BRITISH STANDARD

BS 5258-9: 1989

Safety of domestic gas appliances —

Part 9: Specification for combined appliances: fanned-circulation ducted-air heaters/circulators

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Gas Standards Policy Committee (GSE/-) to Technical Committee GSE/17, upon which the following bodies were represented:

Association for Consumer Research (ACRE)
British Gas plc
British Non-ferrous Metals Federation
Consumer Policy Committee of BSI
Department of Energy (Energy Efficiency Office)
Department of the Environment (Building Research Establishment)
Department of Trade and Industry (Consumer Market Division)
Department of Trade and Industry (Consumer Safety Unit, CA Division)
Gas Consumers' Council
Institution of Gas Engineers
Liquefied Petroleum Gas Industry Technical Association (UK)
National Caravan Council Ltd.
Royal Society for the Prevention of Accidents
Society of British Gas Industries

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

Coopted member

This British Standard, having been prepared under the direction of the Gas Standards Policy Committee, was published under the authority of the Board of BSI and comes into effect on 31 October 1989

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Contents

Foreword

This Part of BS 5258 has been prepared under the direction of the Gas Standards Policy Committee to meet the need for a standard specifying the safety requirements and associated methods of test for combined gas-fired fanned-circulation ducted-air heaters and circulators burning 1st, 2nd and 3rd family gases.

In common with other Parts of BS 5258 currently being revised and prepared, this Part can be applied to all production appliances through a recognized scheme of quality assurance, whereas earlier Parts were written with type approval in mind. The intention is that all appliances manufactured in accordance with this standard will be safe in normal use when installed and maintained in accordance with the relevant British Standard codes of practice and with the manufacturer's instructions. Furthermore, it should be possible for such servicing as may be necessary to maintain the appliance in a safe condition to be carried out by a competent fitter without difficulty.

This Part of BS 5258 has been prepared for this type of combined appliance by taking into account the requirements of Parts 1 and 4 (see the list below), as appropriate, for the individual units, and adding those requirements relevant to the combined appliance. While the requirements and methods of test follow existing UK practice, they are in no way intended to prejudice any future negotiations of a European Standard.

The codes of practice relevant to this Part of BS 5258 are BS 5440-1 and BS 5440-2, BS 5482-1, BS 5482-2 and BS 5482-3, BS 5546 and BS 5864.

Attention is drawn to the requirements of the Gas Safety (Installation and Use) Regulations, Electrical Equipment Safety Regulations, the Model Water Byelaws and of the various Building Regulations.

The following Parts of BS 5258 are already published or are, as indicated by an asterisk, in preparation:

— *Part 1: Central heating boilers and circulators;*

— *Part 2: Cooking appliances;*

— *Part 4: Fanned-circulation ducted-air heaters;*

— *Part 5: Gas fires;*

— *Part 6: Refrigerators and food freezers;*

— *Part 7: Storage water heaters;*

— *Part 8: Combined appliances: gas fire/back boiler;*

— *Part 10: Flueless space heaters (excluding catalytic combustion heaters) (3rd family gases);*

— *Part 11: Flueless catalytic combustion heaters (3rd family gases);*

— *Part 12: Decorative gas log and other fuel effect appliances;*

— *Part 13: Specification for convector heaters;*

— *Part 14: Specification for barbecues (3rd family gas);*

— *Part 15: Specification for combination boilers*.*

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 36, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. General

1 Scope

This Part of BS 5258 specifies safety requirements and describes associated methods of test for gas-fired combined appliances consisting of a fanned-circulation ducted-air heater together with a circulator. The combined appliance is usually of integral construction, the circulator being fitted inside the air heater casing.

It also covers fanned-circulation ducted-air heaters which are designed to be fitted with circulators, as a purchaser's option.

This Part of this standard only applies to circulators intended for use as an integral part of the combined appliance. Circulators intended for independent use are covered by BS 5258-1.

It covers appliances in which the rated heat input of the air heater does not exceed 60 kW[1)] and that of the circulator does not exceed 8 kW[1)].

This Part of BS 5258 is not applicable to:

a) flueless appliances;

b) type C appliances burning 3rd family gas;

c) appliances incorporating full sequence automatic control systems;

d) appliances with premixed gas and air burners;

e) appliances designed to make use of the latent heat of condensation of the water vapour in the combustion products.

It does not include the special requirements for appliances for outdoor installation or for appliances with fan-powered combustion circuits or fan-assisted flues.

In specifying requirements for appliances burning 2nd family gases it is assumed that a meter governor will be fitted and for appliances burning 3rd family gases it is assumed that the gas supply from the container will be governed by a pressure regulator complying with the requirements of BS 3016.

There are circumstances, particularly in regard to central heating, where means of control may be provided either on the heating appliance or as part of the installation; where this option exists it is stated. Where the control forms part of the installation and its application conforms with established practice, no reference to the installation procedure is deemed necessary in this Part of BS 5258.

The requirements for controls relate to controls fitted as part of, or supplied with, particular appliances; they do not necessarily provide a complete specification for controls intended for general use.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this Part of BS 5258 the definitions given in BS 1179:1967, in BS 1179-6 and in the relevant British Standard codes of practice apply, together with the following.

2.1
adjustment pressure

the pressure, measured at the test point, that is required to obtain the rated heat input using the reference test gas

2.2
fan control

a temperature activated control that causes the fan to operate when the minimum circulation air temperature is achieved and that stops the operation of the fan when the circulation air temperature is below this minimum

2.3
fanned-circulation ducted-air heater

a ducted-air heater incorporating a fan to move the heated air through the ducting

[1)] Based on gross calorific value.

2.4
circulator

an appliance with a rated input not exceeding 8 kW designed primarily for the supply of domestic hot water in conjunction with a separate storage vessel and for operation by gravity circulation

2.5
limit control

a temperature-actuated control intended to prevent the air discharge temperature from exceeding a specified limit

2.6
limit thermostat

the temperature sensing device which actuates a limit control

2.7
minimum operational rate

70 % of the minimum rate of the control system

2.8
overheat cut-off device

a temperature-actuated, pre-set, non-adjustable device designed to protect an appliance and its surroundings in the event of failure of the limit thermostat

2.9
rated heat input

the appliance manufacturer's declared heat input for the appropriate reference test gas

2.10
setting pressure

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

2.11
water control thermostat

a thermostat intended to control the water flow temperature of a water heating appliance when in normal operation. The temperature setting is usually, but not necessarily, adjustable by the user

2.12
range-rated appliance

an appliance whose rated heat input is adjustable within a specified range

3 Classification of appliances

3.1 Classification by category

The category system of appliance classification is described in **A.1.3** of BS 4947:1984 by which an appliance is denoted by a category number I, II or III, according to the number of gas families that it is designed to burn. The families are identified by subscripts T, N and L for the 1st, 2nd and 3rd gas families respectively.

For the purposes of this Part of BS 5258, the following categories of appliances are permitted:

Categories I_T, I_N, I_L, $I_{L/B}$, $I_{L/P}$

Categories II_{TN}, II_{NL}, $II_{NL/B}$, $II_{NL/P}$

Categories III, $III_{TNL/B}$, $III_{TNL/P}$

3.2 Classification by flue type

For the purposes of this Part of BS 5258, appliances are also classified into the following types according to the flue system for which they are designed and the source of the combustion air.

a) *Type A: flueless appliances.*

b) *Type B: open-flued appliances.*

c) *Type C: room-sealed appliances.* These comprise the following:

1) Type C_1: balanced-flue appliances.

2) Type C_2: Se-duct appliances.

NOTE 1 This Part of BS 5258 does not cover type A appliances or type C appliances burning 3rd family gases.
NOTE 2 The relevant definitions of these types of appliances are given in BS 1179-6.

4 General requirements

The appliance shall comply with this Part of BS 5258 when tested using the specified test gases of the appropriate gas family. Full details of the test gases are given in BS 4947.

NOTE For purposes of quality assurance, line gas may be used instead of reference test gas but the latter has to be used in cases of dispute.

Appliances designed to burn 1st family gases shall be suitable for gas groups G4 and G5 with or without a change of injectors or jets.

5 General conditions of test

5.1 Test room

The room shall be adequately ventilated, but free from draughts likely to affect the performance of the appliance. If the test results are influenced by the temperature of the ambient air, the room temperature shall be maintained at 20 ± 5 °C.

5.2 Preparation of the appliance

5.2.1 *All appliances.* The appliance shall be set up taking due account of the manufacturer's instructions, with particular reference to minimum clearances around the appliance. It shall then be adjusted in accordance with the manufacturer's instructions, using the appropriate reference test gas at the following inlet pressure.

Family	Test gas	Inlet pressure
		mbar[a]
1st	TGA	17.5
2nd	NGA	20
3rd	LPGA LPGC	28 37

[a] 1 mbar = 100 N/m^2 = 100 Pa.

Except where otherwise specified in section 2, an appliance requiring an electrical supply shall be connected to a 240 V 50 Hz electrical supply.

Before any tests are made, the appliance shall be operated at its full working temperature for a period sufficient to dry any insulation and remove any temporary finish that might interfere with observations.

5.2.2 *Type B appliances.* Except where otherwise specified in section 2, an appliance with a vertical flue outlet shall be tested with 1 m vertical secondary flue of the same nominal diameter as the flue outlet.

The vertical flue shall be made from uninsulated aluminium having a metal thickness less than 1 mm.

An appliance with a horizontal flue outlet shall be fitted in accordance with the manufacturer's instructions; thereafter the vertical flue shall be fitted.

The manufacturer's instructions shall include the maximum length of horizontal run and the method of adaptation to a vertical flue.

5.2.3 *Type C_1 appliances.* Except where otherwise specified in section 2, the appliance shall be tested in still air conditions with the flue/air ducts and terminal assembled in accordance with the manufacturer's instructions. Due account shall be taken of variations in duct and/or terminal lengths.

5.2.4 *Type C_2 appliances.* Except where otherwise specified in section 2, the appliance shall be tested in still air conditions with the connecting ducts assembled in accordance with the manufacturer's instructions, but not connected to a test duct. Due account shall be taken of variations in length of the ducts between the appliance and the Se-duct.

5.3 Test rig: water side

For the tests specified in clauses **10** and **16** and for other tests, if desired, the circulator shall be connected to a test rig capable of allowing it to be operated at the rated heat input(s) and at the flow and return temperatures specified in section 2. Means shall be provided for measuring the flow and return temperatures and the inlet water temperature to within 0.5 °C.

NOTE A suitable test rig is shown in Figure 1, but any other arrangements having the same capability may be used.

The flow and return of the appliance (1) are short circuited via a connecting pipe containing a circulating pump (2) and control valve I (3). Cold water at a temperature t_3 is fed into the return pipe after the control valve (3) from a raised tank (4) which ensures a static head on the system. An equivalent amount of water at the flow temperature t_2 flows out of the system via a ventilated offtake.

The water flow rate corresponding to the required flow temperature at the preset output is regulated by control valve II (5). The specified temperature difference $(t_2 - t_1)$ °C is set by means of control valve I (3).

It is advisable to fit a water flow meter (6) into the cold feed to the circulator for preliminary setting of water flow rate and to allow spot checks to be made during tests.

5.4 Test conditions

5.4.1 The test conditions given in **5.4.2** to **5.4.7** shall apply except where otherwise specified in section 2.

5.4.2 The test rig and appliance shall be examined for gas and water soundness both before and after the tests and the results are deemed invalid unless the system is sound (see **7.1** and **7.2**).

5.4.3 The appliance shall be at room temperature at the start of each test unless otherwise stated.

5.4.4 The air heater shall be operated to give a temperature rise of 50 ± 5 °C.

5.4.5 During testing, the initial adjustment of the appliance shall not be altered.

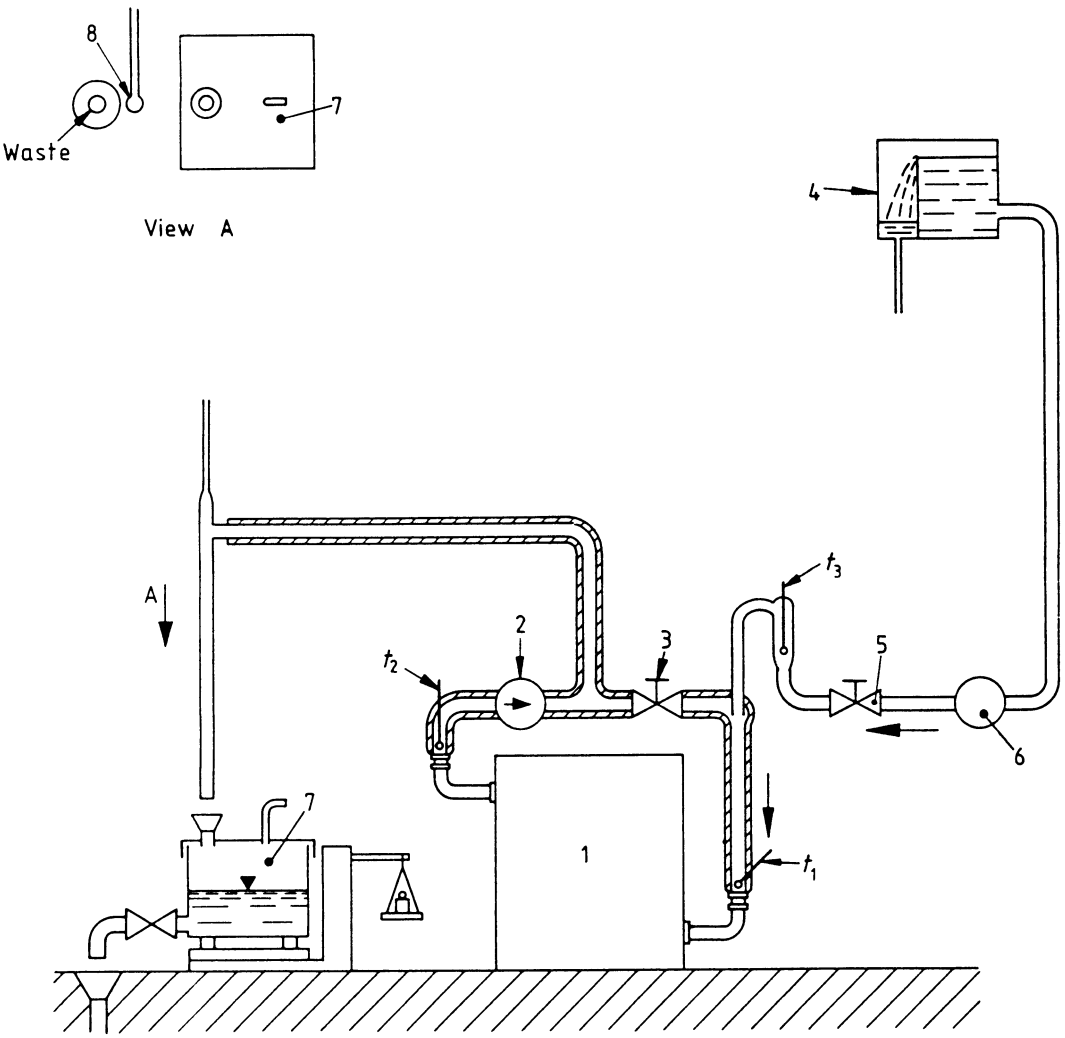
5.4.6 Precautions shall be taken to prevent thermostats or other variable controls from acting to interfere with the gas flow, except as necessitated by the test.

NOTE 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 adjustment of the gas pressure at the inlet to the appliance.

5.4.7 Test pressures shall be measured correct to 0.2 mbar and controlled so that the variation does not exceed ± 0.2 mbar.

NOTE 1 BS 4947 gives guidance on the measurement of heat input rate.

NOTE 2 The test gases (and, where appropriate, their conditions of application) to be used are specified in relevant clauses of section 2. For 3rd family appliances, test gases LPGA and LPGB are used with the appliance adjusted for butane and test gases LPGC and LPGE with the appliance adjusted for propane. For appliances designed to burn butane, the 3rd family reference test gas is LPGA; for appliances designed to burn propane, but not butane, the 3rd family reference test gas is LPGC.



1. Appliance under test
2. Circulating pump
3. Control valve I
4. Raised tank with constant head
5. Control valve II
6. Water flow meter
7. Weighing tank
8. Swinging arm

t_1, t_2 and t_3 are the temperatures taken at the points shown.

Figure 1 — Test rig: water side

Section 2. Safety requirements and associated methods of test

6 General design and construction

6.1 Materials, fittings and finishes

Materials, fittings and finishes, the failure of which may affect the safe operation of the appliance, shall comply with the relevant British Standards and shall be appropriate to the conditions arising in the part of the appliance in which they are used. The appliance shall be free from swarf, grit or other foreign matter.

The appliance shall be free from sharp edges that are liable to damage clothing or cause injuries.

Asbestos-containing materials shall not be used.

6.2 Component location

Parts that are intended to be removable by the user, e.g. for cleaning, shall be readily accessible, shall not require the use of tools for their removal, shall be easy to assemble correctly and difficult to assemble incorrectly.

Mechanical means shall be provided to secure the circulator firmly to the air heater.

The burners shall be positively located and so arranged that they cannot be misaligned.

It shall not be possible to loosen complete burner assemblies, jets or injectors without the use of tools.

For an appliance where the fitting of a circulator is optional, it shall be possible to fit the circulator and its flueways to the air heater without having to remove the latter from the installed position and without having to carry out any alteration work on the air heater, other than punching through knock-outs etc. in the casing and any alterations necessary to connect the gas supply to the circulator.

6.3 Materials in contact with gas

6.3.1 *Copper tubing.* Copper tubing shall not be used where it would be exposed to temperatures above 100 °C.

6.3.2 *Jointing compounds.* Jointing compounds shall comply with BS 5292.

6.3.3 *Unions and flanges.* Unions in gas lines shall be of the cone or spherical seated type. Flange joints shall include a gasket or "O" ring seal resistant to the action of components of the gas and suitable for the temperature to which it is likely to be exposed.

6.4 Bolts and screws

Drillings for bolts and screws shall not connect with fuel gasways or waterways. The minimum residual wall thickness shall be at least 1 mm.

Where self-tapping screws are used to secure components that are removed during servicing, they shall engage into spring steel fasteners.

6.5 Aeration adjustment

There shall be no means of adjusting the primary aeration of Category I_T or Category I_N appliances. For other categories, the means of adjusting the primary aeration shall be preset and locked by the manufacturer.

6.6 Insulation

Thermal or acoustic insulation shall be non-combustible (see BS 476-4), securely located and protected against mechanical damage and the effects of condensate.

6.7 Deposits from appliance

Appliances that give rise to either liquid or solid deposits shall be provided with effective means of collecting and retaining such deposits. Any deposits shall be easily removable.

6.8 Fans

The direction of rotation of fans shall be clearly marked.

Any belt drive in normal operation shall present no hazard. Means shall be provided to adjust belt tension.

Products of combustion shall not be drawn into the air distribution system under normal operating conditions or when user access panels are removed.

If it is necessary to remove a panel in order to light the pilot, the removal of the panel shall not provide access to the compartment housing the air-circulating fan.

Access to the compartment housing the air-circulating fan for maintenance shall not be possible without the use of tools.

All tests for temperature rise as required by BS 3456-101 shall be carried out with the appliance at thermal equilibrium when operated at rated heat input on reference test gas and also immediately after the appliance has been switched off.

6.9 Air filters

Provision shall be made for the fitting of an air filter. The filter shall be of either the cleanable or renewable type and shall be capable of easy and safe removal and replacement.

Air filter material shall possess ignitability characteristics designated P tested in accordance with BS 476-5.

6.10 Lint resistance of type B appliances

6.10.1 *General.* An appliance fitted with aerated burners and/or aerated pilots shall comply with **6.10.2** to **6.10.5**. For the purposes of **6.10.1** to **6.10.5** 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 inlets.** Any opening(s) in the appliance casing for the supply of combustion air.

6.10.2 *Ignition.* After the appliance has been tested in accordance with **6.10.3** and Appendix A, the appliance shall comply with **10.2.1**.

6.10.3 ***Combustion***

6.10.3.1 For type approval purposes, when the appliance is tested as described in Appendix A the CO/CO_2 ratios shall not exceed those specified in **6.10.3.2** and **6.10.3.3**.

For a production appliance the requirements of **6.10.3.2** and **6.10.3.3** are deemed to be satisfied provided that the dimensions and/or specification of the lint arrester system are in accordance with drawings which shall be supplied to the test authority.

6.10.3.2 At a lint concentration where the measured change in pressure differential is that given by curve A in Figure 2 for the appropriate height of the air inlet above the floor, the CO/CO_2 ratio shall be not greater than the larger of the following:

a) the CO/CO_2 ratio that would be obtained at 110 % rated heat input in the absence of lint;

b) 0.004 plus the CO/CO_2 ratio at rated input in the absence of lint.

6.10.3.3 At a lint concentration where the measured change in pressure differential is that given by curve B in Figure 2 for the appropriate height of the air inlet above the floor, the CO/CO_2 ratio shall not exceed 0.02.

6.10.3.4 For the purposes of **6.10.3.2** and **6.10.3.3**, the height of the air inlet above the floor shall be as measured from the lowest edge of the air inlet to the floor. For wall mounted appliances, the measurement shall be that when the appliance is fitted at the minimum height permitted by the installation instructions.

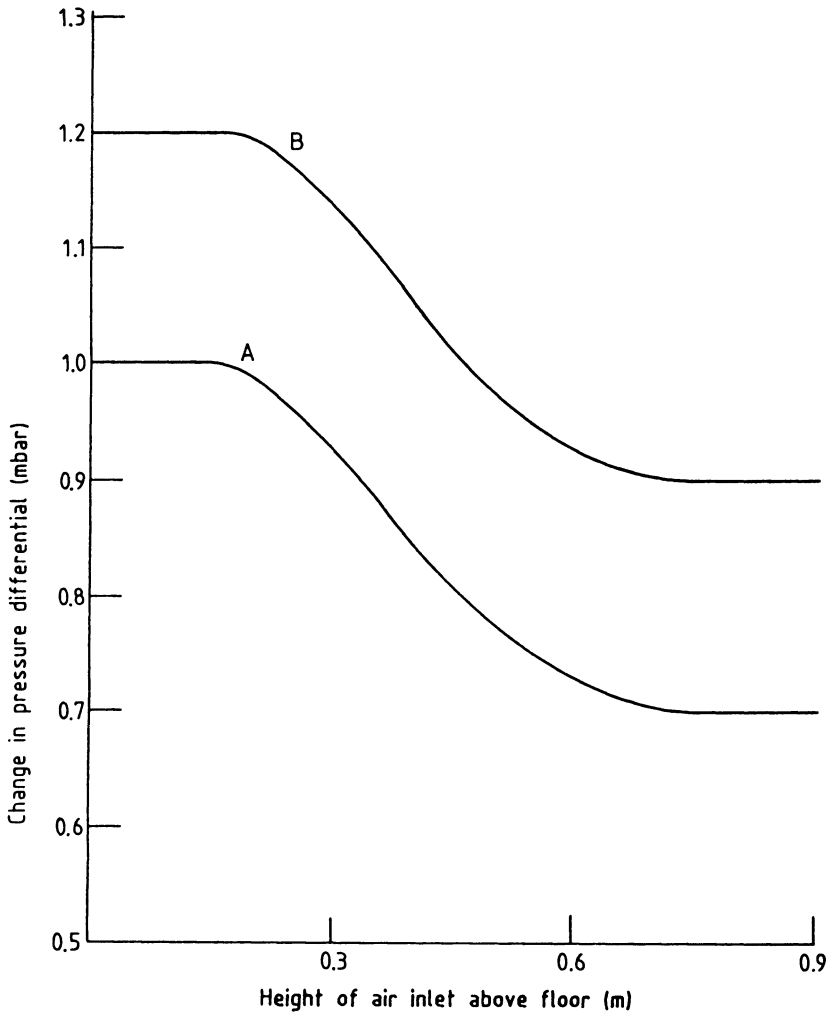
6.10.4 ***Cleanability***

6.10.4.1 The manufacturer shall provide instructions for the cleaning of the complete appliance.

6.10.4.2 Where box-type burners are employed that are not capable of being opened using standard tools, or are not otherwise accessible for internal cleaning, the combustion ratio at the end of the second linting test, as described in **A.4.9**, shall be not more than 0.004 above the combustion ratio obtained at the end of the first linting test, subject to a maximum permissible combustion ratio of 0.02.

6.10.4.3 A burner that is not capable of being opened shall not exhibit any appreciable accumulation of lint, on examination in accordance with **A.4.9**.

6.10.5 *Pilot performance.* After the appliance has been tested in accordance with **6.10.3** and Appendix A, any aerated pilot shall comply with **11.2**.



NOTE See **A.4.3**.

Figure 2 — Pressure differential criteria to be applied according to the height of the appliance air inlet

7 Soundness

7.1 Gas soundness

7.1.1 *General.* All gas-carrying parts of the combined appliance shall be sound and, when connected, shall form a complete assembly that is sound.

NOTE Additional and more stringent tests may be required by other standards for certain components to ensure an adequate margin of safety.

7.1.2 ***Complete assembly***

7.1.2.1 *Requirement.* When tested as described in **7.1.2.2**, the fully assembled appliance shall be sound at the following internal air pressure.

Family	Air pressure
	mbar
1st	50
2nd	50
3rd	150

Where the appliance is for use on more than one gas family, one of which is 3rd family, the test pressure shall be 150 mbar.

This requirement shall be deemed to be met if the leakage rate does not exceed 130 cm^3/h over a period of 1 min.

NOTE One convenient method of measuring the leakage rate is by the bubble leak indicator shown in Figure 3. A rate of nine bubbles per minute should be equivalent to 130 cm^3/h but this should be checked before the indicator is used.

7.1.2.2 *Method.* Connect to the appliance inlet an air supply maintained constant at the appropriate pressure and embodying a suitable meter for measuring air flow.

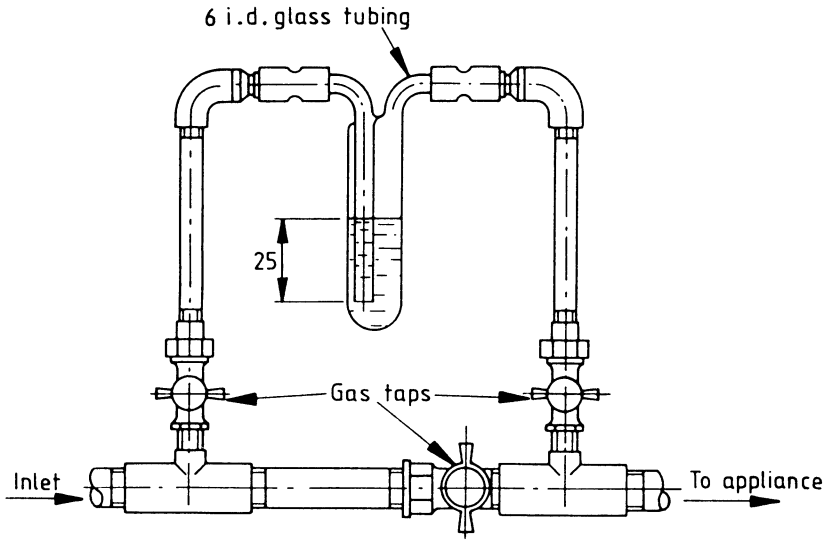
Test the appliance under the following conditions:

a) with all gas taps in the OFF position;

b) with all gas taps turned to the ON position, the flame supervision device being maintained by suitable means in the open position and all injectors and pilots capped off;

c) with all controls in the open position, except that control which in normal operation opens and closes the gas supply, and with pilots capped off.

Ensure that any means (e.g. thermal or mechanical) used to maintain the flame supervision device in the open position is compatible with the normal operation of the device.



All dimensions are in millimetres.

Figure 3 — Bubble leak indicator

7.2 Water soundness

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

When tested over a 1 min period at a water pressure 50 % greater than the stated maximum pressure, the appliance shall not leak or show any sign of permanent distortion.

7.3 Room sealing: type C appliances

NOTE All joints should be designed to make an effective seal without the use of any sealing compound.

7.3.1 *Joints.* Joints that need to be broken for servicing or maintenance shall be made without the use of a sealing compound, e.g. glues and pastes.

Where sealing compounds are required in fixed joints, the joint shall be such that the compound remains permanently in place.

7.3.2 *Lighting door.* Any lighting door shall be easy to close or replace to form a seal.

7.3.3 ***Soundness of combustion system***

7.3.3.1 *Requirement.* The leakage rate shall not exceed the following values according to the rated heat input of the appliance when the combustion chamber, together with any inlet and outlet ducts, is subjected to an air pressure of 1.25 mbar and tested by the method described in **7.3.3.2**.

Rated heat input	Leakage rate
kW	m^3/h
Up to 35	0.4 per kW of rated heat input (gross calorific value)
Greater than 35	14

7.3.3.2 *Method.* Assemble the appliance according to the manufacturer's instructions.

Seal the terminal, close any lighting door and stop the gas inlet to the pilot and main burner. Pass air into the appliance and note the air flow rate when the pressure inside the appliance is steady at 1.25 mbar.

A convenient method of testing the appliance is to enclose the terminal (or duct ends for type C_2 appliances) in a plastics bag into which an air entry pipe and a tube connected to a pressure gauge can be fitted.

7.4 Heat exchanger leakage (air heater)

For the purposes of this clause the heat exchanger shall be defined as the combustion chamber and heat exchanger assembly as far as its connection to any additional primary flue.

The leakage rate shall not exceed 0.05 m^3/h per kW of the heat input of the appliance when the cold heat exchanger, with its purpose-made openings sealed, is subjected to an internal air pressure of 2.0 mbar.

8 Heat input

8.1 Definition and conditions of measurement

For the purposes of **8.1** to **8.4**, the heat input is that which would be obtained with a reference gas of the following Wobbe number.

Family	Test gas	Wobbe number[a]
		MJ/m^3
1st	TGA(4) TGA (5)	27.6 25.2
2nd	NGA	50.8
3rd	LPGA LPGC	87.5 77.0

[a] The reference conditions are 1013.25 mbar, 15 °C, dry.

The heat input shall be measured with the appliance at thermal equilibrium and in its normal operating condition.

8.2 Tolerance

The heat input of each unit of the appliance operating on its own shall be within ± 5 % of its rated heat input at the manufacturer's recommended setting pressure, with the following pressure applied to the inlet of the appliance.

Family	Test gas	Inlet pressure
		mbar
1st	TGA	17.5
2nd	NGA	20
3rd	LPGA LPGC	28 37

Under the same inlet pressure conditions it shall be possible to obtain the manufacturer's recommended setting pressure(s) when both units are operating in combination.

8.3 Adjustment

8.3.1 *General.* Any gas rate adjuster provided shall not be liable to inadvertent movement.

8.3.2 *1st and 2nd family gases.* If any means of adjustment to the heat input of the appliance is provided, it shall be designed to discourage unauthorized interference with the adjusted mechanism.

NOTE Suitable means of sealing the adjusting mechanism include lock-nuts, locking wire with seal, a cover screw with a screwdriver slot or any means that requires the use of tools to gain access to the adjusting mechanism.

8.3.3 *3rd family gases.* Gas rate adjusters shall be set and sealed by the manufacturer in such a way that any subsequent interference is evident.

8.4 Limits of adjustment

With the appliance restrictor/governor adjustment set to give the maximum gas rate available without the breaking of a manufacturer's seal and under the conditions shown in the following table, the CO/CO_2 ratio shall not exceed 0.02.

Family	Test gas	Inlet pressure
		mbar
1st	TGA	17.5
2nd	NGA	20
3rd	LPGA	28
	LPGC	37

9 Combustion

9.1 Requirement

When tested in accordance with **9.2** under the conditions described in **9.3** and **9.4**, the CO/CO_2 ratio shall not exceed 0.02. When tested in combination, each unit of the appliance shall comply with this requirement.

NOTE For the purposes of this Part of this standard, the carbon dioxide and carbon monoxide contents of the products of combustion should be determined with respective accuracies of 0.05 % and 0.001 % of the volume of the dried sample. The concentrations of the two gases can be determined conveniently with adequate accuracy by a variety of methods (see BS 1756) and the ratio is not appreciably affected by dilution of the products of combustion during sampling.

9.2 Method

Set up the appliance as described in **5.3**.

Adjust the water side test rig to give the following water temperatures when the appliance is operated at the rated heat input. The settings of the water valves shall not be altered for tests at other heat inputs. t_2 shall be 60 ± 2 °C and $(t_2 - t_1)$ shall be 30 ± 2 °C.

Carry out tests at a sufficient number of heat input rates to determine the combustion performance over the whole of the prescribed range. No extrapolation shall be made.

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

9.3 Still air conditions (all appliances)

The units of the appliance are operated, under still air conditions, each on its own and in combination, over the following range of inputs and pressures.

Family	Test gas	Conditions
1st	TGA	Minimum operational rate to 115 % of rated heat input
	TGB	Adjustment pressure
2nd	NGA	Minimum operational rate to 115 % of rated heat input
	NGB	Adjustment pressure
3rd	LPGA	Minimum operational rate to 112 % of rated heat input
	LPGC	Minimum operational rate to 110 % of rated heat input

If it is likely that any temporary distortion observed during the water soundness tests described in **7.2** will affect the combustion performance of the circulator, additional combustion tests shall be carried out at the maximum distortion of the heat exchanger obtained within the manufacturer's working pressure range.

9.4 Adverse flue conditions

9.4.1 *General.* For type approval purposes combustion tests shall be carried out in accordance with **9.4.2**, **9.4.3** or **9.4.4**, as appropriate.

Along with the type approval sample, the manufacturer shall supply to the test authority drawings of the following:

a) draught diverter for type B appliances;

b) terminal box for type C_1 appliances; or

c) flue connection box for type C_2 appliances.

The combustion requirements of production appliances under adverse flue conditions shall be deemed to be met provided that the dimensions of the above items are within the tolerances given, but in cases of dispute the appliances shall comply with the requirements of **9.4.2**, **9.4.3** or **9.4.4** respectively.

9.4.2 ***Type B appliances***

9.4.2.1 *Secondary flue blocked.* The units of the appliance are operated on their own and in combination, with the appropriate reference test gas at adjustment pressure and with the outlet from the secondary flue blocked.

9.4.2.2 *Secondary flue with down-draught.* For this test the appliance is fitted with a secondary flue, which shall be the same nominal diameter as the flue connection and shall be straight for a length not less than 10 diameters immediately above the draught diverter. The units of the appliance are operated on their own and in combination with the appropriate reference test gas at adjustment pressure and with a down-draught of up to 3 m/s through the secondary flue.

NOTE It is suggested that tests are made at increments of 0.5 m/s down-draught. Closer increments may be necessary to investigate a critical region.

Compliance with the requirements of **12.2.1.2** shall be checked during this test.

9.4.3 *Type C_1 appliances: wind conditions.* The units of the appliance are operated on their own and in combination with the appropriate reference test gas at adjustment pressure and with the wind speeds and directions specified in the test method.

Compliance with the requirements of **11.3.2** and **12.2.2** shall be checked during this test.

9.4.3.1 *Method.* Using the apparatus described in Appendix B, subject the terminal to winds of speeds from 2.5 m/s to 12.5 m/s at 2.5 m/s increments. Apply the winds at directions between ± 90° in the horizontal plane and ± 45° in the vertical plane, both at 15° increments.

9.4.4 *Type C_2 appliances: vitiated conditions.* The units of the appliance are operated on their own and in combination under the following conditions of vitiation and upward flow in the duct. Compliance with the requirements of **10.4**, **11.3.3** and **12.2.3** shall be checked during this test.

Family	Test gas	Conditions	Extent of vitiation	Duct air velocity
			% CO_2	m/s
1st	TGA	Adjustment pressure	1 2	4.5 2.0
2nd	NGA	Adjustment pressure	0.75 1.6	4.5 2.0

9.4.4.1 *Method.* Using the apparatus described in Appendix C with dampers E and F shut, start the fan and control the rate and vitiation in the system by means of dampers A, B, C and D to obtain the required conditions ± 10 %. Control the proportion of fresh to recirculated air by combinations of adjustments to dampers A, B and C; damper D provides an overriding flow rate control. Allow the appliance to be alight for at least 15 min before sampling. Draw off the samples of inlet air and products in quick succession, analyse and calculate the CO/CO_2 ratio as follows:

$$\frac{\text{Percentage of CO in outlet} - \text{Percentage of CO in inlet}}{\text{Percentage of } CO_2 \text{ in outlet} - \text{Percentage of } CO_2 \text{ in inlet}}$$

10 Ignition

10.1 Ease of ignition

10.1.1 *Type B appliances.* It shall be possible to light the appliance when cold from an easily accessible position, and to determine readily that the pilot of each unit of the appliance, or main burner if there is no pilot, is alight.

NOTE In the event of failure of the ignition device it is preferable that the appliance can still be lit with a match.

10.1.2 *Type C appliances.* It shall be possible to light the appliance when cold from an easily accessible position by means of an electrical or other convenient ignition device incorporated in the appliance. It shall be possible to determine readily that the pilot of each unit of the appliance, or main burner if there is no pilot, is alight.

10.1.3 *Spark ignition.* Where appliances incorporate spark ignition, 10 attempts shall be made to ignite the burner (or pilot), of which 9 shall be successful. For piezoelectric spark ignition devices, the electrodes shall be shorted after each attempt.

10.2 Main burner ignition

10.2.1 *Still air conditions*

10.2.1.1 *Requirement.* When tested as described in **10.2.1.2** under the following conditions, ignition of the main burner shall be smooth and the flame shall carry over to all ports or jets with the appliance hot and cold.

Family	Test gas	Conditions
1st	TGA, TGB, TGC, TGD	Adjustment pressure
2nd	NGA, NGB, NGC, NGD	
3rd	LPGA, LPGB, LPGC, LPGE	

10.2.1.2 *Method.* Operate each unit of the appliance both when it is hot and when it is cold in accordance with the manufacturer's instructions under the test conditions given in **10.2.1.1**. Repeat these tests with the other unit in operation.

For a range-rated, modulating or high/low/off appliance repeat the tests with the appliance set at its low rate.

10.2.2 *Pilot reduction.* Using the appropriate reference test gas(es) at adjustment pressure, ignition shall be achieved without undue noise or flame roll out at all conditions that allow the flame supervision device to pass gas to the main burner.

Compliance shall be checked by verifying that ignition is satisfactory when the pilot is turned down to just below the minimum input flow required to hold open the flame supervision device, ensuring that any means, e.g. thermal or mechanical, used to maintain the flame supervision device in the open position is compatible with the normal operation of the device. The tests are carried out with each unit of the appliance operating on its own, and with the units operating in combination.

For the purposes of these tests any flame that actuates the flame supervision device shall be regarded as a pilot.

10.2.3 *Ignition at reduced inlet pressure.* With the appliance adjusted in accordance with **5.2**, ignition of the main burner of each unit shall occur without violence with the appliance hot or cold when the inlet pressure is reduced to the following value and the gas is ignited in accordance with the manufacturer's instructions. When the inlet pressure is progressively reduced below the following value, the gas supply to the main burner shall be shut off before ignition becomes violent.

NOTE A convenient method of carrying out the tests is to reduce the gas pressure at the appliance inlet by an externally fitted adjustable governor. A gas bleed is incorporated between this governor and the appliance to bleed off gas at a rate at least equal to the gas rate of the appliance under test.

Family	Test gas	Inlet pressure
		mbar
1st	TGA	3.7
2nd	NGA	12.5
3rd	LPGA	20
	LPGC	25

10.3 Supplementary requirements for type C_1 appliances

When the appliance is operated in accordance with the manufacturer's instructions using the test gas(es) and under the wind conditions specified in **9.4.3**, ignition of the main burner shall be smooth and the flame shall carry over to all ports or jets.

NOTE It is not necessary for the appliance to be cold at the start of each of these tests.

Compliance with **11.3.2** and **12.2.2** shall be checked during this test.

10.4 Supplementary requirements for type C_2 appliances

When the appliance is operated in accordance with the manufacturer's instructions, ignition of the main burner shall be smooth and the flame shall carry over to all ports or jets. Compliance shall be checked during the test specified in **9.4.4**.

11 Ignition system

11.1 General

Pilots and igniters shall be protected by design and position against diminution or extinction resulting from, for example, draughts, products of combustion, overheating, condensation, corrosion or matter falling from above. Pilots shall be protected against blockage by gas borne particulate matter.

Pilots, igniters and their mountings shall be so designed that they can only be located correctly in relation to every component with which they are designed to operate.

Where a main burner is protected by a flame supervision device, any pilot capable of holding open the flame supervision device shall also be capable of igniting the main burner. The pilot may consist of more than one flame; such a pilot shall be designed to ensure adequate cross-lighting between the flames.

The lighting instructions for the appliance shall state clearly that, if the pilot is extinguished either intentionally or unintentionally, no attempt should be made to relight the gas until at least 3 min have elapsed. This warning shall appear on the appliance in a permanent form.

For type C appliances, if any tap or equivalent device that is accessible to the user is turned off and then on again after 3 s, gas shall not flow (apart from the weep rate) to the main burner unless the pilot is alight.

NOTE For the purposes of this requirement, a service cock that may be left without easy means of turning off or on, e.g. a keyless cock, is not considered accessible to the user.

11.2 Pilot performance: still air conditions

11.2.1 *Requirement.* The pilot flame(s) shall ignite and shall not light-back, lift, or deposit soot, when tested as described in **11.2.2** over the following range of inlet pressure.

Family	Test gas	Inlet pressure range
		mbar
1st	TGA, TGB, TGC, TGD	3.7 to 25
2nd	NGA, NGB, NGC, NGD	12.5 to 27.5
3rd	LPGA, LPGB	20 to 35
	LPGC, LPGE	25 to 45

11.2.2 *Method.* Any appliance governor remains in circuit for these tests, any adjustable pilot having been previously adjusted at the following pressure in accordance with the manufacturer's instructions.

Family	Test gas	Inlet pressure
		mbar
1st	TGA	17.5
2nd	NGA	20
3rd	LPGA LPGC	28 37

The tests are carried out with each unit of the appliance operating on its own, and with the units operating in combination.

Check the performance of the pilot both without and with any burner (operating at full-on rate) that may have an adverse effect.

11.3 Pilot performance: abnormal flue draught conditions

11.3.1 *Type B appliances.* Under the conditions described in **9.4.2.1** and **9.4.2.2**, both with and without the main burner alight, the pilot flame(s) shall ignite and remain stable without light-back or lift. There shall be no nuisance shut-down through operation of the flame supervision device.

11.3.2 *Type C_1 appliances.* Under the conditions described in **9.4.3**, the pilot flame(s) shall ignite and remain stable. There shall be no nuisance shut-down through operation of the flame supervision device.

11.3.3 *Type C_2 appliances.* Under the conditions described in **9.4.4**, the pilot flame(s) shall ignite and remain stable. There shall be no nuisance shut-down through operation of the flame supervision device.

11.4 Pilot adjustment

Where provided, pilot gas rate adjusters shall not be liable to accidental alteration. They shall be set and, for 3rd family gases, sealed by the manufacturer in such a way that any subsequent interference is evident.

The length or shape of the pilot flame(s) when the appliance is operated on the reference gas shall be defined by the manufacturer either by dimensions or picture.

12 Flame stability

12.1 Still air conditions

12.1.1 *Requirement.* The main burner flames shall remain stable without lighting back to the injector(s) or lifting off when the appliance is tested in accordance with **12.1.2**.

12.1.2 *Method.* Adjust the appliance at thermal equilibrium on reference gas for the conditions in the following table. Substitute the appropriate test gas without further adjustments to the appliance or supply pressure and turn off the main burner. With the appliance in the cold condition, ignite the main burner and observe the flame until thermal equilibrium is reached. The tests are carried out with each unit of the appliance operating on its own, and with the units operating in combination.

Family	Test gas	Reference gas conditions
1st	TGC	Minimum operational rate to adjustment pressure
	TGD	Adjustment pressure
2nd	NGC	Minimum operational rate to adjustment pressure
	NGD	Adjustment pressure
3rd	LPGA, LPGB	Minimum operational rate to 112 % of rated heat input
	LPGC, LPGE	Minimum operational rate to 110 % of rated heat input

12.2 Abnormal draught conditions

12.2.1 *Type B appliances*

12.2.1.1 *Direct draught.* With a wind of 2 m/s blowing towards the burner from any direction in a horizontal plane there shall be no light-back, and no flame lift shall be exhibited over more than 10 % of any individual burner under the following conditions.

Family	Test gas	Conditions
1st	TGA	Minimum operational rate to adjustment pressure
2nd	NGA	
3rd	LPGA, LPGB LPGC, LPGD	

Under these conditions the pilot shall continue to function normally. The tests are carried out with each unit of the appliance operating on its own, and with the units operating in combination.

The outlet nozzle of the wind generator shall be 200 mm in diameter and at least 1 m from the appliance. The wind speed shall be measured 500 mm from the appliance.

12.2.1.2 *Secondary flue with down-draught.* When tested under the conditions described in **9.4.2.2**, there shall be no light-back and no lift.

12.2.2 *Type C_1 appliances.* During the test specified in **9.4.3**, the main burner flames shall not be extinguished.

12.2.3 *Type C_2 appliances.* During the test specified in **9.4.4**, the flames shall not be increased in length.

13 Sooting

The sooting propensity of the circulator shall be checked during the test described in **9.3**.

The sooting propensity of the air heater shall be checked during the test specified in clause **16**.

14 Flue system

14.1 Type B appliances

14.1.1 *Flue outlet and connections.* The flue outlet of the appliance shall be suitable for connection to round flue pipe complying with BS 715 or BS 567 or BS 835. The flue outlet shall either have a minimum depth of 15 mm and be of the socket type or be designed to prevent condensation from running down the outside of the appliance.

14.1.2 *Draught diverter.* Means shall be incorporated in or provided with the appliance to protect it from up draughts and from down draughts. Such means shall comply with the following requirements and those contained in **9.4.2**.

All the products of combustion shall pass through the secondary flue when the appliance is operated using the appropriate reference test gas at adjustment pressure at thermal equilibrium while connected to a 1 m vertical secondary flue of the same nominal diameter or equivalent area as the flue outlet from the appliance.

The tests are carried out with each unit of the appliance operating on its own, and with the units operating in combination.

NOTE A suggested method of spillage detection is by sampling for carbon dioxide at the skirt of the draught diverter. An increase in the carbon dioxide concentration above ambient of more than 0.05 % is to be regarded as unsatisfactory. Any instrument used has to be sensitive to a concentration of 0.01 % carbon dioxide.

14.2 Type C_1 appliances

14.2.1 *Flue terminal and ducts.* The terminal and any necessary ducts shall be supplied by the manufacturer.

The terminal shall be designed to prevent the penetration of rain or snow to the appliance or to the fabric of the building. Any opening in the terminal shall not permit the entry of a ball of 16 mm diameter when applied with a force of 5 N (to ensure against the entry of birds). If the terminal performance is dependent on a chamber within the wall, a chamber lining shall be provided with the appliance.

Any condensate formed on operating the appliance when cold shall be either retained and subsequently re-evaporated or discharged clear of the wall.

14.2.2 ***Terminal guards***

14.2.2.1 The manufacturer shall specify a protective guard, for use as required by the Building Regulations, that complies with **14.2.2.2** to **14.2.2.6**.

14.2.2.2 The appliance installation instructions shall specify how the guard shall be fixed and its location relative to the terminal.

14.2.2.3 The dimensions of the guard shall be such that, when fitted in accordance with the manufacturer's instructions, no part of the guard is less than 50 mm from any part of the terminal, not including the wall plate.

14.2.2.4 The guard shall not have any sharp edges likely to cause injury nor shall any opening permit the entry of a ball of 16 mm diameter when applied with a force of 5 N.

14.2.2.5 The material finish and mechanical strength of the guard shall be such as to ensure a reasonable life in normal working conditions.

14.2.2.6 The guard shall not affect the performance of the appliance.

14.3 Type C_2 appliances: ducts

Any ducts required for connecting the appliance to the Se-duct shall be specified by the manufacturer who shall also be prepared to supply them.

The connecting ducts shall be of sufficient length to pass through the wall and cladding of the Se-duct, the termination point in the Se-duct being in accordance with the manufacturer's instructions.

15 Fire hazard and limiting temperatures

15.1 Temperature of adjacent surfaces

15.1.1 *Requirements.* When installed in accordance with the manufacturer's minimum recommended clearances and tested as described in **15.1.2** the appliance shall not cause the floor, wall or ceiling temperatures to rise by more than 60 °C.

15.1.2 ***Methods***

15.1.2.1 *Apparatus*

15.1.2.1.1 *Wooden floor* with detachable side and back walls as shown in Figure 4. The floor is 50 mm thick and consists of a lower layer of pine board and an upper layer of hardwood, both 25 mm thick, with a sheet of building paper between them. The hardwood is preferably oak, but any wood or board having a thermal conductivity of 0.16 W/m·K is acceptable. It is finished in clear varnish. The side and back walls are both of 25 mm pine, painted dull black.

Thermocouples are normally embedded in each panel at 150 mm centres, but for areas susceptible to high temperature, e.g. the area adjacent to flue outlets, at 50 mm centres. The thermocouples enter the panel on the side remote from the appliance, the junctions being fixed 3 mm from the surface of the wood adjacent to the appliance. They are conveniently inserted in holes of diameter 8 mm with the thermocouple junctions bent at right angles and sealed in position with an insulating cement.

NOTE 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 the thermojunction is measured by a suitable instrument, preferably a potentiometer. General guidance on thermocouples and their circuitry may be found in BS 1041-4.

The woodwork is thoroughly dried out, either by previous tests or by heating for 24 h with an appliance in position and operating at a suitable gas rate.

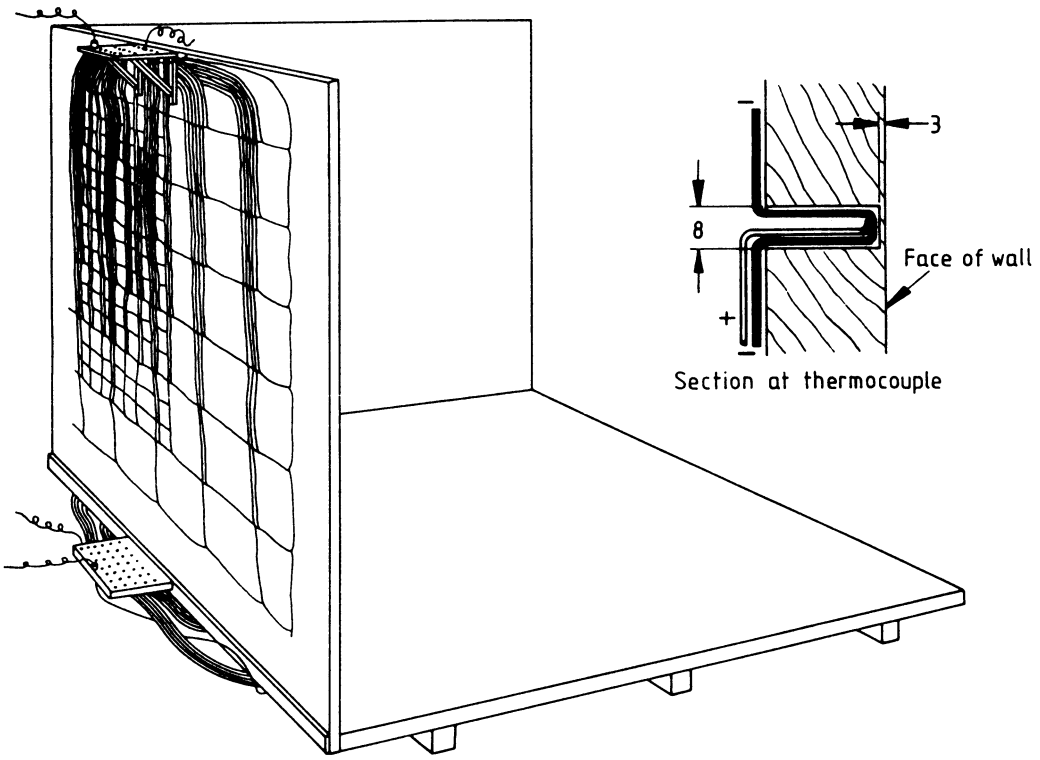
15.1.2.2 *Procedure.* Fit the appliance to the apparatus in accordance with the manufacturer's instructions using recommended minimum clearances (see **5.2.1**).

Operate the appliance at rated heat input using the appropriate reference test gas(es) at adjustment pressure.

Adjust the air rate by restricting the outlet so that the limit control operates, and adjust the water rate to give the manufacturer's stated maximum flow temperature with the manufacturer's recommended flow through the circulator.

Allow the air heater to cycle under the control of the limit switch until maximum temperatures of all adjacent surfaces are reached. Take temperature readings, in accordance with BS 1041-4, at the thermocouple junctions most affected by the heat of the appliance. Determine the temperature rise in degrees Celsius above room temperature.

For the measurement of ceiling temperature for wall-mounted appliances or of wall temperature for slot-fit appliances, the standard apparatus may be adapted.



All dimensions are in millimetres.

Figure 4 — Apparatus for measuring floor and wall temperatures

15.2 Surface temperatures

When the appliance is operated as described in **15.1**, the temperature rise of the parts listed below shall not exceed the figures specified.

Parts of the appliance	Temperature rise
	°C
Handles, knobs, grips and the like that in normal use are held for short periods only:	
of bare metal	35
of porcelain or vitreous material	45
of plastics, rubber or wood	60
Parts that are likely to be touched accidentally (excluding working surfaces) (see note):	
of bare metal	80
of vitreous enamelled steel or painted metal or similar surfaces	95
of plastics, rubber or wood	100

NOTE Working surfaces include external primary flues and draught diverters.

15.3 Component temperatures

When the appliance is installed in accordance with the manufacturer's limiting conditions and operated as described in **15.1**, the temperature rise of any component, when added to 25 °C, shall not exceed the maximum temperature specified by the component manufacturer. The temperature of components incorporating leather diaphragms shall not exceed 60 °C.

16 Prolonged performance test

16.1 Complete appliance (air heater)

16.1.1 *Requirements.* For type approval purposes only, the appliance shall be tested in accordance with the method given in **16.1.2** after which it shall comply with the following requirements.

a) The heat input measured under equilibrium conditions shall not have changed by more than 10 % from its initial value.

b) The CO/CO_2 ratio shall not exceed 0.02 under the still air conditions specified in **9.3**.

c) There shall be no sooting or appreciable distortion or disturbance of the flames.

d) There shall be no signs of leakage of combustion products from the combustion chamber, flue connections, etc.

e) There shall be no signs of corrosion.

f) There shall be no breakdown or distortion in any part of the appliance that could affect its safety.

g) There shall be no breakdown or failure of electrical equipment and fans.

16.1.2 *Method.* Install the appliance in a draught-free position representative of typical installed situations, e.g. with adjacent wall. Adjust the gas rate of the appropriate test gas to give the following conditions and operate the appliance at the manufacturer's recommended fan speed and temperature rise.

Family	Test	Conditions
1st	TGA	115 % of rated heat input
2nd	NGA	115 % of rated heat input
3rd	LPGA	112 % of rated heat input
	LPGC	110 % of rated heat input

For type B appliances, subject the flue to the minimum suction required for the complete passing of products on first lighting.

Successively light and extinguish the main burner to give 200 cycles each of 30 min on and 1 h off.

16.2 Heat exchanger (air heater)

16.2.1 *Requirements.* For type approval purposes only, either:

a) the appliance shall be tested in accordance with the method given in **16.2.2** in order to assess the prolonged performance of the heat exchanger elements, particularly those of the clam-shell type: or

b) if the physical form of the heat exchanger or the type of controls adopted make such a test inappropriate, an equivalent test shall be devised and agreed between the manufacturer and the test authority.

At the completion of the test specified in **16.2.2**, the heat exchanger shall comply with the requirements of **7.4**. In addition, if the heat exchanger has any slit, opening or perforation visible to the naked eye, it shall be deemed to have failed the test. Surface deterioration or defects shall be ignored.

16.2.2 *Method.* Examine the heat exchanger elements carefully. Eliminate, as far as possible, manufacturing abnormalities, e.g. tool damage, poor welding, careless assembly etc.; any remaining abnormalities will not be considered in the assessment of the test.

Take any necessary action to safeguard any other components that may be adversely affected during the test and to avoid abnormal deleterious effects on the heat exchanger.

Install the appliance on a test rig equipped with inlet and outlet air ducts sized to suit the output rating of the appliance.

Disconnect the limit control and overheat cut-off devices. Use the appropriate test gas and conditions as follows.

Family	Test gas	Conditions
1st	TGA	111 % of rated heat input
2nd	NGA	111 % of rated heat input
3rd	LPGA	112 % of rated heat input
	LPGC	110 % of rated heat input

Rearrange the control system with a timing device to give a cycle of gas-on-with-fan-off for 3.5 min followed by gas-off-with-fan-on for 3.5 min.

At the end of the gas-off-with-fan-on period check that the outlet air temperature has dropped to below 50 °C when the ambient air temperature does not exceeed 20 °C.

Inspect the heat exchanger for failure at least every 2 000 cycles until 10 000 cycles have been completed.

NOTE If for category II and category III appliances it can be agreed between the manufacturer and the test authority which of the test gases will produce the most onerous test conditions, 10 000 cycles using that gas only will be sufficient.

When inspecting the heat exchanger, operate the appliance with both fan and gas on together and check that the burner operates correctly. Visually examine the heat exchanger in situ using a mirror and inspection lamp.

On completion of 10 000 cycles, carefully dismantle the heat exchanger from the appliance and examine it for slits, openings and perforations.

17 Manual controls

17.1 Application

The appliance shall be provided with such gas taps, push-buttons or electric switches as are essential for normal operation of the appliance by the user.

The appliance shall be fitted with a gas tap or taps, or equivalent devices, accessible to the user, to enable the gas supply to the pilot and main burner to be turned on and off.

Means shall be provided for cutting off the main gas supply, leaving any pilot in normal operation.

NOTE 1 This facility may be provided by means of a gas tap or by a valve actuated by a room thermostat, time clock, etc.

The manufacturer shall provide a keyless service cock(s), accessible to the fitter, to enable the gas supply to each unit to be shut off for servicing.

NOTE 2 It is preferable that the service cock(s) be incorporated as integrally-designed parts of the appliance; they need not then be keyless if they are not accessible to the user.

17.2 General

Any gas cock or tap or equivalent device shall be designed, identified or positioned to avoid inadvertent operation but shall be easy to operate when required. The OFF and ON positions of the device shall be easily distinguishable.

A gas cock or tap used for the purpose of OFF/ON operation shall be provided with a positive stop at the OFF and full ON positions.

Any cock or tap shall be easy to operate with the appliance at its highest working temperature and shall be sound at that temperature.

17.3 Tap design

Any gas tap shall comply with BS 5494 and have the following operating parameters:

a) a working temperature that is the maximum temperature measured under the conditions given in **15.1**;

b) a nominal flow rate that is the gas flow rate corresponding to the rated heat input measured as described in clause **8**;

c) a service suitability number of 1.

17.4 Tap handles

It shall not be possible to replace the tap handle other than in the correct position.

Tap handles shall have a minimum length of positive engagement of 6 mm with the "D" section or other engagement of the spindle. This engagement shall not depend solely upon a spring clip used for retaining purposes.

For taps that operate by rotation, the tap handles shall withstand a torque of 3 N·m without damage, the torque being applied with any spring-retaining clip removed or, for taps that operate other than by rotation, the tap handles shall withstand a force of 150 N without damage unless, in the event of breakage, there is a means of shutting-off the tap.

17.5 Multifunctional controls

Multifunctional controls shall comply with BS 6067[2)].

The torque required to operate the spindle shall not exceed 0.017 N·m per millimetre of effective knob diameter.

18 Automatic controls

18.1 Multifunctional controls

Multifunctional controls shall comply with BS 6067[2)].

18.2 Governors

18.2.1 An appliance burning 1st family gases shall include a gas governor.

18.2.2 For an appliance burning 2nd family gases the use of a gas governor is optional.

[2)] BS 6067 is being amended to cover 1st family gas.

18.2.3 An appliance burning 3rd family gases shall not include an operational governor.

18.2.4 Any constant pressure governor on appliances burning 1st and 2nd family gases shall comply with the relevant requirements of BS 6448-1 and shall be installed in a position suitable for its declared working conditions.

18.3 Flame supervision devices

18.3.1 Each unit of the appliance shall incorporate a flame supervision device.

18.3.2 The flame supervision device shall be arranged to shut off the main gas supply in the event of flame failure and, unless it is evident that pilot gas cannot cause a hazardous condition, the pilot gas supply shall also be shut off.

18.3.3 The flame supervision device shall be a thermocouple device or one of at least equivalent reliability. If it is a heat sensitive type it shall comply with BS 6047-1[3)].

18.3.4 Where the flame supervision device controls the weep line of a relay valve, the flame supervision device shall come first in the weep line.

18.3.5 A flame supervision device shall open fully from cold in not more than 40 s for the air heater and 90 s for the circulator. It shall cut off the main gas to the air heater within 60 s and that to the circulator within 90 s when the device is fully heated and the main burner is cold and hot. No device shall require more than 20 s of sustained manual operation before opening. The flame supervision device shall be designed to fail to safety.

18.3.6 The arrangement of the flame supervision device shall be such that it complies with **10.2.2** and **10.2.3**.

18.3.7 When the flame supervision valve is fully closed and all other valves fully open, the total gas passing, other than to the pilot where this is not protected, shall not exceed 3 dm^3/h at the following inlet pressure.:

Family	Test gas	Inlet Pressure
		mbar
1st	TGA	7.5
2nd	NGA	20
3rd	LPGA LPGC	28 37

18.3.8 When the flame supervision device is operated by rotating a spindle, the torque required for operation shall not exceed 0.017 N m per millimetre of effective knob diameter.

18.4 Valves

18.4.1 Any relay valve shall be installed in a position suitable for its declared working conditions and shall comply with BS 1963.

Weep pipe terminations shall be protected by design and position against blockage, for example, by products of combustion, overheating, condensation, corrosion or matter falling from above. They shall be rigidly located near a point of ignition.

Weep gas shall be burnt in the combustion chamber.

The weep gas rate shall not exceed 0.3 kW.

18.4.2 Electrically operated safety shut-off valves shall comply with BS 5963.

18.5 Control of temperature

18.5.1 *General requirements for thermostats.* Any thermostat shall comply with BS 800, BS 3955 and BS 4201.

18.5.2 ***Air heater***

18.5.2.1 *Limit control.* A limit control shall be provided to ensure that the mean temperature of the delivered air at the heater outlet measured over three cycles shall not exceed 95 °C when tested as described in **18.5.2.1.1**.

[3)] BS 6047-1 is being amended to cover 1st family gas.

18.5.2.1.1 *Method.* Mount the appliance in accordance with the manufacturer's instructions with the outlet air spigot fitted with ducting of the same shape and of length six times the major dimension of the outlet. Measure temperatures within the duct at a distance from the end of three times the major dimension of the outlet. The ambient air temperature in the vicinity of the air inlet shall remain within a band not more than 4 °C wide. Gradually introduce a restriction at the downstream end of the duct until the limit control cuts off the gas supply.

18.5.2.2 *Overheat cut-off device*

18.5.2.2.1 *Requirements.* An overheat cut-off device shall be provided to shut off the gas to the main burner in order to protect the appliance and the environment from an overheat condition.

A single control may combine the function of limit control and overheat cut-off device.

When an appliance is tested as described in **18.5.2.2.2** it shall comply with the following requirements.

a) The gas supply to the main burner shall be cut off to prevent:

1) a hazardous condition being reached;

2) any damage to the appliance;

3) the mean temperature of the air at the heater inlet or outlet exceeding 110 °C.

b) The overheat cut-off device, if separate from the limit control, shall not operate during the normal cyclic action of the heater, i.e. by room thermostat, clock control or by limit control.

c) Flame stability shall be satisfactory throughout the test.

18.5.2.2.2 *Method.* Mount the appliance in accordance with the manufacturer's instructions with the outlet air spigot fitted with ducting of the same shape and of length six times the major dimension of the outlet. Restrict the end of the duct to 10 % of the normal area. Disconnect the fan and make the limit thermostat inoperative unless it combines the function of overheat cut-off device. Start the appliance from cold at the rated heat input until the overheat cut-off device operates to cut off the gas to the main burner. Allow the appliance to cycle on the overheat cut-off device for sufficient time to ensure that the worst condition has been reached.

If the overheat cut-off device is of the manual reset type, operate the manual reset mechanism after the first cut-out, and after each minute of this and every subsequent cooling period, until the device causes reheat. If the overheat cut-off device is such that the replacement of a part is necessary to re-establish main gas, carry out the test once only.

18.5.3 ***Circulator***

18.5.3.1 *Control of water temperature under normal operating conditions.* Means shall be provided on, or with, the circulator for controlling the water temperature during normal running conditions such that the appliance water temperature shall not rise to such an extent as to cause:

a) any overheat cut-off device to operate;

b) damage to the appliance;

c) boiling.

If a control device is supplied separately with the circulator to form part of the installation, the instructions supplied with the appliance shall indicate clearly how it should be fitted and, where applicable, adjusted.

18.5.3.2 *Safety under abnormal conditions.* When the appliance is fitted in accordance with the manufacturer's instructions no hazardous condition or damage to the appliance shall occur as a result of:

a) failure of the normal means of water temperature control, or

b) cessation of circulation in the system, for example, due to blockage, closure of a valve or failure of a pump.

NOTE In many cases the open vent pipe will provide the necessary safeguard (but see **18.5.3.3**).

18.5.3.3 *Dual shut-off system.* A dual shut-off system shall be incorporated in any circulator which is designed to operate with a pump and which, when fitted according to the manufacturer's instructions, would sustain damage or create a hazardous condition when the burner is on and the pump is off.

The dual shut-off system shall have two gas valves in the main burner gas supply actuated by more than one sensor.

The system shall be arranged so that:

a) on failure of any sensor monitoring the temperature or other parameter of fluid being heated by the appliance, or

b) on failure of the gas valve(s) or control circuit associated with such a sensor, the main burner gas supply is cut off before a hazardous condition can occur.

18.6 Failure of gas or electricity supplies

The control system shall be so arranged that a hazardous condition cannot arise in the event of failure of the gas or electricity supplies or upon their subsequent restoration, nor shall any damage to the appliance occur. If the gas controls require manual resetting following interruption and subsequent restoration of the electricity supply, the manufacturer shall state this in the installation and user's instructions.

18.7 Clocks and timing devices

The failure of a clock or timing device shall in no way affect the safety of the appliance.

The operation of a manual override, if provided, shall not affect the safe operation of the appliance.

When a clock or timing device controlling the air heater is in an "OFF" period, there shall still be power available to the fan subject to the fan control.

Where an appliance is to be controlled by a plug-in type of motorized time switch, integrally fitted or mounted in the external control wiring of the appliance, the substitution of any alternative type of control that may be plugged into the socket in place of the specified control, shall not create a hazard. This requirement applies to motorized time switches supplied with the appliance and to those recommended by appliance manufacturers.

19 Electrical safety

NOTE Attention is drawn to the Electrical Equipment Safety Regulations.
This clause applies only to circuits intended for connection to the domestic electrical supply at voltages not exceeding 250 V of standard frequency 50 Hz single phase with a maximum rated current of 13 A. It does not apply to spark ignition or other circuits operating at high voltage.

19.1 General

The appliance and its electrical circuits and components shall comply with the appropriate requirements of BS 3456-101, BS 3955 and with **19.2**, **19.3** and **19.4**.

19.2 Supply voltage tolerance

The electrical circuits and components of the appliance shall function safely when the appliance is connected to a supply of 0.90 times the minimum rated voltage and of 1.10 times the maximum rated voltage.

19.3 Internal conductors

Solid or rigid internal conductors shall not be used where they are subject to vibration, repeated bending or undue strain.

19.4 Electrical motors

Any electrical motor shall comply with the requirements of BS 5000-11.

20 User's instructions

Instructions shall be clear and simple to follow and the terms acceptable in common usage. Whenever necessary, diagrams or photographs shall be used to augment the text.

Separate labels carrying instructions for lighting and for the safe use of the appliance shall be attached to each appliance in a permanent manner. They shall be easily legible and so sited as to be visible to the user at the point of lighting, preferably on the outer casing, though acceptably on the inside of a *hinged* door or panel. The labels shall not be on the inside of a panel that is completely removed for lighting access.

The instructions shall give information on the possible causes of safety device operation and on the action necessary to reset the controls.

The lighting instructions shall state clearly that, if the pilot light is extinguished either intentionally or unintentionally, no attempt shall be made to relight the gas until at least 3 min have elapsed. This warning shall appear on the appliance in a permanent form.

The instructions for safe use shall be printed red on a white background and worded as follows.

IMPORTANT

a) This air heater is installed in a ventilated area. DO NOT MAKE ANY ALTERATIONS likely to reduce the supply of fresh air to the heater without reference to the gas supplier or a competent installer.

b) DO NOT OBSTRUCT and DO KEEP CLEAN any air grilles on the heater or heater compartment, or any grilles or other ventilators in the walls, windows and doors of the building.

c) DO NOT PLACE anything (clothing, linen, etc.) touching, or so that it may fall on to, the heater or its flue pipe.

d) DO NOT USE the heater compartment for storage or airing.

e) DO NOT turn off the mains electricity supply to the air heater until the gas supply has been turned off.

f) DO CLEAN, and REPLACE correctly, the air filter (if fitted) at least once a month or in accordance with the manufacturer's instructions.

Instructions for lighting and the safe use of the appliance shall also be provided with each appliance. They shall be separate or easily separable from the installation instructions and from any servicing instructions. The instructions shall include the information given on the labels and shall include statements of the need for and the frequency of servicing which, by the Gas Safety (Installation and Use) Regulations has to be carried out by a competent person.

21 Installation and servicing

21.1 Installation, commissioning and servicing instructions

Installation and commissioning instructions shall be provided with each appliance.

Servicing instructions shall be made available by the manufacturer.

The names of the parts used in the instructions shall agree, wherever possible, with BS 1179:1967 and BS 1179-6. Wherever necessary, diagrams and/or photographs shall be used to augment the text.

The instructions shall take due account of the provisions of the relevant British Standard codes of practice, the Gas Safety (Installation and Use) Regulations, the Model Water Byelaws, the Building Regulations issued by the Department of the Environment and the Building Standards (Scotland) (Consolidation) Regulations issued by the Scottish Development Department.

The installation instructions shall include minimum clearances around the appliance. They shall describe how the appliance can be checked for clearance of products when it is installed, and, where applicable, they shall also include complete electrical installation instructions and a wiring diagram.

The servicing instructions shall indicate the frequency of servicing.

The procedure for removing or gaining access to parts or components to be serviced, together with the recommended service work and the associated procedures, shall be clearly defined.

The servicing instructions shall also include a short list of parts and part numbers of key functional items that the manufacturer considers may be required for replacement purposes.

For an appliance which can be sold without a circulator, detailed instructions shall be provided describing the method of fitting the circulator.

21.2 Access

It shall be possible to shut down or remove the circulator for servicing purposes and leave the air heater operational.

Components and controls affecting the safe operation of the appliance shall be accessible for servicing or adjustment.

Adjustments necessary to ensure the proper working of the appliance shall be possible without personal risk.

Where necessary, it shall be possible to clean the heat exchanger and combustion chamber of the appliance to ensure safe operation.

It shall be possible to carry out all necessary servicing of type C_2 appliances without removing those connections that are sealed to the main duct.

21.3 Gas and water connections

The gas and water connections of the appliance shall:

a) have a jointing thread specified in clause **5** of BS 21:1985, or

b) be suitable for direct connection to copper tube to BS 2871-1, or

c) be suitable for direct connection to copper capillary and compression fittings to BS 864-2.

NOTE These requirements are not intended to mean that the gas and water connections shall be made in the same way.

21.4 Pressure test points

A pressure test point shall be provided on each unit of the appliance for measurement of the gas pressure between the gas controls and the burner. Pressure test nipples shall have an external diameter of 9 mm (tolerance + 0, – 0.5) and a useful length of at least 10 mm for connection to tubing. The diameter of the hole in the nipple shall not be greater than 1 mm.

21.5 Marking

21.5.1 *Badges (data plates).* Separate data plates shall be fitted to the air-heater and the circulator, in inconspicuous positions but readily accessible to the fitter. They shall be clearly and indelibly marked with the following information.

a) *Items common to both data plates*

1) The name of the manufacturer.

2) The appliance type name and/or number, with identification of more detailed variations or modifications, for example, by suffix or prefix, by serial number, batch number, date of manufacture.

3) The gas family or families for which the appliance is designed. The category system of identification shall be used (see **3.1**).

4) The gas family for which the appliance is adjusted. The letters T, N and L shall be used to denote 1st, 2nd and 3rd family gases respectively and the combinations L/P and L/B to denote propane and butane respectively. These letters and combinations shall be used exclusively for this purpose.

5) The gas group for which a 1st family gas appliance is adjusted where a change(s) other than of setting pressure is required.

6) Rated heat input and heat output.

7) Jet size(s) or identification.

8) Setting pressure and, for 3rd family gas appliances, the supply pressure.

b) *Air heater data plate only*

9) The electrical voltage.

10) The fuse value.

c) *Circulator data plate only*

11) The maximum working head of water.

21.5.2 *Appliance parts.* Where possible, burner jets and injectors shall be marked for identification.

Items that have to be changed on conversion from one gas family to another shall be marked to designate the particular family for which they are suitable. This shall be by letter, e.g. T for 1st family, N for 2nd family, and L for 3rd family, or by number.

21.5.3 *Electrical data.* A wiring diagram shall be affixed to the appliance in a position easily visible to the fitter.

Wiring coding shall be such that it is easily identifiable with the wiring diagram.

Every fuse or circuit breaker shall have on its case or cover or in an adjacent position an indelible indication of its rated current appropriate to the circuit or circuits it protects.

Any electrical component intended for service replacement shall be marked with its electrical characteristics, e.g. capacitance, resistance.

21.5.4 *Warning notices.* Where considered necessary, notices shall be fitted to the appliance to warn of the danger of removing panels that cover live electrical components.

21.6 Electrical servicing

21.6.1 *Fuse links.* Fuse links shall be of cartridge type complying with BS 2950 or BS 1362.

Where a fuse is intended to be changed by the user, the fuse holder shall be of a type that enables this operation to be performed without danger.

21.6.2 *Termination of conductors.* Any internal conductor intended to be removed during normal servicing shall be suitably terminated by rigid connection to a terminal tag, cup-shaped washer, terminal block or other device capable of repeated use, with means to prevent any working loose.

Any wiring that requires disconnection during a normal maintenance service shall be non-interchangeable and non-reversible where correct polarity has to be maintained.

21.6.3 *Appliance earthing terminal.* The appliance incoming earthing terminal shall not require removal during the replacement or adjustment of the gas-carrying components of the appliance.

21.6.4 *Plugs and sockets.* Plugs and sockets shall be such that it is not possible to make incorrect connections.

21.6.5 *Connections for ancillary controls.* Connection of any ancillary controls recommended by the manufacturer shall be achieved without disturbing any internal connections.

NOTE A shorting link which is removed as part of the ancillary control connection is permitted.

21.6.6 *Connection to mains supply.* When the cable or cord connecting the appliance to the mains is not provided, the manufacturer's instructions shall give adequate guidance to enable the installer to fit and secure it to the appliance.

Appendix A Method of test for resistance to airborne lint

A.1 Test room

An internal room of normal construction, of about 17 m^3 capacity (no dimension being less than 2 m) and having at least one observation window is suitable. The walls and ceiling are papered, painted or varnished to give smooth surfaces that will minimize dirt collection. Similarly the floor is smooth tiled.

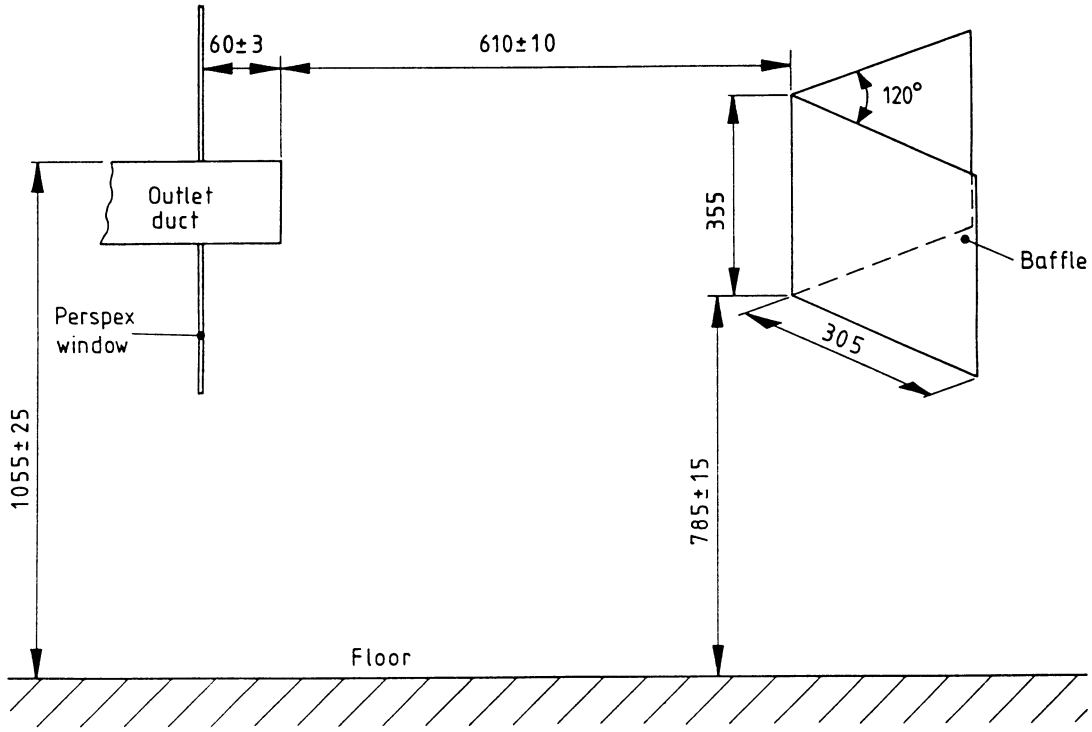
The air required for combustion and ventilation is provided partly through the lint generator and partly from outside the room via two grilles 0.3 m square situated on the side walls. The air in the room is mixed by means of small fans that are fixed in the ceiling and adjusted so that they do not interfere with the performance of the appliance under test. These fans are allowed to rotate backwards and forwards about their vertical axes and are run at their lowest speed. Lint is 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 are operated intermittently for periods of 30 s every 4 min. Lint is 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 indicated in Figure 5.

Combustion products are exhausted through an extract hood by means of a 150 mm diameter fan.

The products extract duct is fitted with a pre-set flow detection device operating on the appliance gas valve.

NOTE Explosion relief should be fitted in three walls and the roof.

The room is provided with supplies of test gases and water and is 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 electrically, from outside the room, the appliance under test.



NOTE The figure is not to scale.
All dimensions are in millimetres.

Figure 5 — Position of baffle with respect to lint generator outlet duct

A.2 Apparatus

A.2.1 Lint generator as shown in Figure 6[4)] comprising a vertical shaft, standing on a horizontal base, fitted with spools of cotton, nylon and wool yarns. The yarns pass between two contrarotating 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).

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

NOTE At the start of each of the test runs described in **A.4.5** and **A.4.8**, the lint generator should be fitted with new cutting blades. Cutting blades should not be used for more than 6 h.

A.2.2 Lint/dust mixture consisting 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 are in the range 5 μm to 50 μm and are of length not exceeding 30 mm. The Bentonite dust has a particle size not exceeding 25 μm.

A.2.3 Lint filter as shown in Figure 7 comprising 0.9 mm thick 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 suitable holder[4)].

Linted air is drawn through the filter at such a rate as to give an approximate rate of change in pressure differential across the filter of 0.1 ± 0.03 mbar/h. The change in pressure differential (Δp_d) is measured continuously.

A.3 Measurement of lint concentration

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

The filter is mounted 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 is not more than 300 mm from the air inlet.

The filter is sited 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 is not less than 75 mm from the floor.

The filter element is placed such 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 is placed in front of the air inlet that is most convenient for the execution of the test.

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

A.4 Procedure

A.4.1 Carry out the procedure given in **A.4.2** to **A.4.9** in a test room as described in **A.1** using the appropriate reference test gas.

A.4.2 Install the appliance in accordance with the manufacturer's instructions; position free standing or wall-mounted appliances against an artificial wall without any obstruction at either side or in front of the appliance.

A.4.3 For a free-standing appliance note the height of the air inlet above the floor as measured from the lowest edge of the air inlet. For a wall-mounted appliance take this distance as the minimum height of the air inlet permitted by the installation instructions.

A.4.4 Adjust the appliance to the manufacturer's recommended heat input rate using the appropriate reference test gas.

[4)] Full details of the design and construction of the lint generator and of the filter holder may be obtained from British Gas plc, Watson House, Peterborough Road, London SW6 3HN.

Determine the CO/CO_2 ratios at this setting and at 110 % of maximum rated heat input.

A.4.5 After re-setting to the manufacturer's specified heat input rate, operate the appliance under test continuously for periods of 1 h in an atmosphere of airborne lint produced as described in **A.2.1**.

At the end of each hour's operation switch off the appliance for a period of 2 min and then switch it on and allow it to regain thermal equilibrium.

A.4.6 Sample the combustion products continuously during the operational period and analyse for carbon monoxide and carbon dioxide.

NOTE The combustion measurements described in **A.4.7** are made after the appliance has reached thermal equilibrium following the off/on operation referred to in **A.4.5**.

A.4.7 When the total change in pressure differential is equal to the value obtained from curve A in Figure 2, stop the test and note the CO/CO_2 ratio.

Continue the test until the total change in pressure differential is equal to the value obtained from curve B in Figure 2 and note the CO/CO_2 ratio.

A.4.8 Clean the appliance and burner(s) using the method described in the manufacturer's instructions and repeat steps **A.4.3** to **A.4.7**.

A.4.9 If the burner is not capable of being opened, after the second linting test (**A.4.8**) clean it in accordance with the manufacturer's instructions and then cut it open and visually examine for compliance with **6.10.4.3**.

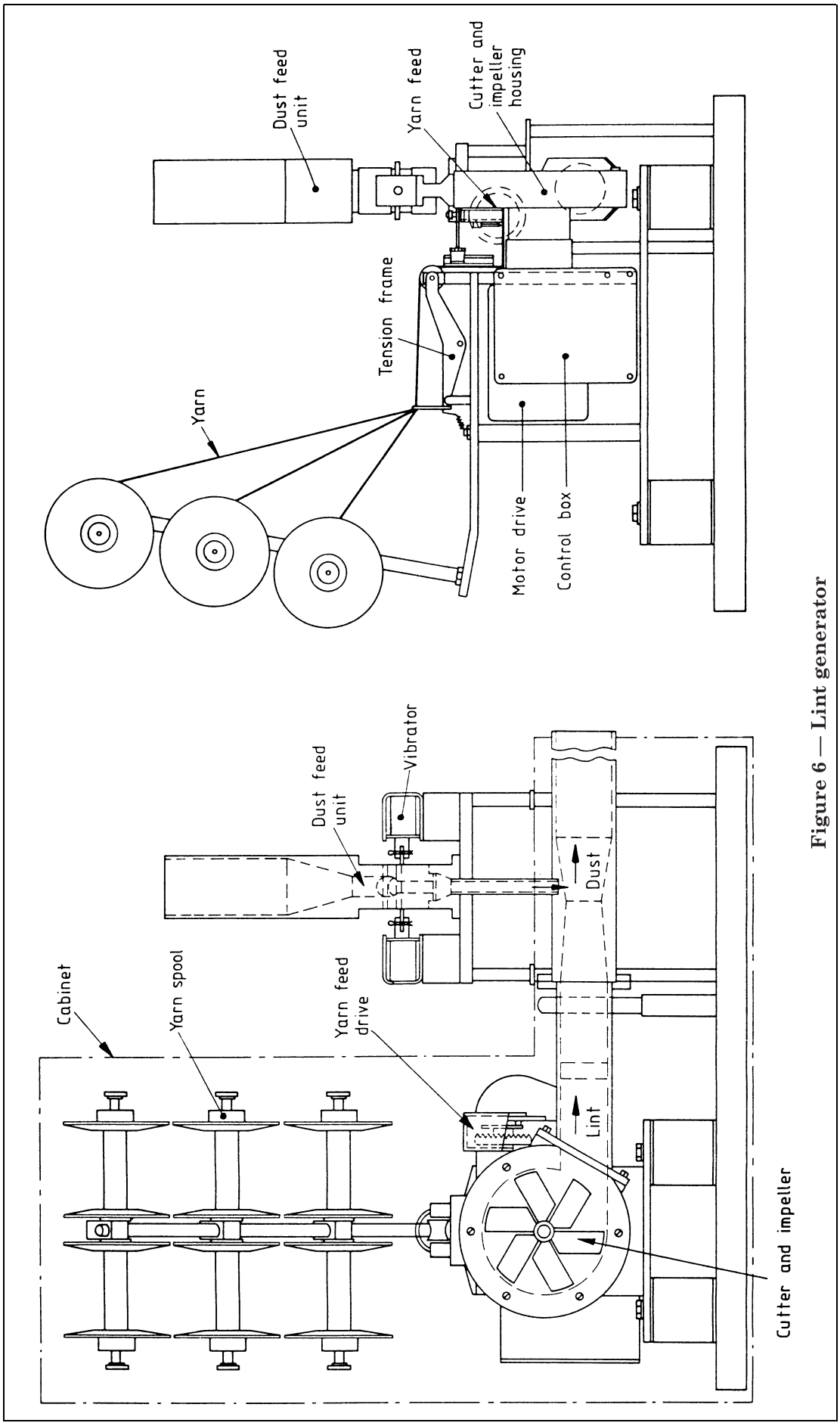
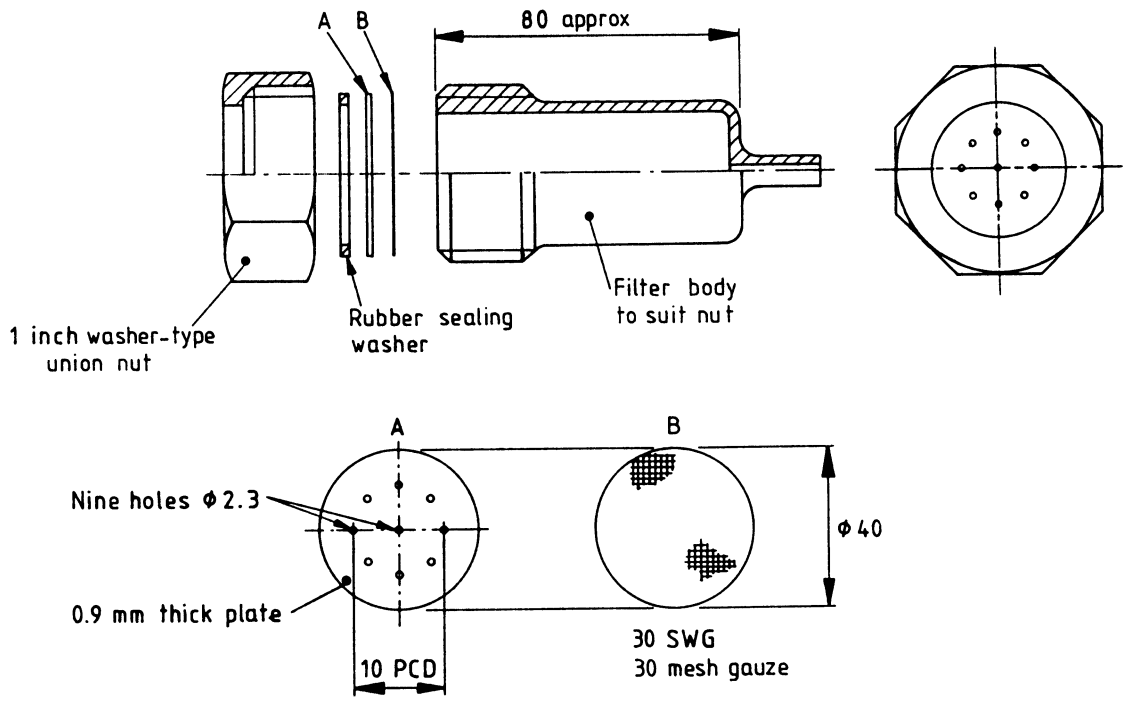
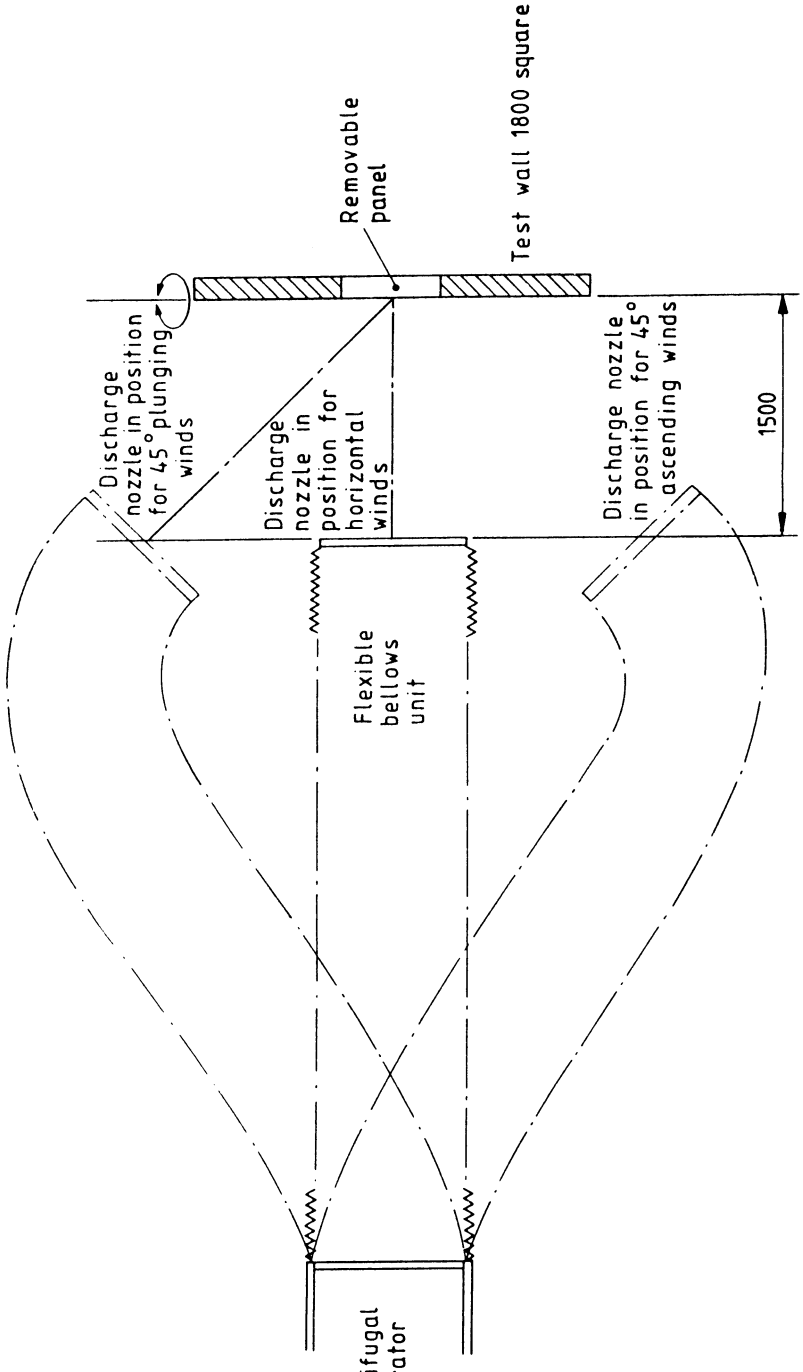


Figure 6 — Lint generator



All dimensions are in millimetres.

Figure 7 — Lint filter



NOTE Side elevation is shown.
All dimensions are in millimetres.

Figure 8 — Typical test apparatus for type C_1 appliances (side elevation)

Appendix B Apparatus and conditions for combustion tests on type C_1 appliances

B.1 Apparatus

B.1.1 *Wind generator* (see Figure 8[5)]) capable of providing wind streams coaxial with the axis of the discharge nozzle of uniform velocity profile over a range of efflux velocities from 2.5 m/s to 12.5 m/s and over a wind front 900 mm × 900 mm.

The nozzle of the wind generator is adjustable to provide wind streams between 45° ascending and 45° plunging.

B.1.2 *Test wall,* consisting of a stout wall 1.8 m square with a removable panel at its centre. The wall is mounted normal to the axis of the wind direction and symmetrical about the wind generator discharge nozzle. The distance between the test wall and the nozzle is 1.5 m, measured in an horizontal plane.

The test wall is capable of rotation through 90° in either direction about a central vertical axis.

B.2 Wind uniformity

The pressure profile is such that a head-on wind of 7.5 m/s does not produce a pressure variation over the central 500 mm square area of the wall exceeding 0.025 mbar.

This pressure variation is determined by the use of an instrument having a response time of the order of 5 s.

B.3 Test conditions

There shall be adequate ventilation to satisfy the air requirements of the wind generator and maintain the correct conditions in the test room (see **5.1**).

The appliance shall be mounted so that the geometric centre of the terminal is at the centre of the test wall and otherwise to the manufacturer's instructions.

Any joints that will normally be made when the appliance is fitted in practice shall be perfectly sealed in the test installation.

Appendix C Apparatus and conditions for combustion tests on type C_2 appliances

A suitable apparatus (see Figure 9) consists of a completely enclosed loop of 230 mm × 400 mm rectangular ducting through which air is circulated by a reversible bifurcated axial-flow fan. Velocity and pressure conditions are controlled by a series of single-leaf dampers.

A water heater is supplied to provide an additional source of vitiation, its inlet being open to air and fitted with an air control slide F.

The test appliance is mounted precisely according to the manufacturer's instructions on a long side of the duct with the appliance at least 2 m above the top of the horizontal base limb and with at least 1 m of vertical duct above the appliance. Access panels are provided on the back of the mounting panels to facilitate the fitting of the sample tubes and thermocouple.

The flow in the duct may be measured by a photoelectric type of vane anemometer which is placed 1 m above the top of the horizontal base limb. A calibration factor is used to convert the anemometer reading to the mean flow as determined by pitot-static tube traverses.

NOTE 1 To cover the flow range of 0.3 m/s to 5 m/s, two interchangeable anemometers may be required.

The apparatus is designed to be operated either as a closed or open circuit or in any condition intermediate between these extremes.

NOTE 2 In practice either the open circuit or an intermediate condition is required for the specified tests.

To illustrate the method of operating the test apparatus two conditions are considered, as follows.

a) *Closed circuit.* Dampers A, B, E and F are closed. Dampers C and D are used to control both flow and pressure conditions in the duct. For upflow in the test section positive pressures may be produced with C fully open and flow controlled by D. Negative pressures may be produced with D fully open and flow controlled by C.

NOTE 3 In practice it is necessary to adjust both dampers in turn to establish the required test condition.

[5)] BRADY, K.J.D. and KERAC, Dj., A new wind generator for the laboratory assessment of balanced flue appliances. *J.Inst. Gas Eng.* 1967, 7(4), 255-281.

When it is required under the upflow conditions of test to augment the degree of vitiation, the air slide at F is opened and the water heater is lit.

If the temperature in the duct at Y exceeds 65 °C it has to be reduced by passing water through the finned heat exchanger introduced into the circuit at X.

NOTE 4 In practice, if the duct is made of metal, it is probable that this heat exchanger will not be required.

b) *Open circuit.* Dampers C, E and F are closed. Damper A is fully opened and dampers B and D are used to control both flow and pressure conditions in the duct. For upflow in the test section, a negative pressure has to exist but the magnitude for a given flow is determined by adjustment of B and D.

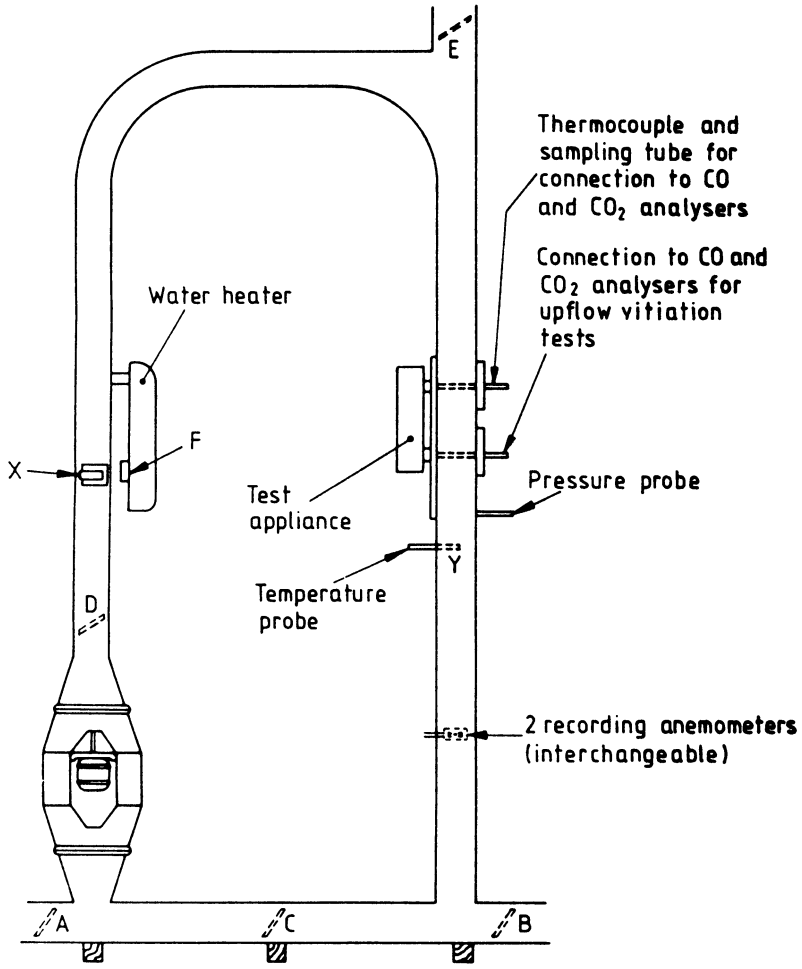


Figure 9 — Test apparatus for type C_2 appliances

Publications referred to

BS 21, *Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads.*

BS 476, *Fire tests on building materials and structures.*

BS 476-4, *Non-combustibility test for materials.*

BS 476-5, *Method of test for ignitability.*

BS 567, *Specification for asbestos-cement flue pipes and fittings, light quality.*

BS 715, *Specification for metal flue pipes, fittings, terminals and accessories for gas-fired appliances with a rated input not exceeding 60 kW.*

BS 800, *Specification for radio interference limits and measurements for household appliances, portable tools and other electrical equipment causing similar types of interference.*

BS 835, *Specification for asbestos-cement flue pipes and fittings, heavy quality.*

BS 864, *Capillary and compression tube fittings of copper and copper alloy.*

BS 864-2, *Specification for capillary and compression fittings for copper tubes.*

BS 1041, *Code for temperature measurement.*

BS 1041-4, *Thermocouples.*

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

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

BS 1179-6, *Combustion and utilization including installation at consumer's premises.*

BS 1362, *Specification for general purpose fuse links for domestic and similar purposes (primarily for use in plugs).*

BS 1552, *Specification for control plug cocks for low-pressure gases.*

BS 1756, *Methods for sampling and analysis of flue gases.*

BS 1963, *Specification for pressure operated relay valves for gas burning appliances.*

BS 2871, *Specification for copper and copper alloys. Tubes.*

BS 2871-1, *Copper tubes for water, gas and sanitation.*

BS 2950, *Specification. Cartridge fuse-links for telecommunication and light electrical apparatus.*

BS 3016, *Specification for pressure regulators and automatic changeover devices for liquefied petroleum gases.*

BS 3456, *Specification for safety of household electrical appliances.*

BS 3955, *Specification for electrical controls for household and similar general purposes.*

BS 4201, *Specification for thermostats for gas-burning appliances.*

BS 4947, *Specification for test gases for gas appliances.*

BS 5000, *Specification for rotating electrical machines of particular types or for particular applications.*

BS 5000-11, *Small power electric motors and generators.*

BS 5292, *Specification for jointing materials and compounds for installations using water, low-pressure steam or 1st, 2nd and 3rd family gases.*

BS 5440, *Code of practice for flues and air supply for gas appliances of rated input not exceeding 60 kW (1st and 2nd family gases).*

BS 5440-1, *Flues*[6)].

BS 5440-2, *Air supply*[6)].

BS 5482, *Code of practice for domestic butane and propane-gas-burning installations.*

BS 5482-1, *Installations in permanent dwellings*[6)].

BS 5482-2, *Installations in caravans and non-permanent dwellings*[6)].

BS 5482-3, *Installations in boats, yachts and other vessels*[6)].

BS 5494, *Specification for gas taps for domestic and catering appliances.*

[6)] Referred to in the foreword only.

BS 5546, *Code of practice for installation of gas hot water supplies for domestic purposes (2nd family gases)*[7)].

BS 5864, *Code of practice for installation of gas-fired ducted-air heaters of rated input not exceeding 60 kW (2nd family gas)*[7)].

BS 5963, *Specification for electrically operated automatic gas shut-off valves.*

BS 6047, *Flame supervision devices for domestic, commercial and catering gas appliances.*

BS 6047-1, *Specification for heat sensitive types.*

BS 6067, *Specification for multifunctional gas controls for domestic, commercial and catering appliances.*

BS 6448, *Gas governors.*

BS 6448-1, *Specification for pressure governors with nominal connection size up to 50 mm for gas appliances with inlet pressures up to and including 200 mbar.*

[7)] Referred to in the foreword only.

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