

Australian Standard[®]

Indirect gas-fired ducted air heaters



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- Appliance and Component Testing
 - Association of Accredited Certification Bodies
 - Australian Gas Association
 - Consumers Federation of Australia
 - Department of the Environment, Water, Heritage and the Arts
 - Energy Networks Association
 - Gas Appliance Manufacturers Association of Australia
 - Gas Technical Regulators Committee
 - LPG Australia
-

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Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through the public comment period.

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Australian Standard[®]

Indirect gas-fired ducted air heaters

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee AG-001, Gas Appliances to supersede AS 4556—2000/AG 106—2000, *Indirect gas fired ducted air heaters*. After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to retain this Standard as an Australian Standard rather than develop it as an Australian/New Zealand Standard.

The objective of this Standard is to provide manufacturers, designers, regulatory authorities, testing laboratories and similar organizations with uniform minimum requirements for the safety, performance and use of indirect gas-fired ducted air heaters. This Standard should not be regarded as a design specification or as an instruction manual.

In this Standard's preparation, consideration has been given to—

- (a) continuity of satisfactory operation;
- (b) the prevention of fire hazards and explosions;
- (c) the prevention of injury to persons or property;
- (d) gas rules and regulations now in force; and
- (e) relevant international standards.

AS/NZS 5601 provides essential requirements and basic standards for gas installations.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

Statements expressed in mandatory terms in notes and footnotes to tables and figures are deemed to be requirements of this Standard.

The relevant Australian technical regulators agree that this Standard includes appropriate requirements for particular appliances or components to be certified.

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STANDARDS AUSTRALIA

Australian Standard

Indirect gas-fired ducted air heaters

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies requirements for indirect gas-fired ducted air heaters with natural draught or fan-assisted combustion systems intended for use with NG, town gas, liquefied petroleum gas (LP Gas) and tempered liquefied petroleum gas (TLP) with gas consumptions not exceeding 500 MJ/h.

NOTE: Other statutory and regulatory requirements may be applicable to the product(s) that fall within the scope of this Standard. It is the manufacturer's, importer's or distributor's responsibility (as appropriate) to ensure that products comply with such requirements.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

- | | |
|--------|---|
| 1375 | Industrial fuel-fired appliances (known as the SAA Industrial Fuel-Fired Appliances Code) |
| 1722 | Pipe threads of Whitworth form |
| 1722.2 | Part 2: Fastening pipe threads |
| 1881 | Zinc alloys—Casting ingots and castings—Quality requirements |
| 4617 | Manual shut-off gas valves |
| 4620 | Thermoelectric flame safeguards |
| 4625 | Electronic flame safeguards and flame detectors |
| 4629 | Automatic shut-off valves and vent valves |
| 4646 | Gas appliance standards—Definitions and calculations |

AS/NZS

- | | |
|--------|--|
| 3500 | Plumbing and drainage |
| 3500.0 | Part 0: Glossary of terms |
| 3820 | Essential safety requirements for electrical equipment |
| 5601 | Gas installations |
| 5601.1 | Part 1: General installations |
| 5601.2 | Part 2: LP Gas installations in caravans and boats for non-propulsive purposes |

AS ISO

- | | |
|-----|--|
| 7.1 | Pipe threads where pressure-tight joints are made on the threads
Part 1: Dimensions, tolerances and designation |
|-----|--|

ISO

- | | |
|------|---|
| 6976 | Natural gas—Calculation of calorific values, density, relative density and Wobbe index from composition |
|------|---|

EN

- | | |
|-----|--|
| 298 | Automatic gas burner control systems for gas burners and gas burning appliances with or without fans |
|-----|--|

Speight, J. *Lange's Handbook of Chemistry*. 16th ed. 2004, McGraw-Hill Professional, USA.

1.3 DEFINITIONS

For the purpose of this Standard the definitions below apply.

1.3.1 Appliance flueway

A port or passage conveying flue gases within the appliance.

1.3.2 Appliance regulator

A device fitted to an appliance to control the gas pressure or gas volume delivered to that appliance.

1.3.3 Atmospheric burner

A burner system where all the air for combustion is introduced by the inspirating effect of a gas injector and/or by the natural draught in the combustion chamber without mechanical assistance.

1.3.4 Authority having jurisdiction

The authority having statutory (legal) control.

1.3.5 Automatic burner

A burner system that, on starting, follows a self-acting sequence that has been manually or automatically initiated, to provide gas and ignition to the burner without any intermediate manual operation.

1.3.6 Automatic ignition

The lighting of gas at a burner without a manual operation whenever gas flows from the burner.

1.3.7 Automatic operation

The use of a sequence of operations, which once initiated, does not require any intermediate manual operation.

1.3.8 Automatic shut-off valve

An automatic valve used to shut-off gas supply to an appliance.

1.3.9 Available gas (line gas)

Readily available gas with similar characteristics to the reference test gas.

1.3.10 Balanced flue appliance

A room-sealed appliance that has combustion air ducted from, and combustion products ducted to, a common terminal assembly located externally.

1.3.11 Burner port

The opening in a burner through which gas or an air–gas mixture issues to be ignited or burned.

1.3.12 Burner unit

A number of burners, fed from the same manifold, controlled together, having one supervised ignition source and performing as a single burner.

1.3.13 Bypass

An integral part of a gas control that enables a preset volume of gas to bypass the control.

1.3.14 Calibration

The determination of the relationship between the measured or indicated value of a parameter and its true value.

1.3.15 Certified (certification)

Assessed by a Certifying Body, and having a certificate number to demonstrate compliance with a Standard.

1.3.16 Certifying body

A body acceptable to the Technical Regulator that provides assurance of compliance of appliances and components with nominated standards or other accepted safety criteria.

1.3.17 CO/CO₂ ratio

The ratio by volume of carbon monoxide to that of carbon dioxide in the combustion products.

1.3.18 Combination gas control

An assembly of two or more different control functions in a single body.

1.3.19 Combustible materials

Materials made of or surfaced with wood, compressed paper, plant fibres or other materials that will ignite and burn.

1.3.20 Combustion products

Constituents resulting from the combustion of a fuel with oxygen, including the inerts associated with the fuel and the oxygen, but excluding any other diluent or contaminant.

1.3.21 Compression fittings

1.3.21.1 General

Compression fittings and components are as defined in AS/NZS 3500.0.

1.3.21.2 Type 1 (non-manipulative) compression fitting

A fitting for a compression joint that does not require any working of the tube other than cutting square. The joint is made tight by means of a loose compression ring that grips the outside wall of the tube when the coupling nut is tightened.

1.3.21.3 Type 2 (manipulative) compression fitting

A fitting in which the joint is made by flaring, croxing, capping or beading the end of the tube, which is then compressed by the coupling nut against the shaped end of the corresponding section in the fitting.

1.3.22 Cross lighting

Lighting of one burner from another either directly or by means of an intermediate flame.

1.3.23 Determined gas consumption

Gas consumption rate, measured in megajoules per hour (MJ/h), using reference gas at specified test pressures and with ambient conditions corrected to standard temperature and pressure.

1.3.24 Draught diverter

A device, without moving parts, fitted in the flue of an appliance for isolating the combustion system from the effects of pressure changes in the secondary flue.

1.3.25 Ducted air heater

A heater with a fan, made for the delivery of warm air by ducts.

1.3.26 Electronic flame safeguard

A flame safeguard utilizing electronic components to perform its function.

1.3.27 Excess air

Air in excess of that required for complete combustion, which is mixed unchanged with the combustion products, in the combustion chamber.

1.3.28 Fan-assisted combustion system

A system in which all or part of the combustion air is supplied, and/or in which the products of combustion are evacuated by mechanical means that is an integral part of the appliance.

1.3.29 Flame abnormality

A flame condition that results in appreciable yellow tipping and carbon deposition (except in the case of appliances specifically designed for a luminous effect), lifting, floating, lighting back or an objectionable odour.

NOTES:

- 1 If the length of the yellow tipping is less than 20% of the total length of the flame on visual inspection, it is not considered to be appreciable yellow tipping.
- 2 In appliances designed specifically for a luminous effect, yellow tipping or limited carbon deposition within the appliance are not considered abnormal.

1.3.30 Flame detector

A device that is sensitive to flame properties and initiates a signal when flame is detected.

1.3.31 Flame establishment period

The total time for which the fuel valve is energized, beginning with the first energization of the valve and ending when the flame supervision system is first required to supervise the flame.

1.3.32 Flame failure response time

The time taken for the flame safeguard to detect loss of flame and de-energize the shut-off valve.

1.3.33 Flame proving period

The supervised period following the flame establishment period and before any further operation other than shutdown is permitted.

1.3.34 Flame safeguard

A safety device that automatically cuts off the gas supply if the actuating flame is extinguished.

1.3.35 Flame safeguard system

A system consisting of a flame detector(s) plus associated circuitry, integral components, valves and interlocks, the function of which is to shut off the fuel supply to the burner(s) in the event of ignition failure or flame failure. Programming flame safeguards automatically sequence at least two burner functions, such as ignition spark, gas valve, etc.

1.3.36 Flash lighting tube

A device for igniting a gas burner in which a flame is made to travel to the burner ports through a tube in which an inflammable mixture of gas and air has been induced.

1.3.37 Flue

The passage through which flue gases are conveyed from an appliance to a discharge point, excluding draught diverter, barometric device, fan or similar part.

1.3.38 Flue connection

A device incorporated in an appliance for the connection of a flue system.

NOTE: Where the draught diverter, barometric device, fan or similar component is an integral part of the appliance, the discharge point of the integral part is deemed to be the flue connection.

1.3.39 Flue cowl

A fitting placed at the flue terminal, designed to prevent the entry of rain or the disturbing effect of wind, while not interfering with the discharge of flue gases.

1.3.40 Flue gases

Combustion products plus all diluents and contaminants intermixed with the combustion products. These include, where applicable, excess air, dilution air, process air and waste products from the process.

1.3.41 Flue system

The passage through which flue products are conveyed from an appliance to a discharge point including draught diverter, barometric device, fan or similar part.

1.3.42 Flue terminal

The point at which flue products discharge from a flue. It is the point where a flue system discharges into a flue cowl (if fitted).

1.3.43 Forced draught

All or part of the air for combustion provided under positive pressure by mechanical means.

1.3.44 Gas

A combustible fuel gas which may be one of the following:

1.3.44.1 *Natural gas (NG)*

A hydrocarbon consisting mainly of methane.

1.3.44.2 *Simulated natural gas (SNG)*

A gas comprising a mixture of LP Gas and air, in the approximate proportions of 55% gas and 45% air for commercial propane.

1.3.44.3 *Town gas (TG)*

A gas manufactured from coal or petroleum feedstocks.

1.3.44.4 *Tempered liquefied petroleum gas (TLP)*

A gas comprising a mixture of LP Gas and air, in the approximate proportions of 27% gas and 73% air for commercial propane.

1.3.44.5 *Liquefied petroleum gas (LP Gas)*

A gas composed predominantly of any of the following hydrocarbons, or any combination of them in the vapour phase—propane, propene (propylene), butane, butene (butylene).

1.3.45 Gas consumption

The rate of energy consumed by an appliance under specific conditions and expressed in megajoules per hour (MJ/h).

1.3.46 Heat load reduction factor (HLR)

Based on an equation for calculating the manufacturer's minimum number of warm air outlets that can be left open at any one time and reflects the ability of the appliance to reduce energy consumption by directing heat only to the areas required.

The HLR equation is based on an average of 50 L/s air flow per warm air outlet, with a default base value of 60% minimum outlets open (as indicative of current heating systems that require at least six outlets open in a 10-point installation).

1.3.47 Heating value, gross (at constant pressure)

The number of megajoules liberated when one cubic metre of dry gas, at standard conditions of temperature (15°C) and absolute pressure (101.325 kPa), is completely burnt in air with all the water formed by the combustion process in the liquid state and with the products of combustion at standard conditions.

NOTE: Calculation of heating value is based upon ISO 6976 as given in AS 4646.

1.3.48 Induced draught

Combustion systems or appliances in which all or part of the air for combustion is introduced by providing suction in the combustion chamber by mechanical means.

1.3.49 Injector

A device that causes air to mix with a stream of gas. In the case of an aerated burner the injector, incorporates an orifice, discharging gas into the mixing throat or tube.

1.3.50 Intermittent pilot

A pilot that is automatically ignited each time the burner is started, and which is automatically extinguished with the main burner.

1.3.51 Interrupted pilot

A pilot that is automatically ignited each time the burner is started, and that is automatically extinguished at the end of the main flame establishment period.

1.3.52 Jointing compound

A manufactured liquid, paste-like or semi-solid material used to seal joints.

1.3.53 Jointing material

A manufactured solid material that may be in tape, cord or sheet form, used to seal joints.

1.3.54 Lift (flame)

Separation of a flame from a burner port, while continuing to burn with its base some distance from the port.

1.3.55 Light back

Transfer of the flame from burner port(s) into the body of the burner or back to the injector. Also referred to as 'lit back'.

1.3.56 Limit device

A device that is actuated by the approach to a hazardous situation in an appliance due to abnormal conditions, and when actuated, causes the gas supply to all burners to shut off with lockout.

1.3.57 Linting

Blocking of a burner port or air opening by dust or fluff.

1.3.58 Lockout

A safety shutdown condition of the control system that requires a manual reset in order to restart.

1.3.59 Lower explosive limit (LEL)

The lowest percentage of gas in the air in which combustion can be self-sustaining at standard temperature (15°C) and absolute pressure (101.325 kPa) conditions.

1.3.60 LP Gas

See **Gas**.

1.3.61 Manual ignition

1.3.61.1 Direct manual ignition

The lighting of a burner by the use of a handheld ignition device.

1.3.61.2 Remote manual ignition

The lighting of a burner by a manual operation where the ignition-activating device is remote from the ignition point.

1.3.62 Mixing tube

That part of an atmospheric burner in which the air and gas are mixed.

1.3.63 Natural draught burner

See **Atmospheric burner**.

1.3.64 Natural gas

See **Gas**.

1.3.65 Nominal gas consumption

The appliance gas consumption, in megajoules per hour, as stated in manufacturer's specifications, data plates, instructions and general communications.

NOTE: This is the fundamental quantity on which all methods of test are based and is the starting point for all performance requirements.

1.3.66 Nominal test point pressure

The gas pressure specified by the manufacturer, at which the appliance is designed to operate, and measured at a test point.

1.3.67 Normal test gas pressure

Readings of 0.75 kPa for TG and TLP, 1.13 kPa for NG and SNG, 2.75 kPa for LP Gas.

1.3.68 Open-flued appliance

An indoor appliance designed to be connected to an open-flue system, its combustion air being drawn from the room or space in which it is installed.

1.3.69 Outdoor appliance

An appliance designed for outdoor installation or use.

1.3.70 Overload gas consumption

A nominal gas consumption of 120% for all gases other than LP Gas. For LP Gas, it is the gas consumption that results when gas at a pressure of 3.5 kPa is supplied to the appliance inlet.

1.3.71 Over-temperature cut-out device

A manual reset or non-resetting device that functions to shut off the gas supply to a burner or burners to prevent temperature exceeding a pre-determined level.

1.3.72 Permanent pilot

A pilot that is permanently alight while the appliance is in service and that is controlled independently of the main burner.

1.3.73 Pilot

A permanently located burner independent of the main burner, small in relation to it, and arranged to provide ignition for the main burner.

1.3.74 Power-flued

A flue system in which products of combustion are removed from the appliance by a fan in the flue.

1.3.75 Primary aeration control

An adjustable device for controlling primary air to a burner.

1.3.76 Primary air

That portion of the total air required for combustion that is mixed with the gas prior to burning on the burner ports.

1.3.77 Primary air ports

The openings in an aerated burner for primary air.

1.3.78 Primary flue

That portion of the flue system conveying flue products from an appliance to the draught diverter, barometric device, fan or similar part when fitted.

1.3.79 Programmable electronic system (PES)

A system based on one or more central processing units (CPUs), connected to sensors and/or actuators, for the purpose of control, protection or monitoring.

NOTES:

- 1 The term 'PES' extends to and includes all elements in the system, such as—
 - (a) sensors and other input devices;
 - (b) data links and other communication paths; and
 - (c) actuators and other output devices.
- 2 The term 'PES' includes system software such as executive, users and communication, that is configured to operate a process.
- 3 The term 'PES' is used to cover systems incorporating a wide range of programmable electronic devices and includes systems incorporating:
 - (a) Microprocessors.
 - (b) Programmable controllers (PCs).
 - (c) Programmable logic controllers (PLCs).
 - (d) Programmable state controllers.
 - (e) Other computer-based devices.
- 4 A PES can include a microprocessor-based temperature, pressure, air/fuel ratio, or level controller or monitor.

1.3.80 Programmed ignition

A multistage system of automatic ignition where each stage takes place automatically in a pre-determined sequence.

1.3.81 Programming flame safeguard

A flame safeguard that automatically sequences at least two burner functions, such as ignition spark or gas valve.

1.3.82 Purge

To replace air or other gases that may become a hazard from pipework, fittings or appliances.

1.3.83 Purge volume

The purge volume includes the combustion chamber and all areas where combustion products and combustible vapours, dusts or gases may accumulate in the appliance or process up to the vertical connection of a flue or chimney that discharges directly to atmosphere.

1.3.84 Reference gas

The gas corresponding to an average of the gases most currently distributed, and for which the appliance has been specifically designed (see **Test gases**).

1.3.85 Relative density

The ratio of the mass of a volume of gas to the mass of the same volume of dry air under the same conditions of temperature and pressure.

NOTE: Calculation of relative density is based upon ISO 6976 as given in AS 4646.

1.3.86 Room-sealed appliance

An indoor appliance that is sealed from the room in which it is installed so that it directly discharges combustion products to, and takes air from, outside the building.

1.3.87 Safety shutdown

The action of shutting off all gas and ignition energy by means of a safety control so that a restart cannot be accomplished without a full start cycle.

1.3.88 Safety shut-off system

An arrangement of valves and associated control systems that shuts off the supply of gas when required, by a device that senses the approach to an unsafe condition.

1.3.89 Safety shut-off valve

An automatic valve used to shut off gas supply to an appliance when a signal is generated indicating the approach to an unsafe condition.

1.3.90 Seasonal operating efficiency

Seasonal operating efficiency is based on the overall operating efficiency of the appliance and a 'penalty weighting' factor that is dependent on the standby energy consumption, e.g. a continuously burning pilot or electric time clock. In the case of appliances that do not have a standby energy consumption, the seasonal operating efficiency is equal to the overall operating efficiency. Seasonal operating efficiency is calculated from the ratio of the total heat delivered by the appliance to the total energy consumed.

1.3.91 Secondary air

Air required for completion of combustion, admitted to the combustion zone after combustion with primary air has commenced.

1.3.92 Secondary flue

That portion of the flue system conveying flue products from the draught diverter, barometric device, fan or similar part to the flue terminal.

1.3.93 Simulated natural gas (SNG)

See **Gas**.

1.3.94 Specific gravity

See **Relative density**.

1.3.95 Spillage

A condition in which the combustion products are not cleared by the flue, but escape from the appliance or the draught diverter relief openings.

1.3.96 Standby energy weighting

A weighting based on the assumption of 600 h of heating per year and that standby energy is consumed for the remainder of the year.

1.3.97 Start gas

The gas flowing at a pilot burner or, when no pilot burner is fitted, at a main burner during the flame establishment period for initial ignition.

1.3.98 Technical regulator

The Government-appointed person, body or authority that has jurisdiction over gas safety legislation (or other entity authorized by that person, body or authority).

1.3.99 Temperature limit device

A device that automatically interrupts the gas flow when the temperature at the control point reaches a pre-determined limit.

1.3.100 Tempered liquefied petroleum gas (TLP)

See **Gas**.

1.3.101 Test gases

The test gases used in this Standard are defined in the Test Gas Table (see Table 1.1), which is based on pure components. Actual test gases are made up using constituent test gases of the purities listed below to the respective Wobbe index $\pm 2\%$. Purities of the constituent gases are to be not less than:

- (a) 99% for hydrogen and nitrogen
- (b) 95% for methane ($H_2 + CO + O_2 < 1\%$, $N_2 + CO_2 < 2\%$)
- (c) 95% for propane ($H_2 + CO + O_2 < 1\%$, $N_2 + CO_2 < 2\%$)
- (d) 95% for propylene ($H_2 + CO + O_2 < 1\%$, $N_2 + CO_2 < 2\%$)
- (e) 95% for butane ($H_2 + CO + O_2 < 1\%$, $N_2 + CO_2 < 2\%$)

Where base gases of the required composition or purity are not readily available, suitable blended gases of the same Wobbe index and other combustion characteristics may be used. In case of dispute, the purity of the constituent gases are not be less than the above values.

1.3.102 Thermostat

A temperature control that automatically maintains a pre-determined temperature in an appliance or component.

1.3.103 Thermostat bypass

An integral part of a thermostat control that enables a preset volume of gas to bypass the thermostat valve.

1.3.104 Town gas

See **Gas**.

1.3.105 Turndown gas consumption

The lowest setting of the burner control or the thermostat bypass, whichever is the lower.

1.3.106 Valve

A device for the purpose of controlling or shutting off flow.

1.3.107 Wobbe index (Wobbe number)

The Wobbe index of a gas is—

$$\frac{\text{Heating value}}{\sqrt{\text{Relative density}}}$$

TABLE 1.1
TEST GAS TABLE

Test gas	Application	Composition, percent							Characteristics*		
		Hydrogen	Methane	Propane	Propylene	Butane	Nitrogen	Air	Heating value MJ/m ³	Relative density	Wobbe index MJ/m ³
N	NG	—	97.5	1	—	—	1.5	—	37.8	0.571	50.0
Na		—	86	14	—	—	—	—	45.7	0.692	55.0
Nb		13	87	—	—	—	—	—	34.4	0.492	49.1
Nc		—	90	—	—	—	10	—	34.0	0.596	44.0
S		—	—	55	—	—	—	45	52.1	1.296	45.7
X	LP Gas	—	—	100	—	—	—	—	95.8	1.553	76.9
Y		—	—	—	—	100	—	—	125.7	2.078	87.2
Z		—	—	—	100	—	—	—	88.5	1.476	72.9
T	TLP	—	—	27	—	—	—	73	25.4	1.142	23.8
Ta		—	—	29	—	—	—	71	27.3	1.153	25.5
Tb		—	—	25	—	—	—	75	23.6	1.131	22.1
A	TG	50	—	18	—	—	32	—	23.0	0.619	29.2
B		65	—	7	—	—	28	—	14.5	0.423	22.2
C		28	—	18	—	—	54	—	20.3	0.817	22.5
D		50	—	15	—	—	35	—	20.2	0.602	26.0

The reference conditions for the characteristics are 15°C, 101.325 kPa, dry. The test gases shall be of a composition and of combustion characteristics as shown in the table. Where base gases of the required combustion or purity are not available, suitably blended gases of the same Wobbe Index and other combustion characteristics may be used. In case of dispute, strictly those gases shown in this table shall be used.

NOTE: The listed characteristics for test gas 'Y' are based on the properties of isobutane.

SECTION 2 DESIGN AND CONSTRUCTION

2.1 GENERAL

2.1.1 Preliminary specification

Testing shall not commence until the manufacturer's written description of the appliance and the instructions for installation and operation, sufficient for testing, have been submitted. The appliance shall not be dismantled for specification study until testing has been completed.

2.1.2 Physical inspection

Before any physical performance testing as set out in Sections 3, 4 and 5 takes place the appliance shall satisfy the design and construction and other requirements as set out in this Section to ensure that it does not possess any obvious features that would prevent its certification. If the appliance is not considered satisfactory, no time will be spent in testing until the manufacturer has made the necessary adjustments.

2.1.3 Certification of safety components

All components relating to the safety of the gas burning operation shall be separately certified or shall be certified as part of the appliance against the requirements of the relevant component Standard(s).

NOTE: This includes, for example, automatic ignition systems, flame safeguards, flue cowls and pressure switches whether or not these carry gas.

2.1.4 Programmable electronic systems

Where a programmable electronic system (PES) is employed for safety-related functions of burner management systems, the PES shall—

- (a) conform to the relevant requirements of AS 4625 and EN 298 (or equivalent); or
- (b) be certified by a body recognized by the certifying body (see Clause 1.3.16) to the requirements of EN 298 (or equivalent).

2.1.5 Manual shut-off gas valves

Manual shut-off valves fitted to an appliance shall be approved as Type 1 or Type 2 in accordance with the classification specified in AS 4617.

2.1.6 Classification of safety shut-off valves

Where a safety shut-off system is required, the minimum classification of the safety shut-off valve fitted shall be selected in accordance with Table 2.1.

TABLE 2.1
SAFETY SHUT-OFF VALVE(S) SELECTION AND CLASSIFICATION

Burner type	Standard and classification
Atmospheric	AS 4620 or AS 4629 Class 3
Induced draught	AS 4629 Class 3
Forced draught with air pressure not exceeding 3 kPa	AS 4629 Class 2
Forced draught with air pressure exceeding 3 kPa	AS 4629 Class 1

NOTE: Refer to Clause 2.7.4 for fitting of flame safeguard systems.

2.1.7 Power failure

During a power failure the appliance shall not be activated automatically when the gas controls are in the 'off' position.

2.1.8 Fluing

All appliances shall be flued.

2.1.9 Automatic operation

All appliances shall be designed for automatic operation.

2.1.10 Draught diverter

An open-flued appliance shall have a draught diverter or alternative system as an integral part of the appliance to prevent an unsafe condition caused by changes of pressure in the flue. The relief opening of this system shall be connected directly to the same space from which the air for combustion is drawn.

2.1.11 Thermostat connection

Provision shall be made for connecting a suitable thermostat to appliances.

2.1.12 Sharp edges

Parts with which the installer, service person or user is likely to come in contact shall not have sharp points or edges.

2.1.13 Handles and knobs

Handles and knobs shall be located to minimize accidental touching of hot surfaces.

2.1.14 Continuity of satisfactory operation

Construction of an appliance shall be such that continuity of satisfactory operation can be expected during normal usage.

2.1.15 Insulation

Insulation shall be fitted in such a way that it is not rendered ineffective or objectionable by settling, dislodgement or condensation during the normal operation of the appliance.

Insulation shall be protected against rodents.

2.1.16 Protection of vitreous enamel

Screw heads in contact with cover coat vitreous enamel shall be provided with means of preventing enamel damage.

This provision is optional in the case of ground coat or wiped areas.

2.1.17 Means of support

The appliance shall be provided with adequate means of support, which shall not allow the appliance to rock on a level surface or have sharp edges in contact with the floor.

2.1.18 Alternative forms

If an appliance is designed so that certain components may be fitted or omitted (e.g. legs), the appliance shall comply with all requirements in its alternative forms.

2.1.19 Means of ignition—Room-sealed appliances

The means of ignition for an outdoor or room-sealed, appliance shall be incorporated as part of the appliance.

2.1.20 Locking of adjusting devices

Adjusting devices shall be provided with locking arrangements that shall be sufficiently positive to prevent subsequent movement, either through accident or through the creep of sealing material. The tightening of a locking device shall not alter the setting.

2.1.21 Sealing of programmed ignition adjustments

Adjusting devices for programmed ignition shall be sealed against unauthorized alteration to settings.

2.1.22 Gas pressure measurement

Readily accessible means shall be provided to allow the gas pressure in the appliance to be measured while the appliance is in operation. Pressure test points shall be designed to suit 6 mm bore flexible tubing and shall contain a limiting orifice not exceeding 1.0 mm diameter or equivalent restriction.

2.2 MATERIALS

2.2.1 General

The quality and thickness of the materials used in the construction of an appliance, and the method of assembling the various parts, shall be such that the constructional and performance characteristics do not alter significantly during a reasonable life and under normal conditions of installation and use.

In particular, when the appliance is installed according to accepted practice, all components shall withstand the mechanical, chemical and thermal conditions to which they may be subjected in the course of normal operation.

2.2.2 Materials containing asbestos

Materials containing asbestos shall not be used.

2.2.3 Materials in contact with gas

Materials in contact with gas shall be suitable for all gases.

2.2.4 Zinc-based alloys

Zinc-based alloys shall not be used in contact with water. Where failure of a zinc-based alloy may affect the safe operation of the appliance—

- (a) the alloy shall comply with AS 1881—TYPE ZN AL 4;
- (b) the alloy shall not be exposed to a temperature exceeding 80°C during normal operation of the appliance; and
- (c) under the conditions of Paragraph B1 of Appendix B the alloy shall not swell, crumble or develop cracks.

2.2.5 Components required to be placed in a flame

Pilot burners, thermocouples and other components required to be placed in a flame shall be resistant to the effects of heat and corrosion. When refractory alloys are being used they shall not produce a catalytic cracking effect. Nickel alloys having less than 1% nickel, such as AISI 416 steel, shall be acceptable.

2.2.6 Spark electrodes

Spark electrodes shall—

- (a) be made of high grade alumina cement or equivalent; and
- (b) have the firing tip made of nickel-chromium steel or equivalent.

2.2.7 Protection of aluminium tubing

Aluminium tubing in areas of restricted ventilation shall be provided with a protective barrier to prevent corrosion due to contact with condensation, insulation and other materials of the appliance.

2.2.8 Thermal insulation

Thermal insulation shall be incombustible, not produce obnoxious odours or fumes, and not corrode materials with which it is in contact.

2.2.9 Compression fittings

Compression fittings on gas lines shall comply with the following conditions:

- (a) They shall be made to an acceptable standard and the mating surfaces shall be compatible.
- (b) The nominal outside diameter of the tube shall not exceed 20 mm.
- (c) Loose olives, where used, shall be symmetrical to prevent incorrect assembly.
- (d) Shear olives, where used, may be asymmetrical.
- (e) After making and breaking the fittings ten times and applying the torque value as listed in the table below to remake the fittings, the joints shall comply with the requirements of Clause 3.3.

Nominal size mm	Torque Nm
6	15
8	20
10	35
15	50
20	75

- (f) The component parts shall be made of materials with a melting point of not less than 430°C.

2.2.10 Corrosion resistant base

The base of an appliance intended to stand on surfaces that may become wet shall be designed to resist corrosion of the base material.

2.3 ELECTRICAL SYSTEMS

2.3.1 Connection to the mains electrical supply

Appliances intended for connection to the mains electrical supply may be required by electrical safety regulations to comply with the requirements of AS/NZS 3820.

2.3.2 Motor bearings suitability

Details and specifications shall be supplied by the manufacturer showing that bearings of motors, blowers or fans shall be of a type suitable for the temperatures to which they are subjected in normal operation.

Normal operation shall mean operation at nominal gas consumption with the fan operating at all fan speeds (including the 'off' position if the appliance will function in that condition).

2.4 INSTALLATION REQUIREMENTS

2.4.1 Fixing of gas inlet connection

The gas inlet connection shall be firmly fixed. The regulator shall be anchored to prevent rotation while making the connection. This requirement shall be deemed to be met if the regulator can be held in position by means of a spanner while making the connection in accordance with the manufacturer's installation instructions.

2.4.2 Gas inlet connection thread

The gas inlet connection shall have a thread in accordance with AS ISO 7.1 or AS 1722.2.

2.4.3 Access to connections

The gas inlet connection shall be located so that sufficient free space is available for the union connection to be made or disconnected.

2.5 MAINTENANCE REQUIREMENTS

2.5.1 Dismantling and replacement by the user

Any dismantling required by the user shall be easily carried out without tools or undue force. Any replacement shall not require undue force, and incorrect replacement shall be either impossible or completely obvious.

2.5.2 Insertion and removal of gas injectors

Removable gas injectors shall be made so that they can be inserted and removed without damage.

2.5.3 Assembly and attachment of handles, dials and pointers

Valve handles, movable dials and pointers shall be designed so that they are incapable of being incorrectly assembled, shall be securely attached to their spindles and shall not contain loose parts that may become detached when the handles are removed.

2.5.4 Accessibility for adjustment

Components and integral parts that may require adjustment shall be accessible for such adjustment. In particular, the following items shall be readily and easily adjusted without risk of injury while the appliance is installed:

- (a) Aeration controls. (It is acceptable for the adjustment to be finalized with the burner removed, provided the setting will not be disturbed during removal.)
- (b) Pilots.
- (c) Thermostat bypasses (where provided).
- (d) Thermostat calibration.
- (e) Regulator adjustments.
- (f) Ignition devices.
- (g) Safety devices.
- (h) Slow lighting adjusters.

2.5.5 Accessibility for replacement

Components that are required to be removed for service shall be constructed and attached to the appliance so that they can be removed and replaced. In particular, except in the case of appliances readily disconnected and easily handled by one person, the following components shall be readily removed from and replaced in the appliance without undue risk of injury, and without moving the appliance from the installed position:

- (a) Regulator diaphragms and valves (body exempt).
- (b) Gas valve plugs.
- (c) Injectors.
- (d) Thermostats, complete including sensing elements.
- (e) Filters.
- (f) Pilot head assemblies, pilot jets.
- (g) Clocks and timers.
- (h) Door springs or other door control mechanisms.
- (i) Burners.
- (j) Ignition devices.
- (k) Flue baffles when flue cleaning is necessary.
- (l) Slow lighting adjusters.
- (m) Automatic control equipment.
- (n) Safety shut-off systems.
- (o) Fans, electric motors and drives.

2.5.6 Screwed connections

Components and assemblies of components with screwed connections shall be provided with flats for spanners unless accessible unions are provided on inlet and outlet connections.

2.5.7 Inaccessible nuts or bolts

Nuts or bolts in inaccessible positions securing parts requiring to be removed for service shall be captive.

2.6 PRESSURE REGULATORS

2.6.1 Provision of a pressure regulating device

A certified gas pressure regulator shall be provided with each appliance intended for operation on NG, TG, and TLP. Where practicable the regulator should be fitted within the perimeter of the appliance.

Regulator outlet pressures nominated by the appliance manufacturer shall not exceed—

- (a) town gas, TLP: 0.63 kPa
- (b) natural gas: 1.00 kPa

2.6.2 Positioning of pressure regulators

Regulators shall be placed so that—

- (a) breather holes cannot easily be blocked; and
- (b) overheating and the risk of ignition of any gas leaking from the breather holes is minimized.

2.7 GAS CONTROLS AND SAFETY SHUT-OFF SYSTEMS

2.7.1 General

The operation of safety devices shall not be overridden by any other devices.

2.7.2 Accessibility of controls

Where controls are required to be operated by the user, they shall be accessible and easily operated.

2.7.3 Accidental change of settings

Gas valves, movable dials and pointers shall be designed or located so that they avoid accidental changes of setting during use.

2.7.4 Provision of flame safeguard

A flame safeguard system shall be fitted to every appliance to shut off all gas to the appliance in the event of flame failure at the point of supervision.

2.7.5 Automatic shut-off valves

An automatic shut-off valve(s) shall be connected in the safety shut-off system in such a manner that it will shut off when an unsafe condition develops.

All gas to the main burner shall pass through at least two automatic shut-off valves in series, which may or may not be in a single control body. One valve shall be actuated by the temperature control device and the other by the device(s) specified in Clauses 5.8.4.7 and 5.8.4.8 unless all devices control both valves.

2.7.6 Pilot burner failure

Failure of any pilot burner shall cause the safety shut-off valve(s) to close.

2.7.7 Multiple burner units

If two or more burner units are served by a common valve train, the supervisory pilot of each burner unit shall function to shut off the gas supply to the valve train serving these burner units, in the event of pilot flame failure.

2.7.8 Independent supervised ignition systems

On multiple burner installations where individual main burners are fitted with independent, supervised ignition systems, flame failure of a burner shall be followed by a normal start procedure on that burner.

2.7.9 Thermostatic control

Appliances shall be thermostatically controlled.

2.8 COMBUSTION AIR SUPPLY AND CONTROLS

2.8.1 Combustion air supply equipment

The combustion air supply equipment shall be supplied with the appliance and shall be correctly sized and arranged to ensure a non-pulsating air flow that is adequate for all operating conditions specified by the manufacturer.

2.8.2 Combustion air flow proving interlock

The combustion air flow proving devices shall be interlocked to cause lockout or prevent an ignition attempt unless the devices are in the 'no flow' condition prior to the startup of their respective supply fans.

2.8.3 Prevention of combustion air backflow

Where air at pressure is pre-mixed with the fuel gas, effective means shall ensure air does not pass back into the gas line.

2.9 IGNITION, PILOTS AND MAIN BURNERS

2.9.1 Remote manual ignition

The remote manual ignition of a burner, including pilots, shall be visible or visibly indicated to the user while operating the ignition devices and the appropriate gas controls.

2.9.2 Direct manual ignition

The direct manual ignition of a burner, including pilots, shall be accessible and visible while operating the appropriate gas controls.

2.9.3 Prevention of injury at ignition

The method of ignition shall be such that it is not necessary to place a hand in a position where injury may occur when ignition takes place.

2.9.4 Manually operated burners in an enclosed compartment

Where manually operated burners are enclosed in a compartment in which an explosive accumulation of gas can occur, it shall be necessary to open the compartment to light the burner.

2.9.5 Burners interconnected by flues or passages

When two or more burners are enclosed in the same compartment, or compartments that are interconnected by flues or other passages, the gas system shall be designed so that—

- (a) each burner has a flame safeguard; or
- (b) there is safe and reliable cross ignition between the burners (see Clause 4.5).

2.9.6 Means for turning off pilot burner gas supply

Means shall be provided for turning off the gas supply to a pilot burner.

2.9.7 Means of ignition

Appliances not fitted with permanent pilots shall incorporate programmed ignition.

2.9.8 Viewing of flames

It shall be possible to view burner flames either directly or by use of a mirror with doors closed and a panel or part removed.

2.9.9 Proving that a burner is alight

It shall be possible to prove that a burner or pilot is alight when the appliance is in operation in the installed position.

2.9.10 Location of flash lighting tubes

Flash or cross lighting tubes shall be positively located in relation to source of ignition and flame ports, to prevent misalignment or rendering of the lighting system inoperative, by normal handling, dismantling or reassembling, or cleaning of the appliance.

2.9.11 Cross lighting

Where cross lighting flames are necessary to accomplish satisfactory ignition between adjacent rows of ports or adjacent burners, cross lighting shall be effected by more than one series of ports or by other means that have been demonstrated to be satisfactory in the field.

2.9.12 Support of pilots, igniters and flame-sensing devices

Pilot burners, igniters and flame-sensing devices shall be supported in such a manner that their position relative to each other and the main burner(s) shall remain fixed.

2.9.13 Location of burner mixing tubes

Burner mixing tubes shall be positively located in relation to gas injectors. Where a mixing tube rests on an injector, provision shall be made to prevent the mixing tube from interfering with the correct functioning of the valve or injector.

2.9.14 Burner supports

Burner supports shall be such that the burners cannot be easily displaced in normal usage.

2.9.15 Fixing of gas manifolds

Gas manifolds shall be firmly fixed to prevent displacement during handling and installation.

2.9.16 Protection of ports and injectors

Any ports and injectors of main and pilot burners that may be exposed in their normal operation to falling particles shall be protected against blockage.

2.9.17 Restriction on gauze over primary air ports

Gauze shall not be fitted over primary air ports of burners other than pilot burners.

2.9.18 Pilot gas filters

Gas filters shall be provided for continuously burning pilots of 0.5 MJ/h or less capacity (optional for LP Gas).

2.9.19 Aeration adjustment for universal LP Gas appliances

For universal LP Gas appliances, primary burner aeration shall be non-adjustable.

2.10 FLUEING REQUIREMENTS

2.10.1 Design of air entry and combustion product discharge

Appliances shall be designed so that flueway terminals, draught diverter relief openings and openings for the entry of air for combustion are part of the appliance structure, and are unlikely to be obstructed by cabinets, walls or partitions on or in which the appliance is installed. In the case of appliances specifically designed to be built-in, any clearance necessary to the safe and effective operation of the appliance shall be ensured by means of permanently attached spacers.

2.10.2 Design of flue connection

The flue connection shall provide means to prevent partial or complete blockage of flueways caused by the fitting of a flue pipe.

Flue connections shall be designed to accommodate both fibre cement where available and sheet metal flue pipe. The use of an adapter to achieve this purpose shall be considered satisfactory. For fibre cement flue pipe, the flue spigot of the appliance shall be no larger than the nominal (internal) pipe size minus 5 mm, or alternatively the flue socket shall be no smaller than the nominal pipe size plus 13 mm.

The connection for a secondary flue shall provide at least 13 mm engagement for vertical outlets and at least 25 mm for horizontal outlets.

2.10.3 Design of flue baffles and draught diverters

Flue baffles and draught diverters shall be constructed so that they cannot be installed in none other than the correct position.

2.10.4 Flue terminal openings

For outdoor and room-sealed appliances, in order to ensure against the entry of birds, no opening of the flue terminal shall permit the entry of a ball of 16 mm diameter.

2.11 MARKINGS AND LABELS

2.11.1 Markings on packaging or appliance

The packaging, or the appliance where there is no packaging, shall be marked in a prominent position with—

- (a) the text ‘TO BE INSTALLED ONLY BY AN AUTHORIZED PERSON’;
- (b) the text ‘THE INSTRUCTIONS PACKAGED WITH THIS APPLIANCE CONTAIN IMPORTANT INFORMATION ABOUT INSTALLATION AND USE’;
- (c) the maximum packaged weight in kilograms; and
- (d) the methods of installation for which the appliance is certified.

2.11.2 Gas type label

A label shall be firmly attached in a prominent position on each appliance stating the type of gas for which it has been manufactured and adjusted. Its colour shall be that appropriate to the gas specified, as shown in the schedule in Clause 2.11.3.

For appliances intended for use with a flexible connection, additional wording shall refer to the local gas authority for confirmation of the gas type, if in doubt.

2.11.3 Gas type colour code

Where a colour code is used to indicate the type of gas for which an appliance or component is to be used, it shall comply with the following:

- | | |
|--|-------------|
| (a) Natural gas: | Black |
| (b) Town gas: | Dark blue |
| (c) Universal liquefied petroleum gas: | Signal red |
| (d) Propane only: | Orange |
| (e) Butane only: | Grass green |
| (f) Tempered liquefied petroleum gas: | Pink |
| (g) All gases: | Primrose |

2.11.4 Identification of injectors

Removable injectors shall carry an identifying cipher. The cipher shall be in the form of numerals indicating the orifice size in millimetres or the BS number of the injector. In the case of pilot injectors, a colour coding in accordance with Clause 2.11.3 is acceptable. Alternatively the injector size may be marked on the appliance.

2.11.5 Marking of fans

The direction of rotation of fans shall be clearly and permanently marked where incorrect fitting of a fan is possible.

2.11.6 Markings on appliances

Appliances shall be provided with clear and permanent markings that are readily accessible and easy to read, and such markings shall include the following:

- (a) Certificate holder’s trade name or identifying symbol.
- (b) Model designation.
- (c) Month and year of manufacture or serial number where this is documented to show month and year of manufacture.
- (d) Gas or gases for which the appliance is intended to be used.

- (e) Total nominal gas consumptions in MJ/h, and test point pressures in kPa for each gas nominated in (d).
- (f) For main burners with an adjustable bypass and that are ignited by a pilot, the main burner test point pressure in kPa at the bypass rate for each gas nominated in (d).
- (g) Electrical markings as required by the appropriate electricity authority.
- (h) Wiring diagrams.
- (i) The certification number.
- (j) Where an appliance is required to be installed on a non-combustible floor, the marking 'TO BE INSTALLED ON A NON-COMBUSTIBLE BASE'.
- (k) The appropriate warning label as shown in Figure A1 in Appendix A.
This label shall be located on the outside of the appliance in a position where it can be easily read by the operator when the appliance is in the installed position.
- (l) Open-flued appliances shall include in the markings the warning 'FOR INSTALLATION INDOORS ONLY'.
- (m) For appliances suitable for indoor installation only, the text: 'CERTIFIED FOR INDOOR INSTALLATION ONLY'.
- (n) For appliances suitable for outdoor installation only, the text: 'CERTIFIED FOR OUTDOOR INSTALLATION ONLY'.
- (o) Instructions as required in Clause 2.12.3.4.
- (p) Any additional information called for in other sections of this Standard.

2.11.7 Marking of doors and covers

Specific doors, covers and other components that need to be left open, closed or removed during operation shall be indicated with a permanent marking. Access panels that are required to be left in position during operation shall be indicated by a permanent marking.

2.11.8 Warning label regarding removing of components

If the removal of any part of any appliance could cause interference with flueing or the entry of combustion air, suitable warning stickers shall be attached to the appliance.

2.11.9 Flue terminal marking

Indoor power-flued appliances venting through a wall shall be provided with a durable label stating:

'THIS TERMINAL MUST ALWAYS VENT DIRECTLY TO OUTDOORS'.

This label shall be fixed to the flue terminal or guard.

2.11.10 Design conditions

Appliances shall bear a permanent label stating the static pressure rise and air flow, or alternatively, the maximum temperature rise for which the appliance has been certified.

When an appliance with the same model number has been tested and found satisfactory for operation at more than one air flow or for different static pressure conditions (no change in the appliance other than blower or motor), the various combinations shall be tabulated on such a permanent label.

2.11.11 Energy label

The energy star rating label, as illustrated in Figure A12 in Appendix A, and incorporating the annual energy consumption and star rating (see Clause 5.17), shall be affixed in a prominent position on each appliance.

2.11.12 Gas valve 'off' position

The 'off' position for all gas valves shall be clearly indicated. Gas valves serving more than one function shall have the position of each function, including any special lighting position clearly indicated.

2.12 INSTRUCTIONS

2.12.1 Documents remaining with user

Any document referencing servicing instructions, supplied with the appliance and remaining with the consumer, shall contain a warning that servicing shall be carried out only by authorized personnel.

2.12.2 Installation

Each appliance shall be supplied with installation instructions that include reference to the following:

- (a) Model or type of appliance.
- (b) Gas or gases for which the appliance is intended and data such as gas consumption, pressure, etc., or reference to the appliance data plates.
- (c) The requirements of AS/NZS 5601 and the authority—gas or electricity.
- (d) Overall dimensions of the appliance and location by measurement of connecting points of gas, air handling ducts, electricity, etc.
- (e) The alternative types of installations that may be made.
- (f) Details of the methods of connection and alternatives.
- (g) Required surroundings of the appliance, (e.g. clearance from cupboards and fixings, walls, curtains, floors, or other combustible material) to ensure adequate accessibility and adequate access for ventilating and combustion air supplies.
- (h) Special conditions of installation, which may be required as the result of the certification test.
- (i) Special conditions that shall be avoided (e.g. marine environment), and any conditions necessary to ensure optimum performance.
- (j) Details of any assembly work required to be done by the installer.
- (k) Definite instructions for installer to test the operation of the appliance before leaving.
- (l) Details of the necessary testing to insure that the air flow is within the range nominated on the data plate.
- (m) Instructions on the procedure to be adopted if the appliance cannot be adjusted to perform correctly.
- (n) Wiring diagram of electrical connections to the unit.
- (o) A statement that the appliance shall not be installed downstream from evaporative coolers, air washers or cooling units of refrigerating system unless its heating element is made of corrosion-resistant material.

2.12.3 Operating

2.12.3.1 General

Operating instructions shall be supplied with each appliance, covering each separate function of the appliance and such dismantling, cleaning and assembly as is necessary for the user. For programmed appliances, these instructions shall include a clear explanation of programming and the effect of any power supply interruption.

2.12.3.2 *Service-related information*

The instructions shall—

- (a) assist the user to recognize abnormal operation that requires service;
- (b) recommend a maintenance schedule for the life expectancy of the appliance; and
- (c) include a reference to where service and any necessary replacement parts may be obtained.

2.12.3.3 *Safety warnings*

The instructions shall contain the statement:

‘DO NOT PLACE ARTICLES ON OR AGAINST THIS APPLIANCE.

DO NOT USE OR STORE FLAMMABLE MATERIALS NEAR THIS APPLIANCE.

DO NOT SPRAY AEROSOLS IN THE VICINITY OF THIS APPLIANCE WHILE IT IS IN OPERATION.

DO NOT MODIFY THIS APPLIANCE.’

2.12.3.4 *Lighting instructions*

Where incorrect lighting and shutdown procedures can result in a hazardous condition, appliances shall be provided with clearly defined and complete instructions. Where necessary, lighting instructions shall require a safe purge before the appliance is re-lit.

2.12.3.5 *Servicing instructions*

Servicing instructions shall be available and they shall include reference to the following:

- (a) Removal of covers and other parts for access to all components.
- (b) Removal of components for service—
 - (i) burner equipment;
 - (ii) pilot and flame safeguard;
 - (iii) ignition system; and
 - (iv) thermostat.
- (c) Parts replacement—
 - (i) fan;
 - (ii) glass panel;
 - (iii) over-temperature cut-out device; and
 - (iv) heat exchanger.
- (d) Adjustments—
 - (i) pilot;
 - (ii) aeration;
 - (iii) thermostat calibration, where applicable; and
 - (iv) ignition (spark gap).
- (e) Fault finding chart.
- (f) Wiring diagram.

2.12.3.6 *Inclusion of warning to prohibit unauthorized servicing*

Servicing instructions remaining with the consumer shall contain a warning that servicing shall be carried out only by authorized personnel.

Servicing instructions shall clearly state ‘DO NOT MODIFY THIS APPLIANCE’.

SECTION 3 PRELIMINARY TESTS — LINE GASES

3.1 GENERAL REQUIREMENTS

3.1.1 Introduction

The nominal gas consumption in MJ/h, as specified by the manufacturer, is the fundamental quantity on which all methods of test are based and is the starting point for all performance requirements.

Before commencing testing in this Section, refer to Clause 2.1.1 for general design and construction requirements.

3.1.2 Test gases

Tests in all parts of this Standard (except Section 4, which requires the use of some special gases in addition to those listed here) shall be carried out using the following test gases:

- (a) Appliances intended for use with natural gas shall be tested using available natural gas, but in the case of dispute or borderline results, test gas 'N' shall be used.
- (b) Appliances intended for use with town gas shall be tested using available town gas but in the case of dispute or borderline results, test gas 'D' shall be used.
- (c) Appliances intended for use with propane only shall be tested with test gas 'X'.
- (d) Appliances intended for use with butane only shall be tested with test gas 'Y'.
- (e) Universal LP Gas appliances are intended for use with propane, butane or any mixture of propane and butane, and shall be tested with test gas 'X' for all performance tests, except for Clauses 5.9 and 5.10 where test gas 'Y' shall be used.

Nominal gas consumption shall be rated on test gas 'X' and this is the figure to be stated on the appliance data plate.

- (f) Appliances intended for use with TLP shall be tested with test gas 'T'.

NOTE: See Table 1.1 for gas characteristics.

3.2 PREPARATION FOR TESTING

3.2.1 Electrical safety requirements (earth leakage)

The appliance shall comply with the following electrical safety requirements:

- (a) When the appliance is disconnected from the power supply, the measured resistance between the earth pin of the plug and any exposed metal on the appliance shall not exceed 1 Ω for rotating parts and 0.1 Ω for all other parts.
- (b) When the appliance is disconnected from the power supply, the measured insulation resistance between current-carrying conductors and any exposed metal shall not be less than 1 M Ω . The resistance for double insulated equipment shall not be less than 10 M Ω .

All appliance switches shall be in the 'on' position.

3.2.2 Setting up appliance for testing

The appliance shall be set up in accordance with the manufacturer's instructions unless otherwise specified in these certification test requirements, and checked that gas consumption, aeration, temperature settings and other adjustments have been made in accordance with the manufacturer's recommendations. Adjustments should be made with the test gas that is applicable (see Clause 3.1.2) with the inlet pressure set at normal test gas pressure (see Clause 1.3.67).

3.2.3 Appliance regulators not to be removed during testing

Appliance regulators shall be considered an integral part of the appliance and shall not be removed during tests, unless specifically instructed otherwise.

3.2.4 Protection from accidental draughts

The appliance under test shall be protected from accidental draughts.

3.2.5 Prevention of gas rate variation

Provision shall be made to prevent thermostats, or any other variable restrictions in the gas line, from varying during tests except as necessitated by the requirements.

3.2.6 Gas pressure and gas volume test equipment

The following equipment shall be used for the control of testing pressures and the measurement of gas volume:

- (a) A wet test gas meter, which shall be calibrated before use.

NOTE: A graph should be provided showing the meter's error or correction factor over as wide a range as possible.

The following also applies to the test gas meter:

- (i) A saturator is used with a wet test gas meter to ensure saturation of the gas.
 - (ii) It is permitted to use a calibrated dry gas meter or a calibrated flow meter for test purposes, but in case of dispute, the wet meter shall be the reference standard.
- (b) An adjustable regulator of adequate capacity, fitted to the meter inlet.
- (c) Pressure gauges connected to meter inlet, appliance inlet and pressure test point, to read to the nearest 10 Pa.
- (d) A thermometer, graduated to at least 0.5°C, installed to measure the gas temperature. The meter water temperature gives a sufficiently accurate figure.
- (e) A barometer to measure atmospheric pressure in the laboratory, correct to 30 Pa.
- (f) A means of determining within 1% the heating value of the gas being used.
- (g) A means of determining within 2% the relative density of the gas being used.

3.3 GAS LEAKAGE

3.3.1 Gas circuit soundness

The fully assembled appliance shall be gastight when subjected to an inlet gas pressure of 14.0 kPa—

- (a) on initial setup; and
- (b) at the conclusion of all certification tests.

3.3.2 Bleed lines

Gas-actuated controls shall be constructed so that there is no continuous bleed during the 'off' period. The bleed line shall be terminated with a suitable heat-resistant tip and positioned so that bleed-gas is ignited.

Bleed lines from diaphragm-type automatic valves shall terminate in a location to ensure that—

- (a) ignition of the bleed-gas by the main burner or pilot is assured; and
- (b) blockage of the bleed line tip is prevented.

3.4 GAS CONSUMPTION

3.4.1 Tolerance on determined gas consumption

The determined gas consumption in MJ/h of each burner shall be within 5% of nominal gas consumption.

3.4.2 Determined gas consumption of permanent pilots

The determined gas consumption of each continuously burning pilot shall not be more than 0.5 MJ/h except where—

- (a) heat is employed for operating a safety device, in which case it shall not exceed 1.0 MJ/h; and
- (b) it is used as part of a safety system.

3.5 GAS PRESSURE REGULATORS

Except for LP Gas appliances, the regulator outlet pressure shall not vary by more than $\pm 20\%$ from the nominal outlet pressure when the appliance inlet pressure is varied from 1.13 kPa up to 5.0 kPa for natural gas appliances and 0.75 kPa up to 3.0 kPa for town gas and TLP appliances.

3.6 IGNITION AND SAFETY SHUT-OFF SYSTEMS

3.6.1 Requirements applicable to all ignition and safety shut-off systems

3.6.1.1 Aerated pilots

- (a) When lit back, aerated pilots shall either ignite the main burner promptly and without undue noise or cause a safety shut-off valve to close.
- (b) When their primary air opening is closed, aerated pilots shall either ignite the main burner promptly and without undue noise or cause the safety shut-off valve to close.

3.6.1.2 Ignition at reduced pilot rate

When the pilot flame is turned down to the point where it will just actuate the flame safeguard system, the main burner, operating at any rate at which its control will permit, shall light safely and reliably from that pilot flame.

3.6.1.3 Means of ignition other than permanent pilot

For any means of ignition other than a permanent pilot, when the voltage supplied to the appliance is lowered to any point where the main gas valves will still actuate, the main burner, operating at any rate at which its control will permit, shall light safely and reliably from that means of ignition, or the appliance shuts down safely.

3.6.1.4 Multi-port pilots

Multi-port pilots shall conform to Clauses 3.6.1.1 and 3.6.1.2, with all ports blocked other than the one activating the flame safeguard sensor.

3.6.1.5 *Holding time for thermoelectric flame safeguard*

On carrying out the normal lighting procedure on a manually ignited atmospheric burner protected by a thermoelectric flame safeguard system, the flame safeguard shall hold open within 1 min of igniting the operating flame.

3.6.1.6 *Flame safeguard required*

Burner systems shall be supervised by a certified flame safeguard system.

3.6.1.7 *Flame travel at ignition*

Flames shall travel freely to all ports on a burner when gas is ignited on any one port.

3.6.1.8 *Cessation of ignition spark*

The ignition spark or other means of ignition shall cease at the end of the start flame establishment period, except where an interrupted pilot is used, and then it may continue until the main flame is established, provided that after the pilot flame establishment period is completed, the electric spark shall not be able to activate the pilot flame detector.

3.6.1.9 *Commencement of ignition after purge period*

Where a preignition purge period is included, the means of ignition shall commence immediately after the purge period is completed. The duration of a mechanical preignition purge shall be sufficient to ensure that the volume of the purging medium is at least five times the purge volume.

NOTE: Appendix H illustrates a typical operating sequence for automatic burners.

3.6.1.10 *Proving of start flame*

Gas shall not flow beyond the start flame establishment period unless the start flame has been proven. Where the start rate is less than the maximum rate, the start flame shall be proven before the gas rate increases beyond the start flame rate.

3.6.1.11 *Self-check for safety shut-off systems*

Safety shut-off systems shall incorporate a self-check of integral circuitry to prove that the system is not in the flame-proved condition prior to startup. Manually-operated thermoelectric flame safeguards are exempt from this requirement.

3.6.1.12 *Flame failure*

Flame failure of the supervised burners shall result in lockout in accordance with Clause 2.7.4 (see Clause 3.6.2.1.4 for reignition attempt conditions for automatic atmospheric burners and Clause 3.6.2.2.3 for forced and induced draught burners).

3.6.1.13 *Flame establishment period for intermittent pilot*

Where an interrupted or intermittent pilot is used, the main flame establishment period shall not exceed 5 s.

3.6.1.14 *Shut-off time for safety shut-off system*

The combined time for the safety shut-off system and its associated valves to shut off the gas supply in the event of flame failure at the point of supervision shall not exceed—

- (a) 90 s where atmospheric type main burners are used, and the total gas consumption is up to and including 50 MJ/h;
- (b) 60 s where atmospheric type main burners are used, and the total gas consumption exceeds 50 MJ/h up to and including 150 MJ/h;
- (c) 45 s where atmospheric type main burners are used, and the total gas consumption exceeds 150 MJ/h up to and including 500 MJ/h; and
- (d) 3 s for all other types of main burner.

3.6.1.15 *Interrupted pilot*

Where an interrupted pilot is used the main flame shall be proved on its own at the end of the main flame establishment period.

3.6.2 Automatic burner ignition systems—Additional requirements

NOTE: Systems based on permanent pilots are exempted from this Clause.

3.6.2.1 *Atmospheric burners*

3.6.2.1.1 *Start flame establishment period*

The start flame establishment period shall not exceed 5 s except—

- (a) for start gas rates up to 50 MJ/h—15 s; and
- (b) for start gas rates up to 4 MJ/h—90 s.

3.6.2.1.2 *Ignition gas flow rate*

The gas flow rate at the time of ignition shall meet one of the following criteria:

- (a) The gas flow rate in MJ/h shall not exceed $200 \frac{V}{T}$

where.

V = the volume of the combustion chamber in cubic metres.

T = is the start flame establishment period in seconds.

- (b) The energy released during the start flame establishment period shall not exceed 0.1 MJ.
- (c) The energy released during the start flame establishment period shall satisfactorily meet delayed ignition tests up to twice the flame establishment period.

NOTE: As this is a safety test under abnormal operation, explosive noise and flame rollout may be acceptable provided—

- (a) there is no damage to the appliance;
- (b) the burner does not light back; and
- (c) there is no danger to persons or adjacent property.

3.6.2.1.3 *Start flame proving period*

Where the nominal gas consumption of the supervised burner exceeds the maximum gas flow rate permitted in Clause 3.6.2.1.2, then there shall be a start flame proving period of not less than the flame failure response time or 5 s, whichever is the greater.

3.6.2.1.4 *Number of reignition attempts*

The total number of reignition cycles after flame failure, and prior to lockout, shall be limited to five.

Flame safeguard systems shall respond to flame failure or loss of flame detector signal by initiating a reignition cycle within 2 s.

The first reignition cycle following loss of flame shall comply with one of the following:

- (a) The ignition source is applied immediately.
- (b) Safety shutdown is followed by a full start cycle including mechanical preignition purge sufficient to ensure that the volume of the purging medium is at least five times the purge volume.
- (c) Safety shutdown followed by a delay of not less than 5 min before a reignition attempt.

Subsequent reignition cycles shall be in accordance with (b) or (c) above.

3.6.2.2 *Forced or induced draught burners*

3.6.2.2.1 *Ignition gas flow rate*

The gas flow rate at the time of ignition shall meet one of the following criteria:

- (a) The gas flow rate in MJ/h shall not exceed $200 \frac{V}{T}$

where

V = the volume of the combustion chamber in cubic metres.

T = the start flame establishment period in seconds.

- (b) Throughout the flame establishment period, the gas concentration in relation to the proved air flow rate for that period shall not exceed 50% of the lower explosive limit (LEL) for NG and TG, or 25% of the LEL for other fuels provided that—
- (i) the gases during the start gas flame establishment period are thoroughly mixed with the air flow except in the immediate vicinity of the burner; and
 - (ii) the preheated air temperature does not exceed 400°C.
- (c) The energy released during the start flame establishment period shall satisfactorily meet delayed ignition tests. These tests shall be carried out at various delay periods up to twice the flame establishment period.

NOTE: As this is a safety test under abnormal operation, explosive noise and flame rollout may be acceptable provided—

- (a) there is no damage to the appliance;
- (b) the burner does not light back; and
- (c) there is no danger to persons or adjacent property.

3.6.2.2.2 *Start flame proving period*

Where the nominal gas consumption of the supervised burner exceeds the maximum gas flow rate permitted in Clause 3.6.2.2.1, then there shall be a start flame proving period of not less than 5 s.

3.6.2.2.3 *Number of reignition attempts*

Up to five reignition attempts after flame failure may be made prior to lockout provided—

- (a) the main burner shut-off valve is closed within 3 s of loss of flame and remains closed during the preignition purge;
- (b) each reignition commences with a preignition purge and the requirements of Clause 3.6.2.2.1 are met; and
- (c) the duration of the preignition purge period is sufficient to ensure that the volume of the purging medium is at least five times the purge volume.

3.6.2.2.4 *Preignition purge period*

A preignition purge period shall be provided prior to any ignition attempt, except where purging continues during the burner 'off' part of the cycle.

SECTION 4 LIMIT GAS TESTS

4.1 GENERAL

Appliances shall comply with the requirements listed in this Section when supplied with the appropriate limit gases from the following list and under the limiting conditions specified in each Clause:

- | | |
|----------------------------------|--|
| (a) Natural gas appliances: | Limit gases Na, Nb and Nc, with an additional test for compatibility with gas S. |
| (b) Propane appliances: | Limit gases X and Z. |
| (c) Butane appliances: | Limit gas Y. |
| (d) Universal LP Gas appliances: | Limit gases X, Y and Z. |
| (e) TLP appliances: | Limit gases Ta, Tb and T |
| (f) Town gas appliances: | Limit gases A, B and C. |

For natural gas appliances, all tests on limit gases shall be performed with the aeration adjustment (if provided) set on Nc gas. If results are satisfactory on Na, Nb and Nc, but not on S gas, the aeration may be reset on S gas for a repeat test on this gas only. If results are satisfactory, a note shall be made in the test report that aeration has been reset.

For town gas appliances, aeration may be reset for each limit gas.

For TLP, the aeration shall be set on T gas.

Before commencing testing in this Section refer to Clause 2.1.1.

4.2 CO/CO₂ RATIO LIMITS FOR ANY INDEPENDENT BURNER—OVERLOAD

The CO/CO₂ ratio of the combustion products of any independent burner of an appliance operating for 10 min at the test conditions specified below shall not exceed 0.02.

The limiting condition shall be as shown in Table B2.

4.3 CO/CO₂ RATIO LIMITS FOR PERMANENT PILOTS—OVERLOAD

The CO/CO₂ ratio of the combustion products of a permanent pilot of an appliance operating for 10 min at the test conditions specified below shall not exceed 0.02.

Pilots shall be tested using the appliance inlet pressures shown in Table B3.

4.4 FLAME ABNORMALITY

A burner shall exhibit no flame abnormality at maximum and minimum limiting conditions whether the appliance is hot or cold.

An open-flued appliance fitted with a draught diverter or similar device shall comply under the following conditions:

- When the flue outlet of the appliance is closed.
- When a downdraught having a velocity head of up to 7.5 Pa is applied progressively to the flue outlet for 1 min.
- When an updraught having a velocity head of up to 7.5 Pa is applied progressively to the flue outlet for 1 min.

NOTE: A velocity head of 7.5 Pa is equivalent to a flow velocity of 3.5 m/s.

An open-flued appliance not fitted with a draught diverter or similar device—

- (i) shall comply if back pressures up to 140 Pa are applied to the flue outlet;
- (ii) shall not shutdown if back pressures up to 140 Pa are applied to the flue outlet; and
- (iii) shall shutdown safely if the flue outlet is blocked.

The limiting conditions shall be as listed in Table B4.

4.5 BURNER IGNITION AT MAXIMUM AND MINIMUM LIMITING CONDITIONS

On carrying out the normal lighting procedure, a burner (other than a pilot burner) shall ignite completely and quietly within 5 s for all gases, irrespective of types of ignition, whether manual or automatic, at maximum and minimum limiting conditions when the appliance is hot and cold. The time shall be measured from the first flow of gas.

In the case of mains ignition systems, a voltage equivalent to both 85% and 110% of the nominal supply voltage shall be applied to the appliance.

Test battery-operated ignition systems with a voltage equivalent to 100% and 80% of the nominal voltage for each battery applied to the supply contacts of the battery holder.

Five successive ignition tests shall be applied. Satisfactory ignition must occur in all five tests.

The limiting conditions shall be as listed in Table B5.

4.6 FLAME STABILITY TO DRAUGHT

When a burner has been set to turndown setting on all gases and the appliance subjected to an 8 km/h draught, complete reignition of the burner shall occur when the draught is removed, or the burner shall lockout.

The limit gases listed in Table B6 shall be used.

4.7 NOISE OF EXTINCTION

Noise of extinction shall not be excessive when the burner is turned off in a normal manner from normal and turndown settings.

4.8 BURNER STABILITY WHEN CHANGING SETTING

Burners that have a fixed turndown or bypass setting shall not light back or be extinguished when turned normally from full 'on' to turndown position, or from the turndown to full 'on' position.

The limit gases in Table 4.1 shall be used with the appliance adjusted to nominal test point pressure.

TABLE 4.1
LIMITING CONDITIONS—BURNER STABILITY

Gas	Limit gases
Natural gas	Nb, S
Propane	X
Butane	Y
Universal LP Gas	X, Y
TLP gas	Tb
Town gas	B

4.9 PILOT IGNITION AND STABILITY AT MAXIMUM AND MINIMUM LIMITING CONDITIONS

When a permanent pilot is set to the manufacturer's specifications, it shall light satisfactorily when the manufacturer's instructions are followed and the flame shall not be extinguished when—

- (a) the appliance is subjected to an 8 km/h draught; or
- (b) the gas to the main burner is turned off and on in a normal manner.

The limiting conditions shall be as listed in Table B7.

4.10 EFFECT OF OPENING AND CLOSING DOORS AT TURNDOWN CONDITION

With an appliance installed in accordance with the manufacturer's instructions, the normal opening or closing of appliance doors and other doors associated with the installation shall not extinguish any burner when tested at turndown setting on all gases. (Pilot burners shall be set in accordance with manufacturer's instruction.)

The limit gases listed in Table B8 shall be used.

4.11 UNBURNT GAS RELEASE FROM BURNER SYSTEM

Unburnt gases shall not spill from any part of the burner system except for the burner ports.

The limiting conditions shall be as listed in Table B9.

4.12 BURNER INTERFERENCE AT IGNITION OR DURING COMBUSTION

Where there is a possibility that the operation of any burner may interfere with the ignition or combustion of any other burner, including pilots, then the tests required in this Section 4 shall be repeated with such interference conditions operating.

4.13 CASE PRESSURE

Appliances that are intended to be built into cavities in walls or partitions, cupboard recesses, or areas that communicate with other rooms or spaces, shall not exhibit flame abnormality and the CO/CO₂ ratio of the combustion products shall not exceed 0.02 when the cavity is subjected to any pressure between 25 Pa positive and 25 Pa negative, providing the air flow required to produce such pressures does not exceed 250 L/sec.

The maximum limiting conditions shall be as listed in Table B10.

The minimum limiting conditions shall be as listed in Table B11.

SECTION 5 PERFORMANCE TESTS

5.1 GENERAL

Before commencing testing in this Section refer to Clause 2.1.1.

5.2 FLUE OPERATION

5.2.1 Spillage of combustion products

There shall be no leakage or spillage of combustion products from an open-flued appliance, its flue system, or draught diverter with 0.6 m of flue attached, 5 min after ignition when the appliance is operated at nominal gas consumption.

5.2.2 Circulating air system

Appliances shall be constructed so that there is no leakage of circulating air into the heat exchanger or of flue products into the circulating air system.

5.2.3 Performance with updraught, downdraught and blocked flue

5.2.4 Natural draught, open-flued appliances

For all appliances with natural draught, open-flued combustion systems equipped with a draught diverter or alternative system, the CO/CO₂ ratio shall not exceed 0.02 when operated with—

- (a) the flue outlet of the appliance blocked;
- (b) a downdraught having a velocity head of up to 7.5 Pa applied progressively to the flue outlet for 1 min; or
- (c) an updraught having a velocity head of up to 7.5 Pa applied progressively to the flue outlet for 1 min.

NOTE: A velocity head of 7.5 Pa is equivalent to a flow velocity of 3.5 m/s.

During testing, the appliance is operated at nominal hourly gas consumption and in the case of appliances with turndown or modulating controls, the appliance shall be tested down to the lowest setting and to sufficient intermediate points that characterize the appliance performance.

5.2.5 Forced or induced draught, open-flued appliances

For all appliances with forced or induced draught open-flued combustion systems or fan assisted fluing systems, the CO/CO₂ ratio shall not exceed 0.02 when operated under the following conditions:

- (a) The flue outlet is progressively blocked until safety shutdown occurs. In addition, lockout shall not occur at back pressures less than 140 Pa.
- (b) Updraughts having a total head of up to 17.5 Pa are progressively applied to the flue outlet.
- (c) Downdraughts with back pressures up to 12.5 Pa are applied to the flue outlet if the flue system incorporates a draught diverter or similar device.

During testing, the appliance is operated at nominal hourly gas consumption and in the case of appliances with turndown or modulating controls, the appliance shall be tested down to the lowest setting and to sufficient intermediate points that characterize the appliance performance.

5.3 THERMAL EFFICIENCY

5.3.1 General

The thermal efficiency of an appliance, based upon gross heating value, shall be not less than 70%.

5.3.2 Reduction in thermal efficiency with maximum flue length

The thermal efficiency of an open-flued, natural draught appliance, when subjected to a flue pull equivalent to a length of the flue terminating 4.5 m above the base of the appliance, shall not be less than 60%.

5.3.3 CO₂ reduction in wind conditions

The CO₂ content of the flue products of power-flued or room-sealed appliances shall not fall by more than 10% of its original value when winds of 15 km/h are directed onto the flue terminal, irrespective of direction.

5.4 FLUE GAS TEMPERATURE

The temperature of the flue gases at the flue connection of an appliance shall not exceed the temperature limit specified in AS/NZS 5601 for either the specified material of the flue connection or the specified flue pipe. For metal flue connections and pipes, the temperature shall not exceed 270°C above room temperature.

5.5 CONDENSATION

5.5.1 Control of flue gas condensate

Appliances shall be designed so that under normal operating conditions, no condensate shall escape from the appliance other than via a condensate drain.

5.5.2 Condensate interference with combustion

Condensate, where present, shall not interfere with combustion.

5.5.3 Blocked condensate drain

A blocked condensate drain shall not create an unsafe condition.

5.6 COMBUSTION AIR SUPPLY

5.6.1 Combustion air flow proving

Where combustion air is supplied mechanically, provision shall be made to prove an adequate air supply and cause safety shutdown immediately if the air supply becomes inadequate.

5.6.2 Automatic air control

An automatically operated air control shall be arranged so that in the case of failure of the operating means, satisfactory combustion shall be maintained, or the fuel shall be shut off.

5.6.3 Power failure

Failure of electricity supply at any stage shall result in safety shutdown of appliances with fan-assisted combustion systems.

5.6.4 Response to electrical power variation or failure

Appliances with fan-assisted combustion systems shall—

- (a) Function normally at rated voltage +10% and –15%; and
- (b) Operate without hazard or cease operation without hazard with—
 - (i) electricity supply disconnected;
 - (ii) electricity supply connected and failure of the mechanical device; and
 - (iii) electricity supply voltage fluctuations outside the limits specified in Clause 5.6.4(a).

5.7 INTERLOCK SYSTEMS

5.7.1 General

An interlock system functions to initiate trip devices when an unsafe condition is approached. The tripping of an interlock should indicate audibly and/or visibly any abnormal condition.

An interlock system shall be tested to confirm that it satisfies design and functional requirements.

An interlock system shall—

- (a) supervise starting procedure and normal operation to ensure safe operating practices and sequences;
- (b) co-ordinate the necessary trip devices into an integrated system;
- (c) provide sufficient instrumentation to enable the operator to complete the safe operating sequence where automatic equipment is not available to accomplish the intended interlock function;
- (d) not permit any manual ‘defeating’ of an interlock in order to start or operate equipment; and
- (e) prevent unsafe operation on interruption and restoration of the interlock power supply.

NOTE: The interlock system should indicate the initiating cause of the trip and prevent starting any portion of the process until safe conditions are established.

5.7.2 Interlocks to ensure safe ignition conditions

Interlocks shall ensure that the burner ignition shall not be initiated until the following limits as applicable have been satisfied:

- (a) Combustion air supply.
- (b) The required purge cycle has been completed.
- (c) Any automatically operated flue damper is in a safe position.

5.7.3 Interlocks to ensure safe reignition conditions

Reignition of a burner upon restoration of an interrupted electricity supply shall not be possible without manual attention or safe automatic startup, incorporating mandatory purge period or any other mandatory interlocks.

5.8 TEMPERATURE HAZARDS

5.8.1 Test conditions

An appliance shall comply with the requirements listed in Clause 5.8 when it has been operated under the following conditions:

- (a) The appliance shall be installed in accordance with any special conditions as indicated by a permanent marking on the appliance. If any such special conditions are specified, the test of surrounding surfaces (see Clause 5.8.2) shall be repeated with the appliance installed with only the clearances specified in AS/NZS 5601, or zero clearances where none is specified in AS/NZS 5601, and without these special conditions.
- (b) The appliance is operated for not less than 1 h, with normal test gas pressure at the appliance inlet with the thermostat set at maximum, if fitted, or until thermal equilibrium is reached.
- (c) The room or return air temperature sensor(s) shall not be allowed to reduce gas input. Where applicable, if the appliance can continue to operate without the discharge air temperature sensor installed, the discharge air temperature sensor shall not be allowed to reduce gas input.

5.8.2 Surrounding surfaces—Temperature limits

The temperatures of floor, wall and overhead surfaces shall not exceed—

- (a) 65°C above ambient when installed in accordance with the manufacturer's instructions; and
- (b) 75°C above ambient when installed in the absence of any special conditions.

5.8.3 Personal safety—Temperature limits

5.8.3.1 *Surface intended to be handled*

The temperatures of surfaces intended to be handled, except those parts that are located in an area where they are obviously hot, shall not exceed—

- (a) 35°C above ambient for metals;
- (b) 45°C above ambient for porcelain or vitreous enamel; and
- (c) 60°C above ambient for plastics.

NOTES:

- 1 The temperatures for plastics refer to components that are substantially, if not entirely, manufactured from plastics material.
- 2 Parts in this category include control knobs, tap handles, push buttons, switches and door handles.

5.8.3.2 *Surfaces likely to be accidentally touched*

All other surfaces not closer than 25 mm to a working surface, e.g. surfaces likely to be accidentally touched shall not exceed—

- (a) 80°C above ambient for metals;
- (b) 95°C above ambient for vitreous enamelled steel, glass and similar surfaces; and
- (c) 100°C above ambient for plastics.

NOTE: Parts in this category include control panel fascia, side panels, panels adjacent to door handles and edges of doors when opened.

5.8.4 Appliance safety—Temperature limits

5.8.4.1 Bodies of gas valves, thermostats, etc

Temperatures of bodies of gas valves, thermostats, etc. shall not exceed the temperature for which they have been approved.

5.8.4.2 Components containing non-metallic diaphragms

Temperatures of components containing non-metallic diaphragms shall not exceed 45°C above ambient, unless specifically approved for higher temperatures and so marked permanently.

5.8.4.3 Body of a clock or timer

The temperature of the body of a clock or timer shall not exceed the maximum specified by the manufacturer.

5.8.4.4 Main gas and pilot lines susceptible to sulphide attack

Temperatures of main gas and pilot lines susceptible to sulphide attack, e.g. copper, shall not exceed 50°C above ambient.

5.8.4.5 Flexible hoses

Temperatures of flexible hoses shall not exceed the maximum temperature for that class of hose.

5.8.4.6 Joints sealed with jointing materials

Temperatures of joints sealed with jointing materials shall not exceed the maximum temperature recommended by the manufacturers of the materials, under the conditions of use.

5.8.4.7 Maximum outlet air temperature limiting device

A device shall be provided to ensure that the average temperature of the delivered air at the appliance outlet does not exceed 93°C.

5.8.4.8 Secondary maximum outlet air temperature limiting device

Where the device required in Clause 5.8.4.7 is not actuated under fan failure or reversed air flow conditions, a second device shall be provided to shut off the gas to the main burner before damage is caused to any part of the appliance or its surroundings.

5.9 HEAT RESISTANCE

5.9.1.1 Heat resistance—Overload conditions

After the appliance has been installed in accordance with the manufacturer's instructions and has been operated at overload gas consumption for 100 cycles of 2 h 'on' and 1 h 'off'—

- (a) doors and other movable fittings shall function correctly;
- (b) outer surface finishes of the appliance or its surroundings shall not deteriorate permanently;
- (c) controls, thermostats, etc. shall not leak, seize or fail;
- (d) refractories shall not deteriorate seriously (incipient cracks appearing in bricks shall not be regarded as failures, unless the appearance or the operation of the appliance is affected);
- (e) burners shall not distort or deteriorate sufficiently to affect normal operation;
- (f) belts, motors and fans shall not deteriorate; and