint assessment is carried out on the boiler part of all appliances having aerated main or ignition burners (see 3.10 for definitions).

7.8.2 Lint concentration

7.8.2.1 Requirements

With a lint concentration obtained by the method specified in **7.8.2.2** such that the change in pressure differential is 1 mbar then the dry air-free CO percentage shall not exceed the larger of; the dry air-free CO % obtained at 110 % of rated heat input in the absence of lint, and; 0.05 % added to the dry air-free CO % obtained at rated heat input in the absence of lint. The dry air-free CO % shall in no case exceed 0.2.

On completion of the test for lint assessment the appliance shall ignite and cross-light smoothly when tested in accordance with **7.8.2.2c**).

7.8.2.2 *Test method*

The tests for linting shall be carried out on the boiler only with the fire in position but unlit.

Carry out the following procedure in a test room as specified in Annex A using the appropriate reference test gas.

- a) Install the appliance in accordance with the manufacturer's instructions.
- b) Adjust the boiler to the manufacturer's recommended heat input rate using the appropriate reference test gas. Determine the ${\rm CO}$ and ${\rm CO}_2$ at this setting.
- c) Operate the boiler under test continuously for periods of 1 h in an atmosphere of airborne lint produced as specified in **A.2.1** of Annex A.
- d) At the end of each hour's operation switch off the boiler for a period of 2 min and then switch on and allow it to regain thermal equilibrium.
- e) Sample the combustion products continuously during the operational period and analyse for carbon monoxide and carbon dioxide.
- f) Continue the test until the total change in pressure differential is equal to 1 mbar and note the CO and CO_2 values. The combustion measurements are made after the boiler has reached thermal equilibrium following the off/on operation referred to in c).
- g) Clean the boiler burner(s) using the method described in the manufacturer's instructions and repeat steps b) to f).
- h) If the burner is not capable of being opened, after the second linting test g) clean it in accordance with the manufacturer's instructions and then cut it open and inspect it for conformance to **7.8.3**.

7.8.3 Cleaning of burners

The manufacturer shall provide instructions for the cleaning of lint from the appliance.

Where burners are employed that are not designed to be opened using standard tools, or are not otherwise accessible for internal cleaning, the dry air-free CO percentage at the end of the second linting test, as specified in **7.8.2.2g**) shall be not more than 0.05 % above the value obtained after the first linting test, subject to a maximum value of 0.2 %.

A burner that is not capable of being opened shall not, on examination in accordance with **7.8.2.2**h), exhibit any appreciable accumulation of lint.

7.9 Guarding (Fires only)

7.9.1 Requirements

Gas fires shall be provided with an integral guard conforming to **7.9.1**, **7.9.2**, **7.9.3** and **7.9.4**, as appropriate.

Live fuel effect fires shall conform to one of the following:

- a) be provided with an integral guard conforming to 7.9.1, 7.9.2, 7.9.3 and 7.9.4, as appropriate; or
- b) the installation and user's instructions shall specify that the fire shall be mounted on a non-combustible hearth;
- c) No naked flame or incandescent part of the firebed shall project more than 50 mm from the vertical plane of the fireplace opening.
- d) The forward projection of any naked flame or incandescent part of the firebed shall be enclosed on all sides except the front.
- e) The hearth shall project at least 300 mm in front of any naked flame, e.g. ignition burner or burner, and any incandescent part of the appliance firebed.
- f) The hearth and any surround which is fitted shall project at least 150 mm beyond each side of the naked flame or incandescent part of the firebed at its widest point.
- g) The periphery of the hearth shall be at least 50 mm above floor level. This requirement is deemed to be satisfied if the appliance is supplied with a fender of at least this height.

7.9.2 Design detail requirements

7.9.2.1 Access requirement

It shall not be possible to touch the heated radiants or the flame with any part of the test probe cone.

No opening in the guard or between the guard and the aperture to be protected shall have a major dimension exceeding 150 mm and a minor dimension exceeding 35 mm and a diagonal measurement exceeding 154 mm. These dimensions are subject to the following exceptions.

- Where it is not possible to pass a 12 mm diameter probe having a hemispherical end, applied with a force not exceeding 5 N, through any opening between the guard and the aperture to be protected, they do not apply to that opening. The weight of the probe shall be taken into account for the force applied.
- Where the gap between any vertical rods does not exceed 5 mm.

7.9.2.2 Test

With the cone illustrated in Figure 4b) assembled to the handle, Figure 4a), under normal conditions of burning, insert the probe through or around the guard with a pressure exerted on the probe not exceeding 5 N. Take the weight of the probe into account for the force applied.

$7.9.3\ Effectiveness\ against\ smouldering\ or\ ignition$

7.9.3.1 Requirement

When tested in accordance with **7.9.3.2** the flannelette shall not smoulder or ignite within 10 s of being placed in close contact with the guard.

7.9.3.2 Test

Operate the appliance at the manufacturer's maximum rating for not less than 30 min and at thermal equilibrium, hold a piece of dry flannelette 100 mm wide and conforming to the following specification in close contact with the guard approximately in the centre and reaching from the top to bottom of the guard. Take care that the flannelette is kept taut and in close contact with the guard throughout the test.

If necessary, a weight, just sufficient to keep the strip taut, may be attached to the edge of the material.

When appliances operate with their guards in a horizontal plane lay the strip of flannelette across the centre of the guard from one extreme edge to the other extreme edge and hold it in close contact with the surface of the guard.

For heating appliances where the guard is in more than one part, the test may be made on the outer part provided that this part conforms to **7.9.3.1**.

Flannelette material specification.

The flannelette used for the scorching test shall be as follows:

CompositionAll cottonWeight per square metre135 g to 152 gForeign matter3 % maximumThreads per mmWarp 2.32 to 2.44WeavePlain or 2/2 twill

Finish Bleached and raised (not sueded)

Humidity can alter the performance of the material during the test, therefore immediately before making the test, air the flannelette, but do not overheat it, in front of the heating appliance and then allow it to cool for 10 min.

7.9.4 Strength of guard

7.9.4.1 For all metallic guard designs

7.9.4.1.1 *Requirement*

The guard, when subjected to the test load specified in **7.9.4.1.2**a) shall not have been removed, permanently distorted or permanently displaced.

When tested in accordance with **7.9.4.1.2**, any hinged guard shall return to its original position on release of the pull but any fastening clip need not necessarily re-engage.

7.9.4.1.2 Test

Place the appliance, used in a cold state for this test, so that the plane of the central section of the guard is horizontal, and then do the following.

- a) Place the load consisting of a flat disc 100 mm in diameter and 5 kg in weight on the guard midway between the fixing points and retain it there for one minute. At the end of that period remove the load; then
- b) With the appliance in the cold condition, apply a pull of 20 N in any direction to the guard when its in its normal position of use.

7.9.4.2 Guard designs which include glass or a similar material

7.9.4.2.1 *Requirement*

The glass shall not break.

7.9.4.2.2 Test

With the appliance in the cold condition, apply a direct blow at the weakest point of the guard equivalent to an impact energy of 0.5 Nm.

When a guard consists of bars of glass or similar material packed alongside each other so as to touch, reduce the impact energy to 0.25 Nm.

Apply the blow by means of the spring-operated impact-test apparatus in accordance with IEC 817.

7.10 Spillage monitoring

7.10.1 General

The appliance fire and boiler both in combination and individually shall conform to **7.10.2** and at least one of **7.10.3**, or **7.10.4**, according to the method of protection in use.

7.10.2 Nuisance shutdown

7.10.2.1 Requirement

The appliance shall not shut down when tested in accordance with 7.10.2.2.

7.10.2.2 *Test method (Combustion products safety device only)*

The appliance shall be operated with all of its burners arranged to give maximum heat output for 30 minutes.

7.10.3 Atmosphere sensing (AS)

7.10.3.1 Requirement

The appliance shall go to non-volatile lockout before the carbon monoxide in the sealed room reaches 200 ppm.

7.10.3.2 *Test method*

7.10.3.2.1 *Installation*

The appliance shall be installed according to the manufacturer's instructions (ignoring the ventilation requirements) on the narrowest wall of a sealed room similar to that specified in **7.10.3.2.2** and shown diagrammatically in Figure 5.

7.10.3.2.2 *Sealed room*

The room dimensions shall be as follows:

Length	$3.5 \text{ m} \pm 0.1 \text{ m}$
Width	$2.0 \text{ m} \pm 0.1 \text{ m}$
Height	$2.5 \text{ m} \pm 0.1 \text{ m}$
Volume	$17.5 \text{ m}^3 \pm 1 \text{ m}^3$

The soundness of the room shall be such that after a homogeneous room content of $4 \% CO_2 \pm 0.2 \%$ has been established then it will not have decreased by more than 0.1 % at the end of a two hour period.

The room shall be well ventilated prior to the test. Ventilation is deemed satisfactory if the CO_2 level does not exceed 0.1 %.

The room shall be designed so that:

- the operator can, at any time, observe the appliance in operation;
- sampling of the room atmosphere for carbon monoxide can be carried out from the geometric centre of the room¹⁸⁾;
- the atmosphere in the room is maintained as a homogeneous mixture;
- the temperature at the centre of the room is maintained between 20 °C and 40 °C.

7.10.3.2.3 Test procedure

The room shall be well ventilated prior to the test. Ventilation shall have a CO₂ level less than 0.1 %.

Ignite the burner(s) of the fire, boiler or both in combination, as appropriate, at the pressure required to obtain the nominal heat input with the door of the room open and the flue functioning normally.

At the end of the 1 h warm up period, cap and seal the flue and seal the room.

Continuously monitor the room for CO %.

7.10.4 Combustion products discharge safety device (BS)

7.10.4.1 Requirements

When tested in accordance with **7.10.4.2** the safety device shall cause at least safety shutdown within the maximum times specified in Table 8.

 $^{^{18)}}$ It is important that the sample line from the probe to the analyzer is as short as possible.

Table	8 —	Products	disc	harge	times
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Degree of blockage	Diameter of opening in the blocking plate		Maximum time to	shutdown (in seconds)
			$Q_{\rm n}$	Q_{m}
		Fire only	200	
Complete Blockage	0	Boiler only	120	$120 \times \frac{Q_{\rm n}}{Q_{\rm m}}$
		Fire and Boiler	120	
Partial Blockage		Fire only	600	
raruai biockage	0.6 D	Boiler only	480	
		Fire and Boiler	480	

D = Internal diameter of the test flue at the spillage point.

After shutdown has occurred, restart shall be possible only after a minimum time of 10 minutes.

7.10.4.2 *Test method*

7.10.4.2.1 Complete blockage

Block the flue completely and measure the time taken to cut off the gas (see **6.2** for installation and **7.10.1** for conditions).

7.10.4.2.2 Partial blockage

Restrict the flue by concentric annuli or by a telescopic flue arrangement to the point that spillage just does not occur (see **7.1.2**). Reduce the final diameter to 0.6 of its diameter by the use of an easily fitted annulus.

If the device is actuated before this point is reached, the partial blockage requirement is satisfied.

Measure the time between the annulus or plate being put into position and the shutdown of the unit(s).

7.11 Cyclic use test — fire only

7.11.1 Requirements

When tested in accordance with 7.11.2 the appliance shall conform to the following.

- a) The heat input shall not have changed by more than 10 % from its initial value at the manufacturer's recommended hot setting pressure.
- b) No part of the appliance shall have suffered any breakdown or distortion liable to affect the safety of the appliance.
- c) There shall be no unsafe deterioration of the inside of appliance cases made of wood.
- d) There shall be no seizure of screws or other changes likely to cause undue difficulty in subsequent maintenance.
- e) Any tap shall be easy to turn both when the appliance is hot and when it has cooled.
- f) After cooling, the appliance shall conform to the soundness requirements of 7.1.1.1.
- g) Combustion shall conform to 7.7.
- h) When tested in accordance with 7.4.1.2, with a reference test gas, the appliance shall ignite.

 Q_n = Nominal heat input.

 $Q_{\rm m}$ = Minimum heat input for modulating or step operating boilers.

7.11.2 Test method

Supply the fire with the appropriate reference gases (see 6.1.1) according to its category. Adjust the burner to a rate equal to 1.15 times the nominal heat input in the case of 2^{nd} family gases and 1.12 times the nominal heat input in the case of 3^{rd} family gases.

Cat II appliances shall be tested using the reference gas having the lowest Wobbe index.

Successively light and extinguish the fire to give 100 cycles each of 2 h on and 2 h off and then a further 4 cycles of 8 h on and 16 h off.

7.12 Products clearance

7.12.1 Spillage assessment

7.12.1.1 Requirement

When tested in accordance with the method specified in **7.12.1.2** the manufacturer's specified method for confirming products clearance shall indicate products spillage.

7.12.1.2 *Test method*

Install the appliance in accordance with the manufacturer's instructions in the standard test box (see Figure 1) fitted with a 125 mm O/D flue pipe to a height equal to the minimum equivalent height i.e. 3 m from the hearth or 2.65 m for fires designed for use with a pre-cast flue.

Test the appliance with reference gas, or any other gas of suitable quality, supplied at the adjustment pressure.

Operate the appliance in accordance with **7.1.2** and restrict the flue outlet to the point where, after heating the appliance for one hour with any thermostat remaining fully open, the leakage from the appliance shall be 0.28 m³/h. carry out the manufacturer's specified method of confirming products clearance.

If any change in the installation method is specified by the manufacturer when installing the appliance on a pre-cast flue the installation shall be tested using both methods.

7.12.2 Clearance assessment

7.12.2.1 Requirement

The manufacturer's specified method for confirming products clearance shall indicate products clearance.

7.12.2.2 *Test method*

Install the appliance in accordance with the manufacturer's instructions in the standard test box (see Figure 1) fitted with a 125 mm O/D flue pipe to a height equal to the minimum equivalent height i.e. 3 m from the hearth or 2.65 m for fires designed for use with a pre-cast flue.

Test the appliance, supplied at the adjustment pressure with reference gas or any other gas of equivalent quality.

With the appliance in the cold condition, operate the appliance with any thermostat fully open and carry out the manufacturer's specified method of confirming products clearance, including any time interval specified in the manufacturer's instructions.

For an appliance intended for use on a pre-cast flue, the test shall only be carried out with an equivalent flue height of 2.65 m if a common method of installation is specified in the manufacturer's instructions.

7.13 Flame supervision device

7.13.1 Requirements

7.13.1.1 Thermoelectric device

7.13.1.1.1 *Cold condition*

When tested as described in **7.13.2.1.1.1**, any flame supervision device shall hold open the valve in not more than 60 s from the cold condition.

No device shall require more than $20\ \mathrm{s}$ of sustained manual operation.

7.13.1.1.2 *Hot condition*

When tested as described in 7.13.2.1.1.2, any flame supervision device shall close the valve from the fully heated condition within 60 s.

7.13.1.2 Automatic burner control system

7.13.1.2.1 *Manually operated devices (e.g. push button)*

When tested as described in 7.13.2.1.2.1, the rapid (on and off) manual operation of any start switch shall not set up a hazardous condition.

7.13.1.2.2 *Safety time*

When tested in accordance with the conditions of 7.13.2.1.2.2 the maximum safety time shall not exceed that specified by the manufacturer see 5.11.9.4.4.1.

7.13.1.2.3 Extinction delay time

When tested as described in 7.13.2.1.2.3, the time for the flame supervision device to de-energize the burner safety shut-off valves upon flame failure shall be not more than 3 s.

7.13.2 Tests

7.13.2.1 Flame supervision device

7.13.2.1.1 Thermoelectric device

7.13.2.1.1.1 *Cold condition*

The tests are carried out with the appropriate reference gases with the appliance adjusted to its nominal heat input.

After this adjustment has been made, the appliance is allowed to cool to ambient temperature. The gas is turned on again and lit at the ignition burner, if any, or main burner as appropriate. The opening time is that between the moment of lighting the ignition burner, or main burner, as appropriate, to that when the safety device is actuated.

7.13.2.1.1.2 *Hot condition*

The appliance is left to operate at its nominal heat input for 1 h.

The time measured is the interval between the moment when the ignition burner and main burner are intentionally extinguished by cutting off the gas supply and the moment when, after turning on again, the gas supply is shut off through the action of the flame supervision device. A gas meter or any other appropriate device may be used to detect the closure of the valve of the flame supervision device.

7.13.2.1.2 Automatic burner control systems

7.13.2.1.2.1 Manually operated devices (e.g. push button)

The appliance is installed as described in 6.2.3 and supplied with an appropriate reference gas (see Table 4) at the nominal heat input in accordance with 7.3.1. The start device is manually operated 10 times, i.e. once every 5 s.

7.13.2.1.2.2 *Safety time*

Isolate the gas supply to the appliance. Attempt to ignite the appliance in accordance with the manufacturer's instructions, and measure the time between the signals for valve opening and closure. Compare this time with the manufacturer's specified time.

7.13.2.1.2.3 *Extinction delay time*

With the appliance in the running condition, isolate the gas supply to the main burner. Measure the time between the moment when the main burner is extinguished and the signal of valve closure is given.

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7.14 Useful efficiency at nominal heat input

7.14.1 Fire

7.14.1.1 Requirement

The useful efficiency measured at its nominal heat input shall be within the limits specified in Table 9.

Table 9 — Gas fire efficiency

Class Useful efficiency per cent	
Class 1	> 80
Class 2	> 70
Class 3	> 50

7.14.1.2 *Test method*

Flue gases shall be sampled at a flow rate of between 8 dm³/min and 12 dm³/min from the sampling probe.

Fit the fire to a gas fire efficiency test rig (see Figure 6) by means of a sealing plate so that all of the air passes through the fire (see example shown in Figure 7). The flue height is set to 1 metre or 2 metres according to the manufacturer's choice.

Ignite the fire and operate it for 30 min. at its rated heat input on reference gas. Confirm conformity to **7.12.2.1** under these operating conditions.

Where the efficiency of the fire is dependent on the flue resistance of the combined appliance, a flue spigot restrictor may be used in the fire for these tests. This flue restrictor shall be supplied by the manufacturer to the test house and the restriction should be not greater than the additional restriction of the boiler.

When tested for conformity to 7.12.2.1 the restrictor shall be fitted.

Sample the products of combustion and measure the temperature $200\,$ mm down from the upper end of the flue using the probe shown in Figure 8.

Take the following readings:

$t_{ m p}$	Combustion products temperature	$^{\circ}\mathrm{C}$
$t_{ m a}$	Ambient air temperature	$^{\circ}\mathrm{C}$
CO_2	CO_2 content of the combustion products	%
$\mathrm{CO}_{\mathrm{2air}}$	CO_2 content of the ambient air	%

Calculate the following values.

$H_{ m i}$	Net calorific value at 15 $^{\circ}\mathrm{C}$ and 1,013.25 mbar, dry	MJ/m^3
$H_{ m s}$	Gross calorific value at 15 $^{\circ}\mathrm{C}$ and 1,013.25 mbar, dry	MJ/m^3
$C_{ m i}$	Mean specific heat of the dry products of combustion	MJ/(m ³ . °C)
$V_{ m f}$	Volume of dry products of combustion per unit volume of gas	${ m M}^3$

The values of H_i , H_s and V_{CO2} for test gases G 20, G 31 and G 30 are specified in Table 10.

 C_i is obtained from the graph in Figure 9.

 $V_{\rm f}$ is obtained from:

$$V_{\rm f} = \frac{V_{\rm CO_2}}{{\rm CO_2 - CO_{2air}}} \times 100$$

 $V_{\rm CO2}$ is the volume of CO₂ produced by the combustion of 1 m³ of gas.

Table 10 — Test gas data

Reference gas	Net calorific value, $H_{ m i}$	Gross calorific value, $H_{ m s}$	$V_{ m CO2}$
	MJ/m^3	MJ/m^3	
G 20	34.02	37.78	1.0
G 31	88.00	95.65	3.0
G 30	116.09	125.81	4.0
NOTE These values apply only to the exact gases as specified in Table 2.			

The efficiency is calculated from:

Net efficiency = $100 - (q_1 + q_2)$

where

$$Q_1 = C_i \times V_f \left(\frac{t_p - t_a}{H_i}\right) \times 100$$

$$q_1 = 0.077 \left(\frac{H_s - H_i}{H_i} \right) \times (t_p - t_a)$$

7.14.2 Back boiler efficiency

7.14.2.1 *Requirement*

When tested in accordance with 7.14.2.2, the useful efficiency of the back boiler at the nominal heat input, or the maximum heat input for range-rated boilers shall be at least that specified in row 1 of Table 11.

In addition, for range-rated boilers, the efficiency at a rate corresponding to the arithmetic mean of the maximum and minimum heat input, expressed in percent, shall be at least that specified in row 2 of Table 11.

When tested in accordance with 7.14, the useful efficiency for a load corresponding to 30% of the nominal heat input (or the arithmetic mean of the maximum and minimum heat input for range-rated boilers), expressed in percent, shall be at least that specified in row 3 of Table 11.

Table 11 — Useful boiler efficiency

		Useful efficiency (per cent)		
		Class 1	Class 2	
1	Full load	$84 + 2\log_{10}P_{\rm n}$	$80 + 2\log_{10}P_{\rm n}$	
2	Range-rated only	$84 + 2\log_{10}P_{\rm m}$	$80 + 2\log_{10}P_{\rm m}$	
3	Part load	$80 + 3\log_{10}P_{\rm i}$	$76 + 3\log_{10}P_{\rm i}$	

 P_n is the nominal output (maximum output for range-rated boilers), expressed in kilowatts (kW).

 P_m is the arithmetic mean of the maximum and minimum useful output as stated by the manufacturer for range-rated boilers, expressed in kilowatts (kW).

 P_i is the nominal output P_n or the arithmetic mean P_m of the maximum and minimum useful output as stated by the manufacturer for range-rated boilers, expressed in kilowatts (kW).

NOTE This standard specifies the procedures for ON/OFF boilers. Where the boiler is fitted with modulating or step operating controls, different set up procedures are necessary. If required, these procedures should be based on the corresponding clauses in BS EN 297 or BS EN 483.

7.14.2.2 Test method — nominal (arithmetic mean) heat input

Install the boiler in accordance with 6.2, connected to either of the insulated test rigs shown schematically in Figure 10a) or Figure 10b), or to any other equipment giving equivalent results, and supply it with the reference gas for the boiler category.

Begin measuring efficiency once the boiler, with the control thermostat put out of action, is at thermal equilibrium and the return and flow temperatures are constant.

Pass the hot water into a vessel placed on scales (suitably tared before the test) and at the same time start measurement of the gas rate (reading the meter.

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Periodically take readings of the water return and flow temperatures to obtain a sufficiently accurate average.

The mass m_1 of the water is collected during the 10 minutes of the test. Wait a further 10 min before evaluating the evaporation corresponding to the test period. Mass m_2 is obtained.

Measure the quantity $m_3 = m_1 - m_2$, which is the quantity by which m_1 has to be increased to take account of evaporation, whence the corrected water mass $m = m_1 + m_3$.

The quantity of heat transferred by the boiler to the water collected in the vessel is proportional to the corrected mass m and to the difference between temperatures t_1 at the cold water inlet and t_2 at the boiler outlet.

The useful efficiency is determined by means of the following equation:

$$\eta = \frac{4.186 \times {10}^{-5} \times m \times (t_2 - t_1) + D_{\rm p}}{V_{\rm r(10)} \times H_{\rm i}} \times 100$$

where

 η is the useful efficiency in percent;

m is the mass of water in kg, corrected for any evaporative losses;

 $D_{\rm p}$ is the heat loss from the test rig corresponding to the mean water flow temperature in kJ, taking into account the heat loss from the circulation pump (a practical calibration method for determining $D_{\rm p}$ is specified in 7.15.3.2)

is the temperature of the water as it leaves the apparatus, ($^{\circ}$ C);

 t_1 is the temperature of the water as it enters the apparatus, (°C);

 $V_{r(10)}$ is the gas consumed in m³ expressed at 15 °C and 1013.25 mbar;

 $H_{\rm i}$ is the net calorific value of the gas used in MJ/m³ at 15 °C and 1013.25 mbar, dry gas.

The measurement shall be to a tolerance of $\pm 2\%$.

The useful efficiency is determined in the following conditions:

- the nominal heat input for boilers without a range-rating device;
- the maximum heat input and the arithmetic mean of the maximum and minimum heat input for boilers with a range-rating device.

7.15 Useful efficiency at part load (back boiler only)

7.15.1 *General*

To determine the useful efficiency at part load corresponding to 30 % of the nominal heat input, or the arithmetic mean of the maximum and minimum heat input for range-rated boilers, the manufacturer has the choice between either the direct method or the indirect method.

7.15.2 Direct method

7.15.2.1 General

The boiler shall be fitted to either of the test rigs shown schematically in Figure 10a) or Figure 10b) (or any other test rig giving at least comparable results and equivalent measurement accuracies) and supplied with the appropriate reference gas at the nominal heat input or, for range-rated boilers, the arithmetic mean of the maximum and minimum heat inputs.

The pump shall be operated continuously throughout the test and the water volume rate shall be maintained constant within ± 1 %.

The boiler shall be operated so that it cycles on for time T_1 seconds and off for time T_2 seconds.

The average water temperature in the boiler shall be no less than 50 °C.

Where

$$T_1 = \begin{array}{ccc} \frac{180 \times Q_1 - 600 \times Q_2}{Q_1 - Q_2} & \text{s} \\ \\ T_2 = & 600 - T_1 & \text{s} \\ \\ Q_1 = & \text{the main burner heat input} & \text{kW} \\ \\ Q_2 = & \text{the ignition burner heat input} & \text{kW} \\ \end{array}$$

The boiler shall be in thermal equilibrium when the efficiency measurement of three consecutive cycles does not vary by more than 0.5 %.

Measure the flow and return water temperatures.

Measure the respective gas and water consumptions over complete cycles.

A variation of ± 1 %, with respect to the 30 % of the nominal heat input may occur. For variations up to of ± 2 % it is necessary to carry out two measurements, one above and one below 30 % of the nominal heat input. The efficiency corresponding to 30 % is determined by interpolation.

Calculate the efficiency at part load using the equation specified in 7.14.2.2.

7.15.2.2 *Operating mode No.1*

The inlet water is pre-heated such that the boiler return temperature is held constant at (47 ± 1) °C, with a maximum variation in this temperature ± 1 K during the measurement period. If the boiler control does not permit operation at a return temperature as low as 47 °C, the test shall be carried out at the lowest return temperature compatible with the operation of the boiler.

7.15.2.3 Operating mode No.2

The boiler flow and return temperatures are obtained by means of the boiler controls.

The average water temperature shall be not less than 50 °C.

If the boiler control does not permit operation at a return temperature that is low enough, the test shall be carried out at the lowest return temperature compatible with the operation of the boiler.

7.15.3 Indirect method

7.15.3.1 Efficiency at reduced heat input

Repeat the test of **7.14.2.2** at the nominal heat input (or at the arithmetic mean of the maximum and minimum heat input for range-rated boilers with a flow temperature of (60 ± 2) °C and a return temperature of (40 ± 1) °C.

Measure the value η_1 .

7.15.3.2 *Heat lost from the test apparatus*¹⁹⁾

Arrange the test apparatus (see Figure 10a) and Figure 10b) so that a well insulated water container of small volume (about 250 ml), containing an electric immersion heater is substituted for the boiler. Fill the circulating system and run the pump at its normal setting. Connect the immersion heater to the mains supply by a continuously variable transformer and a Watt-hour meter. Adjust the transformer so that the temperature of the circulating water reaches equilibrium (this may take four hours or more). Measure the ambient temperature and the heat input to the heater. Test the apparatus at different water temperatures to give test rig heat losses over various temperature rises above ambient.

Calculate the value, $D_{\rm p}$, to be substituted in the equation for efficiency in **7.14.2.2**, by multiplying the rate of heat loss from the test apparatus, at the required temperature difference between water and ambient, in Watts, by the duration of the test in seconds, times 10^{-6} .

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¹⁹⁾ Because the pump is running both in this experiment and in the one to determine efficiency, under the same conditions, its own contribution plays no part in the calculations.

7.15.3.3 Standby losses

The test apparatus used for the determination of efficiency may be used for this test. The apparatus has already been calibrated for heat losses from the apparatus alone. Mount the back boiler in position, and repeat the calibration for total heat loss. This time, several readings are required spanning differences, between the room and the heating circuit mean temperature, of 30 K. The back boiler's own burner may be used to bring the mean water temperature close to the required value. After this the burner shall be extinguished, and the water temperatures allowed to stabilize under the influence of the immersion heater and the pump built into the apparatus alone. Any pump associated with the back boiler itself, shall be off. Plot a graph of power to the immersion heater versus the mean temperature difference between the room and the heating water temperature.

A plot of actual heat lost from the back boiler alone will be the difference between the plot of heat lost from the full circuit and the plot of heat lost from the circuit without the back boiler. From this obtain the heat lost from the back boiler at a temperature difference of 30 K.

7.15.3.4 Ignition burner recovery factor

When the main burner is extinguished, any permanent ignition burner is assumed to operate at a recovery factor of 0.8.

7.15.3.5 *Calculation*

The part load efficiency is calculated using the following equation:

$$\eta_{\rm u} = \frac{\frac{\eta_1}{100}Q_1T_1 + (0.8 \times Q_2 - P_{\rm s})T_2}{Q_1T_1 + Q_2T_2} \times 100$$

where

 $\eta_{\rm u}$ is the part load efficiency;

 n_1 is the full load efficiency at 50 °C;

 $P_{\rm s}$ is the standby loss;

$$T_1 = \frac{180 \times Q_1 - 600 \times Q_2}{Q_1 - Q_2} \text{ (s)}$$

$$T_2 = 600 - T_1$$
 (s)

Q1 is the main burner heat input (kW)

Q2 is the ignition burner heat input (kW)

7.16 Hydraulic resistance

$7.16.1\ Requirements.$

When tested in accordance with **7.15.2** the values of hydraulic resistance or the graph of available pressures shall conform to those specified by the manufacturer's technical instructions.

For boilers with an integral pump, the instructions shall specify the graph of available pressures for the installation calculations.

7.16.2 Test method

Calculate the hydraulic resistance of a boiler (measured in mbar) for the water rate corresponding to operation of the boiler at the nominal heat input with a water flow temperature of 80 $^{\circ}$ C and a temperature difference between the flow and the return water of 11 K generally, or that stated by the manufacturer.

Carry out the test with cold water.

The test rig shall be as specified in Figure 11.

Before or after the test itself, connect the two test pipes directly to each other to determine their own resistance for different flow rates.

When boilers with integral pumps are tested in the same test conditions, the graph of available pressures plotted during the test shall be the same as that supplied by the manufacturer.

7.17 Stability of the fire

7.17.1 Requirement

A fire which in accordance with the manufacturer's instructions can be installed without being fixed to a wall shall not fall forwards when tested in accordance with **7.16.2**.

7.17.2 Test method

- a) Stand the fire (without any connection being made to the gas supply or flue spigot) on a horizontal plane provided with a stop to prevent the front supports of the fire from moving forward and level it in accordance with the manufacturer's instructions. Apply a horizontal force of 6 Newtons to the top of the fire in the forward direction;
- b) With the fire standing on the level plane as described in a) but with the stop for preventing the front supports of the fire moving forward removed, tilt the fire forward on the front supports to an angle of 5° to the vertical.

7.18 Thermostats and water temperature limiting devices

7.18.1 Control thermostat

7.18.1.1 Requirement

When tested in accordance with 7.18.1.2 the appliance shall conform to the following:

- the maximum water temperature of boilers fitted with a fixed setting thermostat shall be within $\pm 10~\mathrm{K}$ of the temperature stated by the manufacturer;
- for boilers fitted with an adjustable thermostat, it shall be possible to select, to within ± 10 K, the water flow temperatures stated by the manufacturer;
- the flow temperature shall not exceed 95 °C;
- the safety temperature limiter shall not operate.

7.18.1.2 Test

The boiler shall be installed as specified in **6.2** and adjusted to the nominal heat input with one of the reference gases for the boiler category, or an actually distributed gas.

For these tests, start the boiler at ambient temperature and leave the controls to operate.

Using control valve I in Figure 2a) or Figure 2b), adjust the cold water rate to give a rate of increase of the flow temperature of about 2 K/min.

When the thermostat is adjustable, test it as follows:

- 1) a test at the maximum setting temperature, and
- 2) a test at the minimum temperature.

7.18.2 Safety temperature limiter

7.18.2.1 Requirement

When tested in accordance with **7.18.2.2**, the safety temperature limiter shall cause non-volatile lockout of the boiler before the water flow temperature exceeds $110\,^{\circ}\text{C}$.

7.18.2.2 Test

The boiler shall be installed in accordance with **6.2**.

With the boiler at thermal equilibrium, and after the control thermostat has been put out of action, progressively reduce the boiler cold water rate by operating control valve I [see Figure 10a) or Figure 10b)] so that a water temperature rise of about 2 K/min is obtained, until the burner is extinguished.

7.18.3 Inadequate water circulation

7.18.3.1 Requirement

When tested in accordance with **7.18.2.2**, no deterioration of the boiler shall occur. This requirement does not apply to boilers intended exclusively for a central heating system with an open expansion vessel.

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7.18.3.2 Test

The boiler shall be installed in accordance with **6.2**. Using control valve II in Figure 10a) or Figure 10b), progressively reduce the water rate through the boiler to obtain a temperature increase of about 2 K/min.

8 Marking and instructions

8.1 General

All specified heat inputs shall clearly indicate whether they refer to the Net or Gross heat input. Where data is required for use in conjunction with national regulations; it shall be stated in the appropriate units.

8.2 Appliance marking

The following information shall be permanently displayed on the appliance in a position readily accessible to the service engineer:

- a) the name and/or trade mark of the manufacturer with a corresponding address;
- b) the serial number or the year of manufacturer;
- c) the commercial designation under which the appliance is presented for approval by the manufacturer;
- d) the gas category for which the appliance is adjusted;
- e) the nominal heat inputs (kW) and outputs (kW) of each appliance unit and, for a range-rated boiler, the values at the minimum of the range;
- f) the burner setting pressures, in mbar;
- g) the nature and voltage of the electrical supply, and the power consumption in watts (W).

8.3 Dress guard

If a dress guard is supplied, a label shall be affixed to the guard carrying the following information:

"THIS LABEL SHALL BE REMOVED ONLY BY THE USER.

THE GUARD IS TO PREVENT RISK OF FIRE OR INJURY FROM BURNS AND NO PART OF IT SHOULD BE PERMANENTLY REMOVED.

IT DOES NOT GIVE FULL PROTECTION FOR YOUNG CHILDREN, THE ELDERLY OR THE INFIRM."

8.4 Warning labels

Appliances shall have affixed to them, a customer removable label headed "To be removed only by the purchaser" and bearing the capital letters not less than 8 mm high the words:

"WARNING: THIS APPLIANCE HAS A NAKED FLAME, A SUITABLE GUARD SHOULD BE USED FOR THE PROTECTION OF YOUNG CHILDREN, THE ELDERLY OR THE INFIRM."

8.5 Packaging

The appliance packaging shall carry the following information and instructions:

- a) the type of gas and the supply pressure for which the appliance is adjusted;
- b) the appliance shall only be installed in a room conforming to the appropriate ventilation requirements;
- c) read the technical instructions before installing the appliance;
- d) carefully read the user's instructions before lighting the appliance

8.6 Name badge

The appliance shall be permanently marked or badged, to enable the user to identify the appliance and shall include the type name and/or number of the appliance.

The name badge may be incorporated as part of the data plate.

8.7 User instructions

Instructions for use and maintenance shall be supplied with every appliance.

These instructions shall provide the user with all the necessary information for the safe and sensible use of the appliance.

The instruction shall be clear and simple and the terms shall be acceptable and in common usage. Wherever necessary, diagrams, and/or photographs shall be provided. The instructions shall contain notes on the care and safe operation of the appliance including its lighting and shut-down procedures.

Wherever fire radiants or parts of the fire fuel bed are meant to be removed by the user, there shall be explicit instructions for their correct replacement.

The instructions shall include the following recommendations:

- the manufacturer's recommended servicing period;
- the fitting of a fireguard for the protection of the young, elderly or infirm;
- that the hot water cylinder should be periodically raised to a temperature of at least 60 °C;
- the procedure in the event that the appliance regularly goes to safety shut down.

8.8 Installation instructions

8.8.1 General

Technical instructions for installation and adjustment, intended for the installer, shall be supplied with the appliance and shall include the following advice/information;

- a) that "the appliance must be fitted in accordance with the rules in force";
- b) the minimum dimensions of the fireplace recess (see Figure 1) necessary to accommodate the appliance and to give satisfactory access for service; where appropriate, the limiting dimensions of the fire surround or other flat surface required for fitting the fire or decorative closure unit; the minimum thickness and type of hearth on which the combined appliance shall stand;
- c) the correct position of the appliance or boiler base;
- d) the recommended positions of gas and water pipes and electrical supply cable;
- e) any limitations in respect of the proximity of combustible material to the appliance; in particular, the need for an incombustible hearth in front of the fireplace opening unless the appliance is wall mounted;
- f) the correct method of flueing the appliance and checking for satisfactory clearance of combustion products; in particular, the installation instructions shall emphasize the necessity for ensuring an adequate flue height e.g. 3 m above hearth level for 125 mm round flue pipe and that it is important that due account is taken of restrictions caused by bends in the flue, and the type of flue terminal fitted;
- g) the necessity to fit an appropriate flue terminal to prevent access to birds and to minimize the effect of adverse winds;
- h) whether or not the appliance is for installation in pre-cast flue blocks and, if so, any special considerations, e.g. wall surface temperature limitations, flue construction, that have to be observed if a satisfactory installation is to be achieved;
- i) complete electrical installation instructions and a wiring diagram;
- j) whether or not the appliance is for sealed systems;
- k) references to relevant standards
- l) a technical data table including the following
 - 1) the appliance heat inputs;
 - 2) the rating of any ignition burner(s);
 - 3) burner pressures;
 - 4) injector sizes;
 - 5) gas and water connection sizes;
 - 6) physical dimensions and weight;

- 7) hydraulic resistance;
- 8) gas supply pressure;
- 9) any other technical data;
- m) any other technical data, such as ventilation requirements, that may be required by the installer or commissioning engineer.

8.8.2 Installation requirements — sealed systems

Specific instructions shall be provided for appliances, specified for use with a sealed system, describing the method for filling, commissioning and servicing the system (see also **5.11.10** and **5.11.11**).

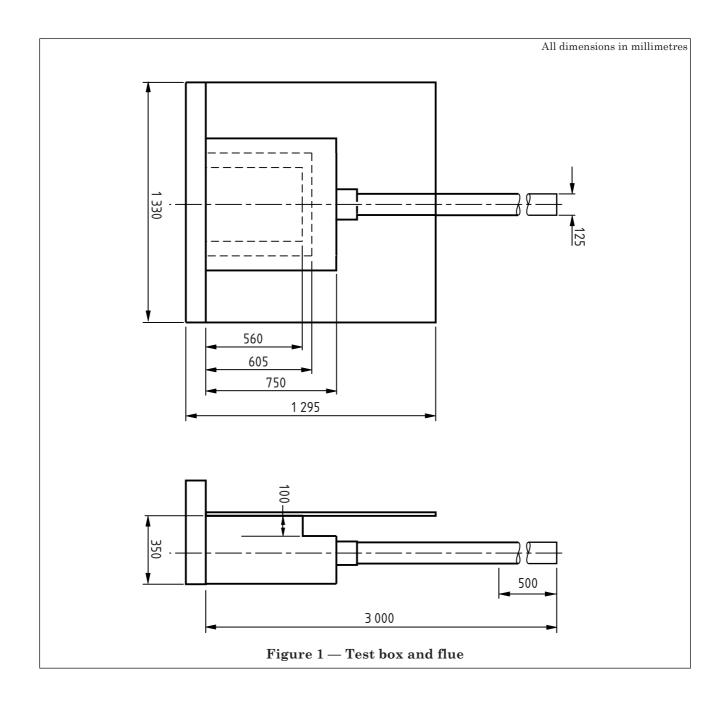
8.9 Conversion instructions

The parts required for conversion to another type of gas or to another pressure shall be supplied with clear and adequate instructions regarding changing the parts.

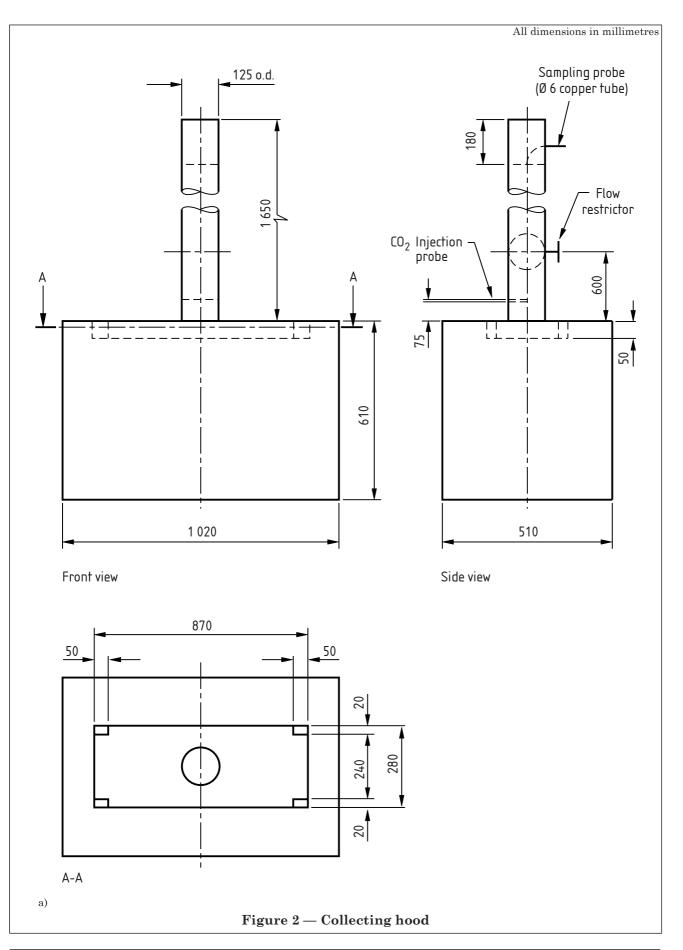
A self-adhesive label shall be supplied to be placed on the appliance; it shall state the nature and pressure of the gas for which the appliance will have been adjusted and also, where appropriate, the heat input set during commissioning.

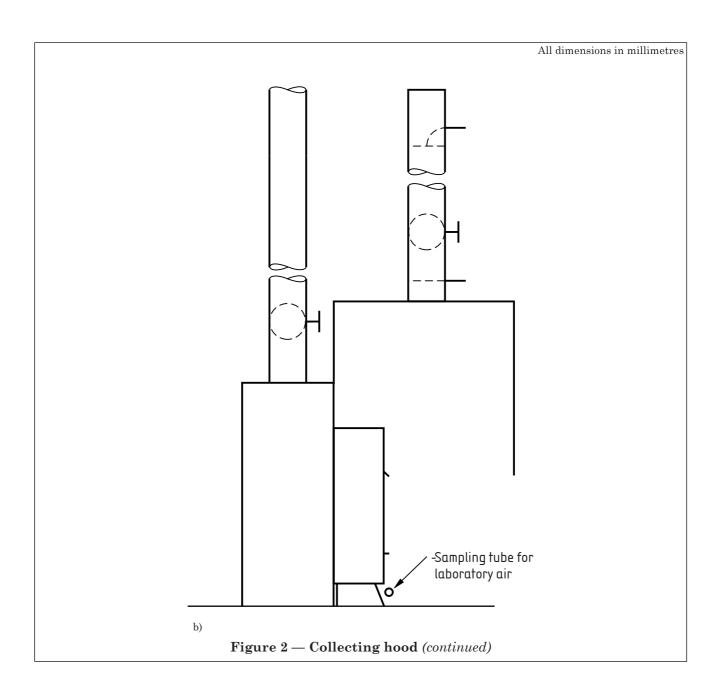
The instructions shall also state the following:

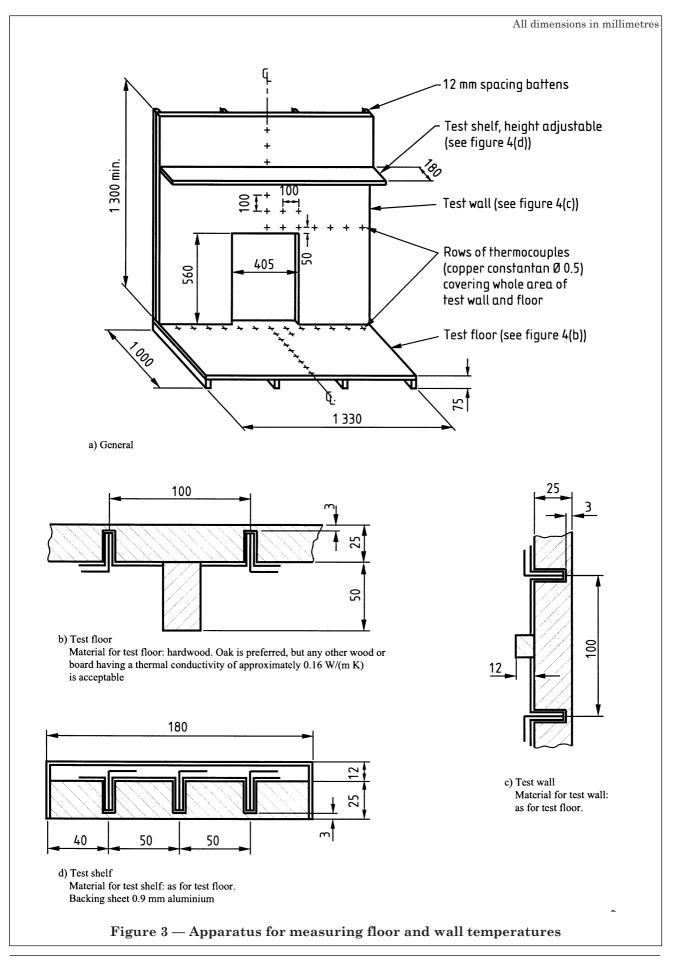
- a) that any adjusters shall be sealed after adjustment;
- b) that any governor shall either be rendered inoperative over the range of normal pressures; or for appliances using second family gases with a pressure couple, be put out of operation and sealed in this position.
- c) any governor shall be made inoperative and sealed for appliances using $3^{\rm rd}$ family gases with a pressure couple.



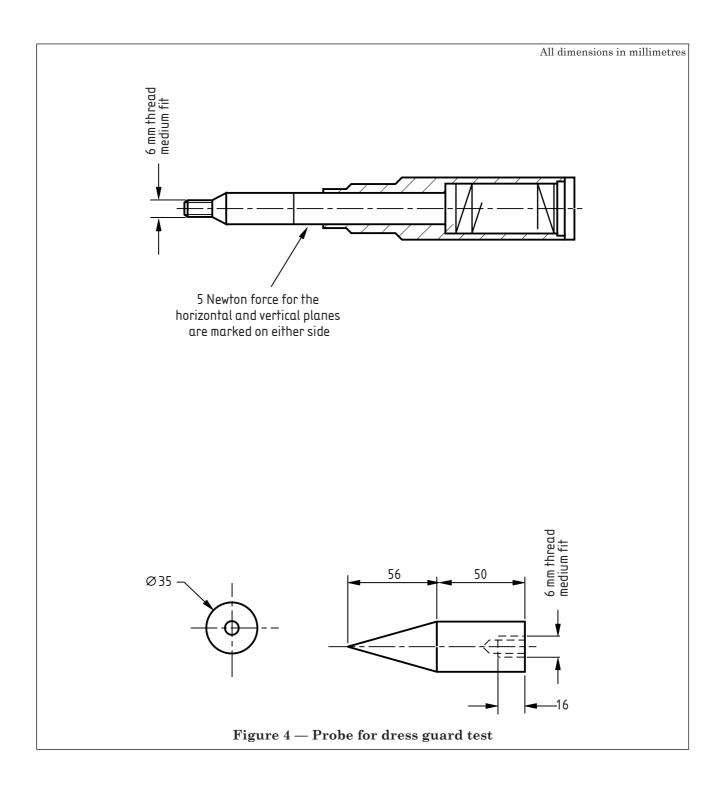
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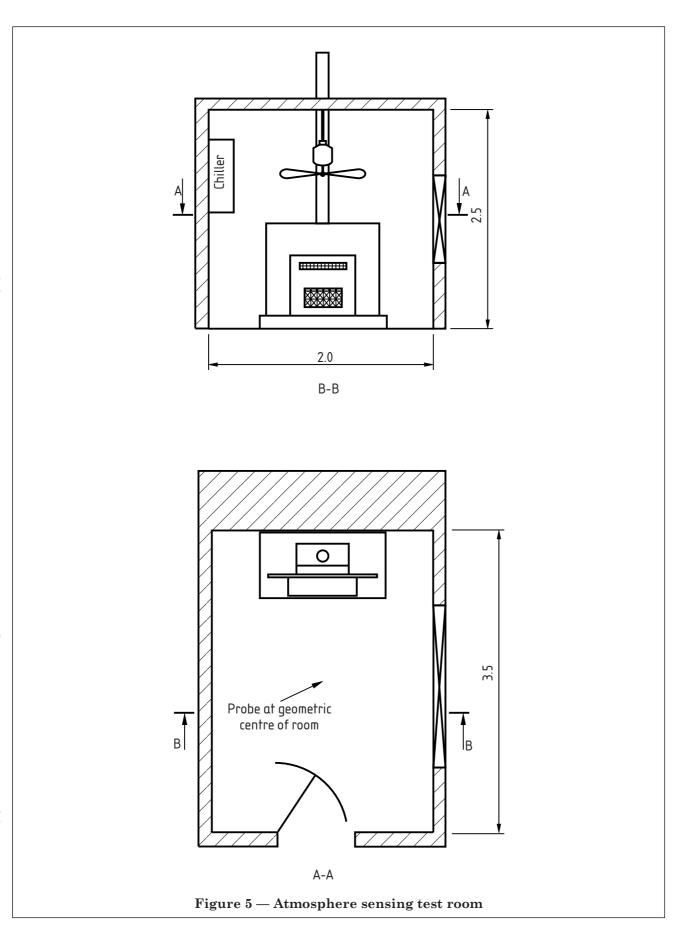


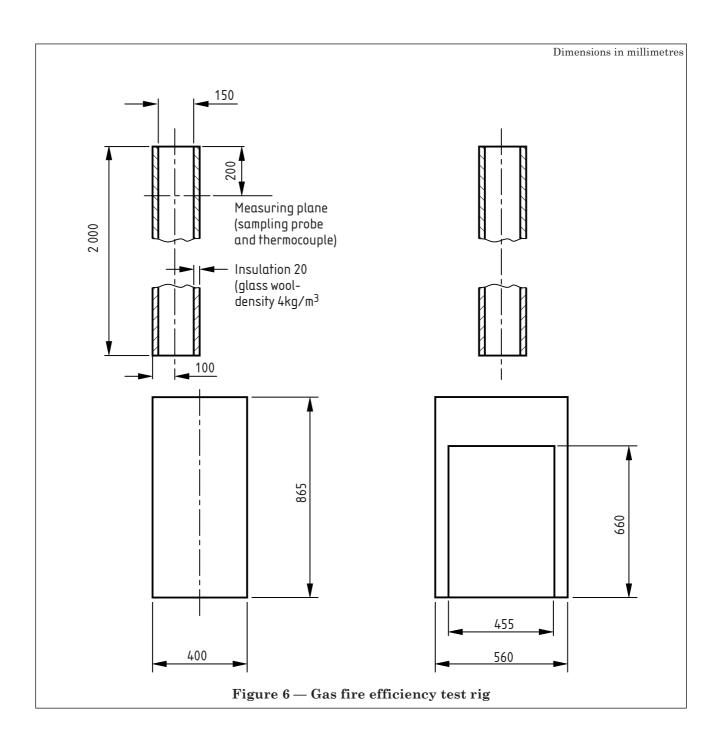


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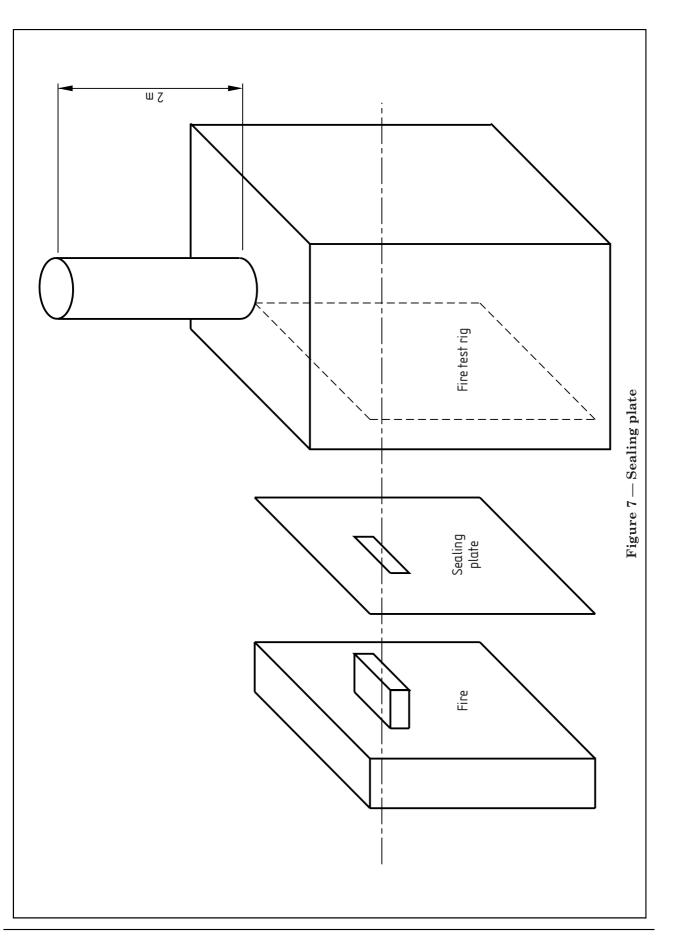


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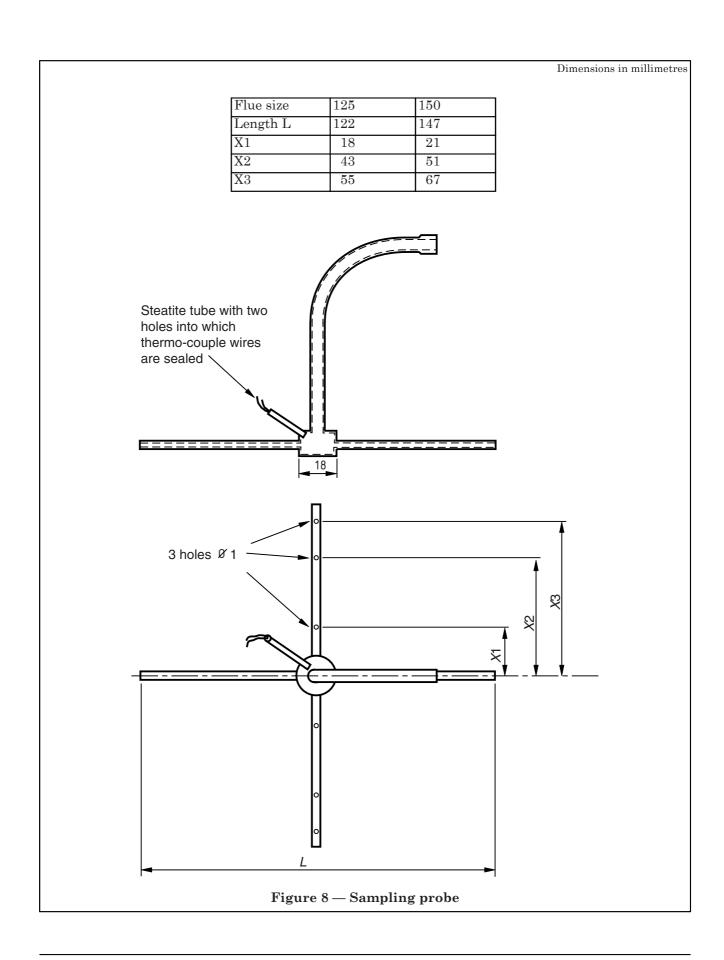




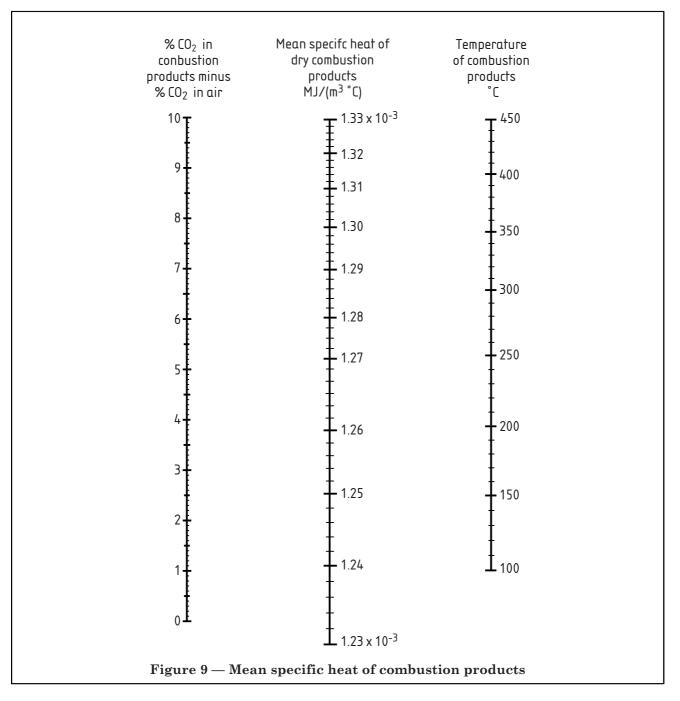
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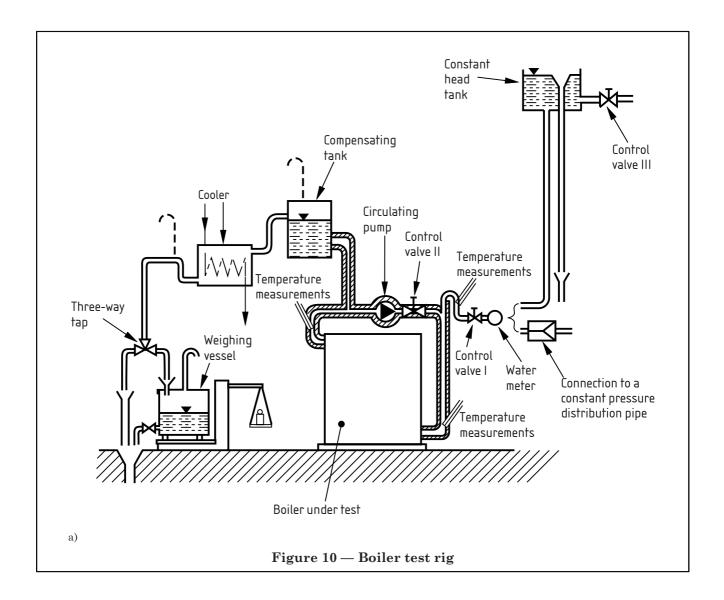


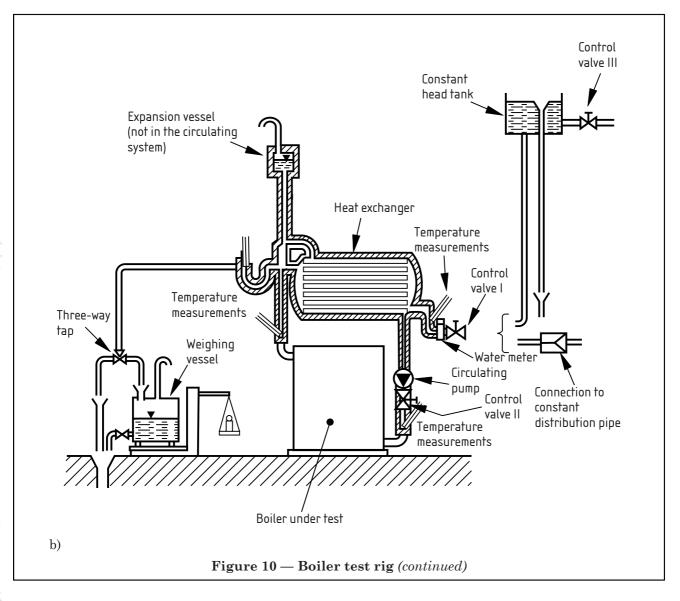
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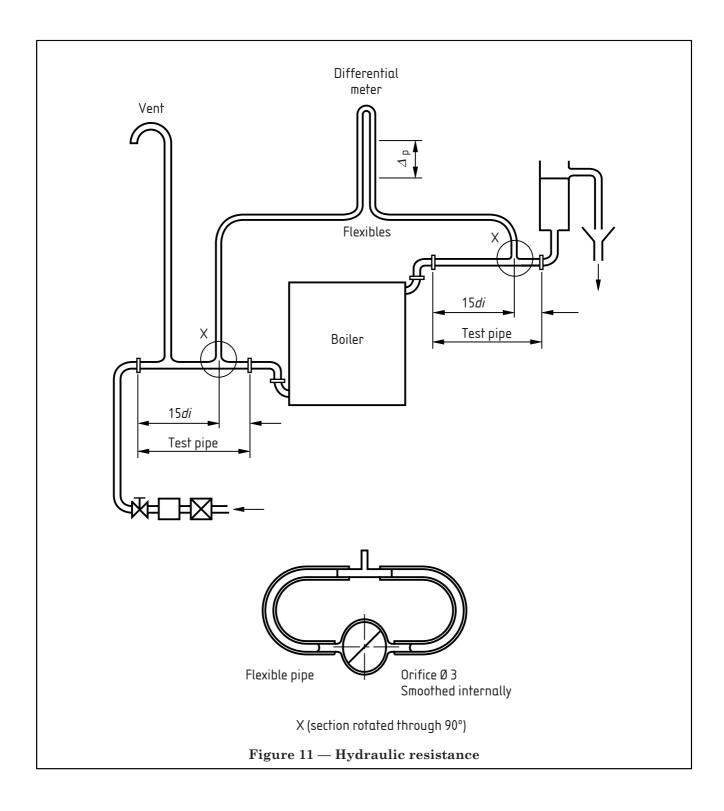


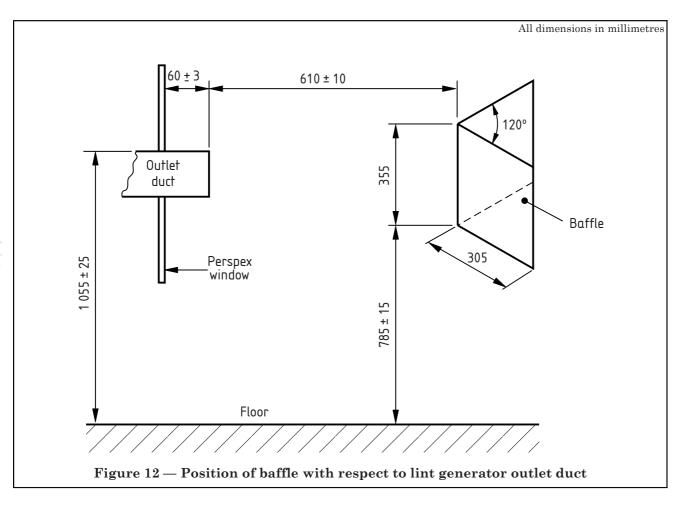
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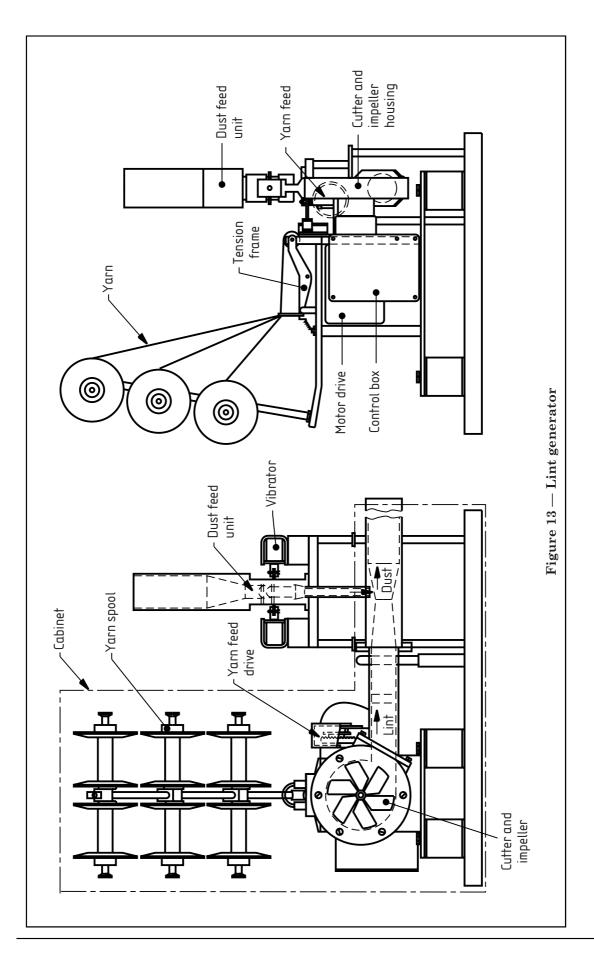


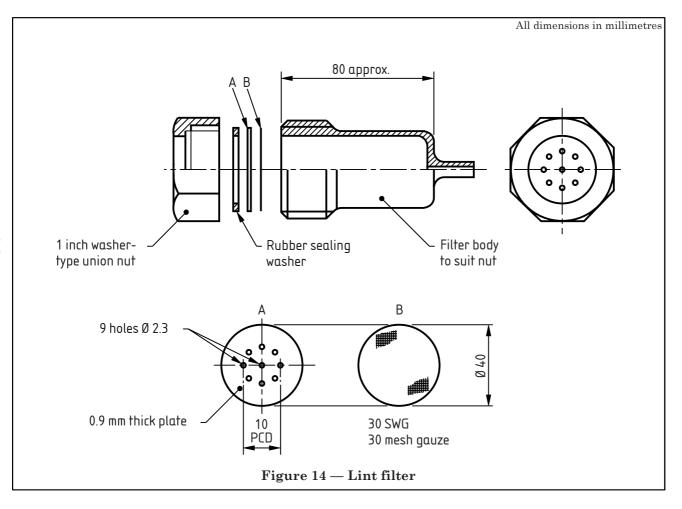












Annex A (normative) Lint — Method of test for resistance to airborne lint

A.1 Test room

The test room shall be of normal construction, of about 17 m³ capacity (no dimension being less than 2 m) and shall have at least one observation window. The walls and ceiling shall be prepared, painted or varnished to give a smooth surfaces that will minimize dirt collection. Similarly the floor shall be smoothly tiled.

WARNING: EXPLOSION RELIEFS SHOULD BE FITTED IN THREE WALLS AND THE ROOF.

The air required for combustion and ventilation is provided partly through the lint generator and partly from outside the room via two grilles 0.3 m square situated on the side walls. The air in the room shall be mixed by means of small fans that are fixed in the ceiling and adjusted so that they do not interfere with the performance of the boiler under test. These fans shall be rotated backwards and forwards about their vertical axis and shall be run at their lowest speed. Lint shall be prevented from settling on the floor by means of compressed air jets, at a supply pressure of 1.4 bar, fitted in the floor. These shall be operated intermittently for periods of 30 s every 4 m. Lint shall be prevented from reaching the appliance under test directly from the lint generator by means of a V-shaped baffle. The dimensions and positioning of this baffle are specified in Figure 12.

Combustion products shall be exhausted through an extract hood by means of a 150 mm diameter fan. The products extract duct shall be fitted with a pre-set flow detection device operating on the boiler gas valve.

The room shall be provided with test gases and water and shall be fitted with points for sampling, from outside, the air entering the appliance and the products of combustion. The air inlet ducts and the combustion products outlet are provided with filters and it should be possible to isolate the boiler under test, electrically, from outside the room.

A.2 Apparatus

A.2.1 Lint generator (as shown in Figure 13)

Comprising a vertical shaft, standing on a horizontal base, fitted with spools of cotton, nylon and wool yarns. The yarns pass between two contra-rotating rollers, into a cutting chamber, where the strands are shaved by means of impeller blades fitted with cutting edges and rotating at high speed (approximately 9 000 r/min).

NOTE At the start of each of the test runs the lint generator should be fitted with new cutting blades. Cutting blades should not be used for more than 6 h.

The lint so produced is mixed with Bentonite dust downstream of the cutting chamber and the mixture, of composition as specified in A.2.2, shall be introduced into the test room through an acoustically insulated tube.

A.2.2 Lint/dust mixture

The lint/dust mixture shall consist of the following:

cotton fibre 20 ± 5 % by mass synthetic fibre 25 ± 5 % by mass wool fibre 30 ± 5 % by mass dust 25 ± 5 % by mass

The diameters of the fibres shall be in the range 5 µm to 50 µm and shall be of length not exceeding 30 mm. The Bentonite dust shall have a particle size not exceeding 25 µm.

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A.2.3 Lint filter (see Figure 14)

Comprising a 0.9 mm circular plate of diameter 40 mm with nine holes, 2.3 mm in diameter, drilled in octagonal formation at 10 mm radius, and a circular 30 s.w.g., 30 mesh wire gauze fitted into a holder.

Linted air is drawn through the filter at a rate which gives an approximate rate of change in pressure differential across the filter of 0.1 ± 0.03 mbar/h. The change in pressure differential (pd) is measured continuously

A.3 Measurement of lint concentration

Monitor the lint concentration by drawing air through a standard lint filter (A.2.3) at a rate of 3.5 L/min and measuring the change in pressure differential (pd) across the filter.

Mount the filter externally and as close to the lowest air inlet of the appliance as is practicable without affecting, or being affected by, the air flow into the appliance. In any case the filter shall be not more than 300 mm from the air inlet.

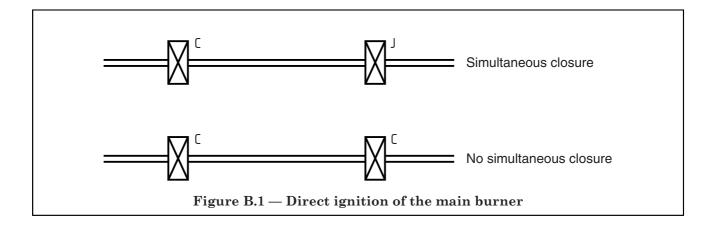
Site the filter at a height above the floor such that the lower edge of the filter element is level with the lowest edge of the air inlet. In any case the filter shall be not less than 75 mm from the floor.

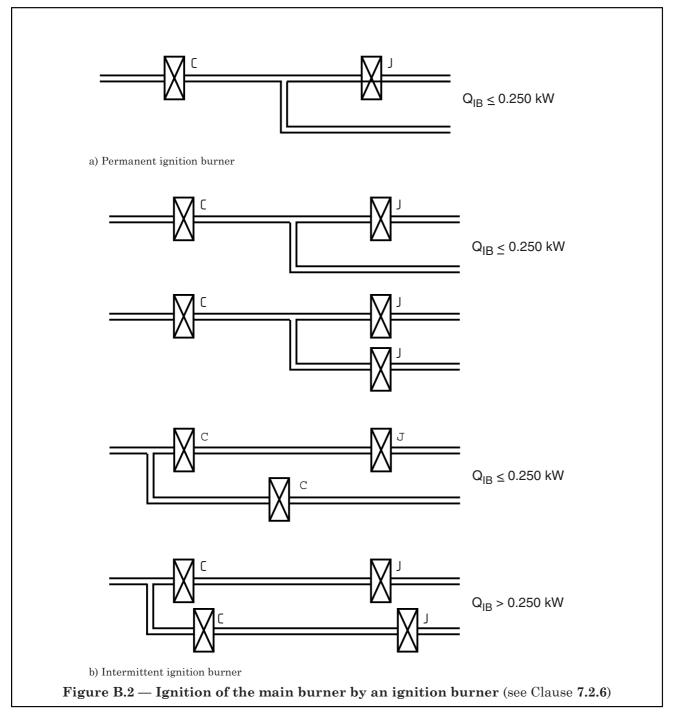
Place the filter element so that it samples at right angles to the direction of air flow into the appliance.

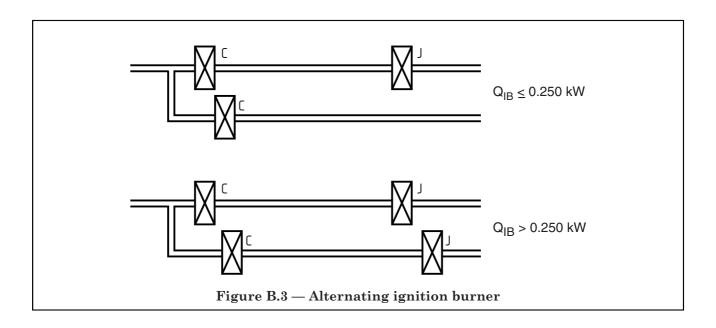
Where the appliance has more than one air inlet at the lowest level, the filter shall be placed in front of the air inlet that is most convenient for the execution of the test.

Clean the filter before the start of each test and subsequently when the change in pressure differential equals 0.1 mbar. The total change in pressure differential is the sum of the individual values of pressure differential determined between each cleaning of the filter.

Annex B (informative) Composition of the gas circuit







Annex C (informative) GAD essential requirements guide

Essential requirement	Subject	Relevant causes in BS 7977-2
1.1	Safe design and construction	Whole standard
	Instructions — installer	8.8
	— user	8.7
	Warning notices	8.2, 8.3, 8.4, 8.5
1.2.1	Type of gas used	8.2, 8.8
	Gas supply pressure	8.8
	Fresh air — for combustion	8.8
	— products dispersal	8.8
	Forced draught burners	Not applicable
1.2.2	Instructions for use and servicing	8.7
1.2.3	Warning notices on appliance and packaging	8.4
		8.5
1.3	Manual gas valves	5.11.4
	Governors	5.11.5
	Flame supervision device	5.11.6
	Automatic valves	5.11.8
	Automatic burner control systems	5.11.9
	Thermostats	5.11.10
	Fittings	Not applicable
2.1	Fitness for purpose	5.1.1
		5.1.2
2.2	Properties	1 ^a
3.1.1	Durability	5.1.1
		5.1.2
3.1.2	Condensation	5.1.1
		5.1.2
3.1.3	Explosion risk	5.5.1
3.1.4	Air/water penetration	Not applicable
3.1.5	Normal fluctuation of auxiliary energy	5.8
		5.9
3.1.6	Abnormal fluctuation of auxiliary energy	7.7.1.1 d)
3.1.7	Electrical hazards	5.8
		5.9
3.1.8	Deformation	7.1.3
3.1.9	Safety/control device failure	
	— gas	5.11
	— automatic burner control system	5.11.9
	— automatic shut-off valve	5.11.8
	— flame supervision device	5.11.6
	— multifunctional control	5.11.7
^a This standard is	type test only.	•

Essential requirement	Subject	Relevant causes in BS 7977-2
3.1.10	Overruling of safety devices	5.11.1
3.1.11	Pre-set adjuster protection	5.11.2.1
3.1.12	Marking of levers and setting devices	5.11
3.2.1	Gas leakage	7.1.1
3.2.2	Gas release during ignition, re-ignition and extinction	5.11.6
		5.11.9
		7.5.2, 7.13
3.2.3	Unburned gas accumulation	5.11.6
3.3	Ignition, re-ignition and cross-lighting	7.4
3.4.1	Flame stability	7.4
	Substances harmful to health	7.7.1
3.4.2	Combustion products release	7.12
3.4.3	Combustion products release — abnormal draught	7.10
3.4.4	Flueless domestic appliances	Not applicable
3.5	Rational use of energy	7.14
		7.15
3.6.1	Temperatures — floors, walls etc.	7.3.1, 7.3.2, 7.3.3
3.6.2	Temperatures — control knobs and levers	7.3.4
3.6.3	Temperatures of external surfaces	7.3.4
3.7	Water used for sanitary purposes	Not applicable

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Standards publications

BS EN 297, Gas-fired central heating boilers. Type B_{11} and B_{11BS} boilers fitted with atmospheric burners of nominal heat input not exceeding 70 kW.

BS EN 483, Gas-fired central heating boilers. Type C boilers of nominal heat input not exceeding 70 kW.

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