

AS 1375:2023



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Industrial fuel-fired appliances



AS 1375:2023

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- Australian Gas Association
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- Engineers Australia
- Gas Appliance Manufacturers Association of Australia
- Gas Technical Regulators Committee

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Industrial fuel-fired appliances

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Preface

This Standard was prepared by the Standards Australia Committee AG-011, Industrial and Commercial Gas Fired Appliances, to supersede AS 1375—2013.

The objective of this document is to specify requirements and safety principles for the design, installation and operation of industrial appliances that involve the combustion of gas or liquid fuel and the controlled generation of combustible vapours or combustible dusts.

The major changes in this edition are as follows:

- (a) Revision of risk assessment and the requirement to conduct a HAZOP to align with other fuel-fired appliance standards.
- (b) Inclusion of pre-purge to align with international standards and trends in appliance and burner design that do not require a pre-purge under specific circumstances.
- (c) Clarification of the incineration process in [Clause 4.2](#).
- (d) Addition of guidance on the use of valves for liquid LP gas burner applications.
- (e) Revision of [Appendix D](#) to achieve a higher level of accuracy when calculating critical time for burner systems. Background information on the research underpinning the methods used for calculating critical time and its application to burner systems will enable appliances, which do not strictly conform to the critical time calculations provided, to be assessed for safe operation during start up.
- (f) Inclusion of worked examples for the use of formula in [Appendix E](#), referencing NFPA 68 or similar standards where the limits of the given equations for explosion relief are exceeded.
- (g) Revision of [Appendix F](#) to reflect changes to EN 1539 and similar standards.
- (h) Expansion of [Appendix G](#) to include additional commentary relating to the use of LEL and LFL data and the application of LOC data. Where the use of LOC data relates to purging systems, NFPA 69 is now referenced as the Standard to be used.
- (i) Review of the typical layout of liquid fuel supply and control systems in [Appendix H](#).
- (j) Inclusion of guidance on risk assessment in [Appendix N](#) to be consistent with other fuel-fired appliance standards such as AS 3814.
- (k) Addition of [Appendix O](#) which summarizes potential hazards.
- (l) Addition of [Appendix P](#) which contains guidelines for assessing the fitness for purpose of legacy appliances, unusual applications, novel designs or the application of new technologies that do not conform to this document.
- (m) Addition of [Appendix Q](#) which covers the use and maintenance of flexible hoses for conveying fuels to burners and appliances. It also contains information on hose and connection failures that have led to serious incidents, how to visually inspect flexible hoses, typical faults in installations, and the suitability of hose components.
- (n) Addition of [Appendix R](#) which provides guidance on waste gas flares and where ISO 23251 and ISO 25457 are not applied. In the case of biogas flares, it provides guidance on many aspects of flare safety and may be used in conjunction with ISO 22580.
- (o) Addition of [Appendix S](#) which lists apparatus for the use and application of LEL devices that monitor flammable vapours and gases for appliances and that need to conform to specific allowable concentration conditions. This aligns with NFPA 86 and EN 1539.
- (p) Addition of [Appendix T](#) which provides guidance on hydrogen combustion safety.

The terms “normative” and “informative” are used in standards to define the application of the appendices to which they apply. A “normative” appendix is an integral part of a standard, whereas an “informative” appendix is only for information and guidance.

Contents

Preface	ii
Introduction	ix
Section 1 Scope and general	1
1.1 Scope	1
1.2 Application	1
1.3 Normative references	1
1.4 Terms and definitions	2
1.5 New designs and innovations	15
Section 2 Appliance design and construction	16
2.1 General design	16
2.1.1 Appliance design	16
2.1.2 Ladders or steps	17
2.1.3 Protection of equipment	17
2.1.4 Accumulation within cavity walls	17
2.1.5 Insulation	17
2.1.6 Ignition hazards	17
2.1.7 Strength of doors	18
2.1.8 Prevention of accidental fires	18
2.1.9 Free circulation	18
2.1.10 Adjusting devices	18
2.1.11 Air inlet guards	18
2.1.12 Systems for heating by hot fluids	18
2.1.13 Electrical equipment	19
2.1.14 Piping, fittings and components	19
2.2 Materials	19
2.2.1 Suitability	19
2.2.2 Combustibility	19
2.3 Safety of personnel	19
2.3.1 Working inside appliances	19
2.3.2 Door handles	20
2.3.3 Injury or burns	20
2.3.4 Projections	20
2.3.5 Explosion reliefs	20
2.4 Operation and maintenance	20
2.4.1 Control and safety equipment	20
2.4.2 Automatic appliance management systems	21
2.4.3 Manual functions	21
2.4.4 Flame to be visible to maintenance personnel	21
2.4.5 Visual indication of the burner flame to operator	21
2.4.6 Removable components	22
2.4.7 Special tools	22
2.4.8 Cleaning	22
2.4.9 Maintenance provisions	22
2.5 Explosion damage protection	22
2.5.1 Provision of protection	22
2.5.2 Explosion relief operation	23
2.5.3 Explosion relief location	23
2.6 Temperature hazards	23
2.6.1 Components, floors and walls	23
2.6.2 Power failure	24
2.7 Instructions	24
2.7.1 General	24
2.7.2 Additional information	25
2.8 Marking	25

2.8.1	Appliance data.....	25
2.8.2	Special purpose appliance data.....	26
2.8.3	Indicators, gauges, and controls.....	26
2.8.4	Emergency stops.....	26
2.8.5	Colour code.....	26
Section 3	Combustion system.....	27
3.1	General.....	27
3.1.1	General suitability.....	27
3.1.2	Burner — retracted or swivelled.....	27
3.1.3	Fuel remaining in burner.....	27
3.1.4	Leak tightness.....	27
3.2	Ignition system construction.....	28
3.2.1	Location and fixing.....	28
3.2.2	Spark-ignition system.....	28
3.2.3	Manual ignition systems.....	28
3.3	Supervision, control and safe procedures.....	29
3.3.1	Introduction.....	29
3.3.2	General requirements.....	29
3.3.3	Automatic systems.....	30
3.3.4	Manual systems.....	31
3.3.5	Interlocking controls.....	31
3.4	Starting and ignition.....	31
3.4.1	Ignition procedures.....	31
3.4.2	Performance.....	31
3.4.3	Attempted reignition.....	32
3.4.4	Ignition during purging.....	32
3.4.5	Safe-start check.....	32
3.4.6	Appliances with multiple main burners.....	32
3.4.7	Sequential ignition of multiple main burners.....	32
3.4.8	Simultaneous ignition of multiple main burners.....	32
3.5	Flame failure during operation.....	33
3.5.1	Flame supervision and failure protection.....	33
3.5.2	Flame failure response time.....	33
3.5.3	Relighting after flame failure.....	34
3.5.4	Extraneous ignition sources.....	34
3.6	Multi-fuel firing.....	34
3.6.1	Application.....	34
3.6.2	Alternative firing.....	34
3.6.3	Simultaneous firing.....	35
3.7	Shutdown procedures.....	35
3.7.1	Safety.....	35
3.7.2	Normal shutdown.....	35
3.7.3	Abnormal shutdown.....	36
3.7.4	Remote isolation.....	36
3.8	Purging.....	36
3.8.1	When to purge.....	36
3.8.2	Method of purging.....	36
3.8.3	Completeness of purging.....	37
3.8.4	Manually controlled purging.....	38
3.8.5	Proof of purge with air or inert medium.....	38
3.8.6	Dampers.....	38
3.8.7	Omission of purge.....	38
Section 4	Control of non-fuel combustible atmospheres.....	40
4.1	General.....	40
4.2	Prevention and relief of explosions.....	40
4.2.1	Explosion prevention.....	40
4.2.2	High concentration of flammable gases and vapours.....	40

4.2.3	Explosion relief.....	40
4.2.4	Exceptions to provision of explosion relief on flammable gas and vapour appliances in which flammable materials are released.....	40
4.2.5	Exceptions to provision of explosion relief on appliances by monitoring the input of releasable flammable substances.....	41
4.2.6	Processes with flammable gases, vapours or combustible dust.....	41
4.2.7	Appliances that operate without sources of ignition.....	42
4.3	Air dilution and purging.....	43
4.3.1	Method of providing dilution air.....	43
4.3.2	Dilution air quantities.....	43
4.3.3	Air distribution.....	43
4.3.4	Purging.....	44
4.4	Vapour and dust removal or destruction.....	44
4.4.1	Safe disposal.....	44
4.4.2	Incineration.....	44
4.4.3	Leakage of hazardous materials.....	46
Section 5	Installation, commissioning, and operation.....	47
5.1	Installation requirements.....	47
5.1.1	Instructions.....	47
5.1.2	Defective equipment.....	47
5.1.3	Suitability for fuel and electricity.....	47
5.2	Standards for workmanship and good practice.....	47
5.2.1	Materials.....	47
5.2.2	Finish.....	47
5.2.3	Connection of services.....	47
5.3	Location and access.....	48
5.3.1	Building safety.....	48
5.3.2	Building structures.....	48
5.3.3	Safety and convenience.....	48
5.3.4	Combustible materials.....	48
5.3.5	Clearance for explosion relief.....	48
5.3.6	Appliance security.....	50
5.3.7	Gas vent discharge.....	50
5.3.8	Foundations, supports.....	50
5.3.9	Lighting.....	50
5.3.10	Location of controls.....	51
5.4	Fresh air supply.....	51
5.4.1	Air supply.....	51
5.4.2	Air entries.....	51
5.4.3	Fan failure.....	51
5.5	Fuel supply system.....	52
5.5.1	Fuel shut-off.....	52
5.5.2	Gas supply system.....	52
5.5.3	Liquid fuel supply system.....	52
5.5.4	Solid fuel systems.....	53
5.6	Commissioning.....	53
5.6.1	Commissioning agent.....	53
5.6.2	Information.....	53
5.6.3	Data and reports.....	53
Section 6	Flues (chimneys), exhaust systems and ducts.....	54
6.1	General.....	54
6.1.1	Rationale.....	54
6.1.2	Removal of products of combustion.....	54
6.1.3	Provision of exhaust systems.....	54
6.1.4	Flues separate from exhausts.....	54
6.1.5	Common exhaust systems.....	54
6.1.6	Temperature hazards and comfort.....	54

6.1.7	Terminals for flues and exhaust ducts.....	54
6.2	Flue design and construction.....	55
6.2.1	Construction.....	55
6.2.2	Performance.....	55
6.2.3	Common flues.....	55
6.2.4	Power flues.....	56
6.3	Flue supports.....	56
6.3.1	Direct-mounted flues.....	56
6.3.2	Free-standing flues.....	56
6.3.3	Guys, stays and supports.....	56
6.4	Earthing.....	56
6.5	Flue dampers.....	56
6.5.1	Damper/fuel interlock.....	56
6.5.2	Damper settings.....	56
6.6	Ducts.....	57
6.6.1	Construction.....	57
6.6.2	Joints.....	57
6.6.3	Cleaning.....	57
6.6.4	Condensation provisions.....	57
6.6.5	Dampers.....	57
Section 7	Additional requirements for liquid fuel-firing systems.....	58
7.1	General.....	58
7.2	Liquid fuel burner starting systems.....	58
7.3	Liquid fuel pre-treatment.....	58
7.4	Controls and safety devices.....	58
7.4.1	General.....	58
7.4.2	Safety shut-off valve system requirements for liquid fuel supplies.....	59
Appendix A	(informative) Operating data, special purpose ovens.....	61
Appendix B	(informative) Maintenance and checks of safety devices.....	62
Appendix C	(informative) Ignition procedures.....	67
Appendix D	(normative) Critical energy and critical time.....	70
Appendix E	(informative) Explosion relief.....	90
Appendix F	(normative) Dilution.....	104
Appendix G	(informative) Characteristic data for flammable gases and combustible dusts.....	126
Appendix H	(informative) Typical commissioning procedure.....	149
Appendix I	(informative) Hazard and operability study (HAZOP).....	153
Appendix J	(informative) Suitability of materials for liquid fuel firing systems.....	157
Appendix K	(informative) Filtration of liquid fuels.....	158
Appendix L	(informative) Typical liquid fuel burner firing sequence.....	159
Appendix M	(informative) Typical layout of liquid fuel supply and control systems.....	161
Appendix N	(informative) Risk assessment for the operation and installation of an industrial fuel-fired appliance.....	165
Appendix O	(informative) List of significant hazards.....	179
Appendix P	(informative) Fitness-for-purpose assessment.....	191
Appendix Q	(informative) Maintenance of flexible connections and hoses.....	197
Appendix R	(informative) Waste gas flare systems.....	207
Appendix S	(informative) Apparatus used to measure the concentration of flammable vapours in dryers.....	216

Appendix T (informative) Hydrogen combustion safety — a brief introduction	220
Bibliography	234

Introduction

This edition has been extensively revised to align with international trends in standards as industry experience is consolidated in key areas. The emergence of new technologies that enable key safety features to be adequately managed has been one of the main areas of change in flammable gases and vapour processing equipment. This document has also benefited from recent research that allows for optimization of safety protection systems.

Safety, which is an essential in all industrial activity, can be achieved by assessing the risk of the hazards involved and implementing effective control measures in the equipment design and operating procedures. Not only do fuel-fired appliances generate fuel–air mixtures, but they may also contain or operate in atmospheres that include finely divided combustible materials and flammable process vapours. In such conditions, hazards are always a possibility and this document provides principles for designing such appliances to operate with safety.

The most common accidents in heated industrial equipment are internal explosions within the enclosure formed by the appliance that result from the accidental ignition of accumulations of fuel–air mixtures, process volatile flammable gases and vapours, other gases and vapours produced by malfunctions, or process combustible dusts. An explosion becomes damaging when the internal pressure exceeds the ability of the appliance enclosure to contain it. Since few appliances are of a strength able to withstand pressures of a high order, it is necessary to —

- (a) prevent the accumulation of combustible mixtures within the appliance enclosure and associated duct and flue systems;
- (b) avoid the accidental ignition of these combustible mixtures wherever possible; and
- (c) provide means of relieving or mitigating the effect of an explosion depending on the operating characteristics and reliability of these preventive measures.

When a fuel is introduced into an enclosed space, it is potentially unsafe until it is ignited. If the ignition attempt fails or if the flame is extinguished at any time after initial ignition, unburnt fuel can accumulate in the enclosure and may quickly reach potentially dangerous proportions.

Therefore, the primary and most important safety device on an appliance is its ignition system; all other protective measures should be considered as secondary. The need for back-up systems arises only when the primary protection (the ignition system) has failed.

Given a known fuel flow rate and a known combustion chamber volume, it is possible to calculate the time it would take for accumulated fuel to become dangerous if not ignited. This is called the critical time and is a characteristic of each appliance. It indicates the maximum allowable delay in the initial ignition and the maximum safe response time for any initial ignition failure protection system.

It is always preferable to extend the critical time to the greatest possible extent rather than depend too much on sensitive flame-monitoring equipment. The use of pilot burner ignition or low-fire starting or the provision of high levels of dilution by excess air, all have the effect of extending the critical time. Since the first edition of this Standard an increasing emphasis has been placed on designs to extend the critical time to infinity. Another alternative is for the structure to be strong enough to resist the explosion. Where the critical time is shorter than the reaction time of the ignition-failure protection system and cannot be extended, the speed, efficiency and reliability of the ignition system becomes vital and facilities for relieving excessive explosion pressures become essential.

This document is based on the premise that the start-up phase is more hazardous than any other phase of the operating cycle. Thus, this document focuses on protection and supervision during ignition, and critical time considerations are applied only during this period. Lighting-off from a pilot burner, turn-up after a low-fire start, or flame failure during operation are not considered to be sufficiently problematic to warrant the application of critical time considerations and this is consistent with worldwide combustion safety experience and assessment.

Flammable vapours or dusts have essentially the same characteristics as fuel, i.e. they possess upper and lower combustible limits, stoichiometric ratios and characteristic fundamental burning velocities. Any material that will oxidize is potentially explosive if it is in a finely divided state and mixed with air. Since it is not possible to guarantee the absolute elimination of all sources of accidental ignition, the first priority is to prevent the formation of combustible mixtures. The usual method is by dilution with air, but sometimes inert gases or products of combustion are used. Since these measures also cannot be absolutely reliable, it is necessary to provide explosion relieving facilities whenever such combustibles are present, unless the appliance can withstand any possible explosion pressure or the amount of dilution is so high as to render the likelihood of the formation of flammable mixture extremely improbable.

Some types of appliances make use of atmospheres that are rich in combustible materials, often well above the upper combustible limit and at temperatures that are above the normal auto-ignition temperatures. For these appliances, the same basic rules apply, i.e. the simultaneous occurrence of combustible mixtures and igniting temperatures need to be prevented, unless in strictly controlled circumstances.

When determining the protection needs of an appliance, the first priority is to prevent injury to personnel. Minimizing or containing damage to the appliance or its surroundings, while important, is a secondary consideration.

Certain essential safety rules have widespread application irrespective of wide varieties of configuration, methods of heating, or types of control. For example, a reaction to a fault or to danger needs to be equally effective whether it is the reaction of an operator or of an automatic device; adherence to a certain sequence of events may be equally important irrespective of whether the timing is provided manually or automatically. The safety of an industrial appliance is a function of the features peculiar to the individual appliance. The functions of any accessories often cannot be specified independently but need to be derived from, and meet the design criteria of, the needs of the individual appliance.

In general, this document avoids giving mandatory lists of specific types of hardware to be fitted to specific appliances. In particular, it makes little mention of automatic burners or package burners and does not provide rules for such burners independently of the whole appliance. When this document is used to check individual appliances, it will be necessary to decide whether the controls provided for the operating techniques specified are capable of providing, with a desired degree of reliability, the functional characteristics that are necessary for the safety of the individual appliance. The intent of this document is to describe how to determine and apply these critical appliance characteristics.

An installation may come under the jurisdiction of several technical regulators with different areas of responsibility. Approval from one technical regulator does not necessarily constitute approval from another. Thus, the construction of any plant may require separate approvals from authorities interested in flammable and combustible liquids, factory or machinery safety, electricity, gas, health, environment, water supply, sewerage and drainage, or the training and licensing of personnel. The application for, and granting of, approvals by authorities and regulators is not within the scope of this document.

Application of this document should be viewed only as a starting point in the control of risks. It should not be assumed that a design conforming to this document is without risk as this document does not deal with all the matters relevant to hazard identification, risk assessment and risk control for an installation and associated plant. Judgement by a competent body needs to be exercised in such circumstances.

Other standards may provide more appropriate safety outcomes in specific circumstances and be deemed to conform to this document provided that the original equipment manager (OEM) or installer has written evidence showing the level of risk for the activity or thing to which the safety requirement applies is equal to or less than the level of risk that would be achieved by conforming to this document. This written evidence should demonstrate that the fundamental safety requirements of this document have been satisfied or exceeded. Therefore, an OEM or installer's report detailing this evidence and clearly identifying and recording departures from this document should be provided as part of the appliance installation documentation.

Currently, ISO Technical Committee 197 is responsible for international standards covering systems and devices for the production, storage, transport, measurement and use of hydrogen. While this work has been primarily focused on the use of hydrogen in vehicles, the scope includes development of standards on end-use applications such as fuel cells, internal combustion engines and hydrogen burners. Fuel quality standards for hydrogen have also been part of this work.

To help develop and implement safe practices in North America, the Hydrogen Safety Panel was established in 2003 to support the US Department of Energy's efforts to commercialize fuel cell technologies. Subsequently, the National Fire Protection Association developed and introduced NFPA 2 in 2011 to focus on safeguards for the generation, installation, storage, piping, use, and handling of hydrogen as a compressed gas or cryogenic liquid. It applies to the production, storage, transfer, and use of hydrogen in all occupancies.

In Australia in 2020, eight key hydrogen standards were adopted and Standards Australia Technical Committee ME-093 established five working groups tasked with overseeing and developing guidance in the following areas:

- (a) Production, handling and storage.
- (b) Pipeline and gas distribution networks.
- (c) End use utilisation.
- (d) Fuel cell applications.
- (e) Mobility applications.

As we move forward, ME-093 will continue to address all aspects of hydrogen, including the production, storage and handling, measurement, transport, transmission and distribution of hydrogen in its pure form, blended with another fuel gas in Australia.

NOTE Refer to the [Standards Australia website](#) for additional information on hydrogen initiatives.

In Queensland in 2022, a Hydrogen Safety Code of Practice was released by the Petroleum and Gas Inspectorate.

NOTES

Australian Standard®

Industrial fuel-fired appliances

Section 1 Scope and general

1.1 Scope

This document specifies requirements and safety principles for the design, installation and operation of industrial appliances that involve the combustion of gas or liquid fuel and the controlled generation of combustible vapours or combustible dusts.

NOTE 1 Although the rules for combustion safety given in this document are applicable in principle to very high energy release appliances, such as large land boilers for electricity generation and for solid fuel and pulverized coal firing, these appliances present unique problems, often requiring comparatively sophisticated control systems. Each case needs to be studied individually and its safety evaluated in relation to its own particular conditions. Guidance for the use of pulverized fuel can be obtained from NFPA 85 and EN 12952-9.

NOTE 2 Gas-fired appliances are comprehensively dealt with in AS 3814.

This document does not apply to —

- (a) hazardous area installations;

NOTE 3 These are covered by other standards such as the AS/NZS 60079 series.

- (b) simple atmospheric burners and simple forced-draught burners not exceeding 1 GJ/h that —

- (i) are not fitted into a combustion chamber; and

- (ii) burn in an open, well-ventilated space under the control of an operator;

NOTE 4 Refer to AS 1668.2 and AS/NZS 5601.1 for guidance on determining if a space is well ventilated.

- (c) petroleum, petrochemical and natural gas industries flares and associated ignition systems for general refinery and petrochemical service conforming to ISO 25457 and ISO 23251;

- (d) petroleum and natural gas industries pressure-relieving and depressurizing systems conforming to ISO 23251;

- (e) stationary engines and turbines; or

NOTE 5 Refer to AS ISO 21789 and AS 3814 for gas turbines, the ISO 8528 series for engines, and AS 3814 for gas engines.

- (e) fuel cells conforming to AS 62282.3.100 and AS 62282.3.300

1.2 Application

This document is intended to be read in conjunction with any applicable legislation or regulations.

1.3 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document.

NOTE Documents referenced for informative purposes are listed in the Bibliography.

AS 1170.4, *Structural design actions, Part 4: Earthquake actions in Australia*

AS 1768, *Lightning protection*

AS 1940, *The storage and handling of flammable and combustible liquids*

AS 3814, *Industrial and commercial gas-fired appliances*

AS 4629, *Automatic shut off valves and vent valves*

AS 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

AS/NZS 1020, *The control of undesirable static electricity*

AS/NZS 1170.2, *Structural design actions, Part 2: Wind actions*

AS/NZS 1680 (all parts), *Interior and workplace lighting*

AS/NZS 1869, *Hose and hose assemblies for liquefied petroleum gases (LP Gas), natural gas and town gas*

AS/NZS 3000, *Electrical installations (known as the Australian/New Zealand Wiring Rules)*

AS/NZS 5601 (all parts), *Gas installations*

AS/NZS 60079 (all parts), *Explosive atmospheres*

AS IEC 61511 (all parts), *Functional safety—Safety instrumented systems for the process industry sector*

ISO 10380, *Pipework — Corrugated metal hoses and hose assemblies*

ISO 23553-1, *Safety and control devices for oil burners and oil-burning appliances — Particular requirements — Part 1: Automatic and semi-automatic valves*

ASTM F1120-87, *Standard specification for circular metallic bellows type expansion joints for piping applications*

BS EN 1762, *Rubber hoses and hose assemblies for liquefied petroleum gas, LPG (liquid or gaseous phase), and natural gas up to 25 bar (2,5 MPa) - Specification*

BS EN 16617, *Pipework — Corrugated metal hose assemblies for combustible gas — Performance requirements, testing and marking*

UL 21, *LP-Gas Hose*

1.4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

1.4.1

appliance

assembly using fuel or other means to produce flame, heat, light, power or special atmosphere

Note 1 to entry: For the purposes of this document, vehicle re-fuelling appliances are not included.

1.4.2

appliance management system

system or operating procedure that controls the overall operation of the *appliance* ([1.4.1](#)) and initiates and executes such actions as are necessary to the usual operation of the *appliance* ([1.4.1](#)) and its protection from *unsafe* ([1.4.100](#)) or potentially unsafe conditions

1.4.3

approval

approved

acceptable to, and meeting the requirements of, the *Technical Regulator* ([1.4.96](#))

1.4.4**auto-ignition temperature****AIT**

lowest temperature at which the rate of self-heating of a gas–air mixture exceeds the rate of heat loss to the surroundings, causing the mixture to ignite

1.4.5**boiler**

vessel or an arrangement of vessels and interconnecting parts in which steam or other vapour is generated or water or other liquid is heated above atmospheric pressure by an external energy source

Note 1 to entry: External energy sources include application of fire, the products of combustion, electrical power, or similar high temperature means.

Note 2 to entry: Boilers include superheaters, reheaters, economizers, boiler piping, supports, mountings, valves, gauges, fittings, controls, the boiler setting and directly associated equipment.

Note 3 to entry: Boilers do not include a fully flooded or pressurized system where water or other liquid is heated to a temperature lower than the normal atmospheric boiling temperature of the liquid.

[SOURCE: AS/NZS 1200:2015 Clause B.2.2 with modifications; text moved to Notes to entry]

1.4.6**burner****1.4.6.1****atmospheric burner**

system where all the air for combustion is produced by the inspirating effect of the *gas* ([1.4.36](#)) or the *natural draught* ([1.4.61](#)) in the combustion chamber or a combination of the two without mechanical assistance

1.4.6.2**automatic burner**

system that on starting follows a self-acting sequence that has been manually or automatically initiated to provide *gas* ([1.4.36](#)) and ignition to the *burner* ([1.4.6](#)) without any intermediate manual operation

1.4.6.3**forced-draught burner**

system where all the air, oxygen or a mixture of the two used for combustion is provided under pressure

1.4.6.4**induced-draught burner**

system where all or part of the air for combustion is introduced by providing suction in the combustion chamber by mechanical means

1.4.6.5**multi-fuel alternative burner**

multi-fuel burner ([1.4.6.6](#)) that can use only one fuel at any time

1.4.6.6**multi-fuel burner**

burner ([1.4.6](#)) that can use more than one fuel

1.4.6.7**multi-fuel simultaneous burner**

multi-fuel burner ([1.4.6.6](#)) that can use more than one fuel at any time

1.4.6.8**part automatic burner****semi-automatic burner**

burner ([1.4.6](#)) system that includes any self-acting operation

1.4.7

burner off cycle

<normal condition> cessation of operation when a predetermined operating condition has been reached and the function is no longer required

Note 1 to entry: Equipment is placed into a safe stand-by condition, ready to restart on demand.

<incorrect condition> *shutdown* ([1.4.90](#)) to a *safe* ([1.4.78](#)) stand-by condition in response to an incorrect condition signal resulting from a fault that is unlikely to be hazardous or is likely to be self-rectifying so that normal restarting is permissible when the fault has been rectified

1.4.8

burner management system

BMS

field devices, final control elements and the logic system, dedicated to combustion safety and operator assistance in the starting, running and stopping of fuel burning equipment and for preventing incorrect operation of and damage to fuel burning equipment

Note 1 to entry: A burner management system includes a flame safeguard system.

Note 2 to entry: Fuel burning equipment includes burners and their associated fuel valve trains and also includes combustion air supply equipment.

Note 3 to entry: Burner management systems can be expected to contain safety integrity requirements for one or more of their safety instrumented functions with a SIL ≥ 1 . In terms of the AS IEC 61511 series, a burner management system is a safety instrumented system (SIS).

[SOURCE: AS 3814:2018, 1.4.15]

1.4.9

certified

certification

assessed by a certifying body as having demonstrated conformance to a relevant standard or other specified safety criteria

Note 1 to entry: A certifying body is either acceptable to the Technical Regulator or is listed as a notified body for the EU Directive for Gas Appliances or the EU Directive for Machinery.

1.4.10

HAZOP

hazard ([1.4.39](#)) and operability study of a control system that is a part of the safety management process that focuses on the potential *hazards* ([1.4.39](#)) associated with the operations of the control system exclusive from the function of the underlying processes that they manipulate and maintain

1.4.11

chimney

final vertical portion of a *flue* ([1.4.30](#)), which discharges directly to atmosphere

Note 1 to entry: Chimney is usually reserved for larger, free-standing flues such as those used on large boilers, brick kilns, or the like.

1.4.12

combustion products

constituents resulting from the combustion of a fuel with air, oxygen or mixture of the two, including the inerts associated with the fuel and the air but excluding any other diluent or contaminant

1.4.13

competent body

body comprising more than one *competent person* ([1.4.14](#))

1.4.14**competent person**

person who has acquired, through education, training, qualification or experience or a combination of these, the knowledge and skills enabling that person to perform the task required

1.4.15**critical time**

time required to build up a pocket or concentration of unignited fuel of such quantity and proportions that, if ignited, the pressure of the resultant explosion could equal the permissible *safe* (1.4.78) internal pressure of the *appliance* (1.4.1)

Note 1 to entry: [Appendix D](#) specifies methods of determination and provides further explanation.

1.4.16**dilution**

supply of *fresh air* (1.4.33), or other inert diluent, and its circulation, distribution and exhaust to outside atmosphere, in a quantity that will dilute the concentration of a flammable vapour or combustible dust to such an extent that it cannot be ignited

1.4.17**double block and vent**

safety shut-off system (1.4.85) incorporating two *safety shut-off valves* (1.4.101.2) in series with a *vent line* (1.4.102) to atmosphere connected between the two safety shut-off valves using a *vent valve* (1.4.101.4)

1.4.18**duct**

closed conduit whose primary purpose is to conduct gaseous fluid from one place to another

Note 1 to entry: Examples include any conduit that —

- (a) leads gases from an external combustion chamber to the appliance;
- (b) introduces ventilating air;
- (c) recirculates air or gases either external to or as an integral part of the appliance; or
- (d) exhausts process products, vapours, gases or dusts.

1.4.19**fail-safe**

feature which ensures that the absence or malfunction of any critical control or safety component, system, signal or function will not result in an *unsafe* (1.4.100) condition

1.4.20**flame abnormality**

flame condition that results in *flame lift* (1.4.25), floating, *light back* (1.4.49), appreciable yellow tipping, carbon deposition or objectionable odour

1.4.21**flame detector**

device in the flame supervision system that is sensitive to a flame property and provides a signal when flame is detected

1.4.22**flame establishment period**

<gas> period that begins when the fuel *valve* (1.4.101) is energized and ends when the flame supervision system is first required to supervise the flame

<oil> period that begins when the fuel exits the *burner* (1.4.6) tip and ends when the flame supervision system is first required to supervise the flame

Note 1 to entry: The term may be applied to either main or pilot burner flames.

1.4.23**flame failure**

loss of flame from its normally detected position, due to any abnormal flame operating condition

1.4.24**flame failure response time**

time taken for the *flame safeguard* ([1.4.26](#)) to detect loss of flame and de-energize the *safety shut-off valve* ([1.4.86](#))

1.4.25**flame lift**

separation of a flame from a *burner* ([1.4.6](#)) port while continuing to burn with its base some distance from the port

1.4.26**flame safeguard**

safety device that automatically cuts off the *gas* ([1.4.36](#)) supply if the actuating flame is extinguished

1.4.27**flame safeguard system**

system to shut off the fuel supply to the *burner* ([1.4.6](#)) in the event of *ignition failure* ([1.4.46](#)) or *flame failure* ([1.4.23](#))

Note 1 to entry: The flame safeguard system consists of a flame detector and associated circuitry, integral components, valves and interlocks.

1.4.28**flame simulation**

signal that falsely indicates the presence of a flame

1.4.29**flare**

safety device to burn excess *gas* ([1.4.36](#)) from the gas or process system

1.4.29.1**enclosed-type flare**

flare ([1.4.29](#)) for burning excess *gas* ([1.4.36](#)) from the gas or process system when the flame is completely contained within the combustion chamber or stack

1.4.29.2**open-type flare**

flare ([1.4.29](#)) for burning excess *gas* ([1.4.36](#)) from the gas or process system when the flame is not completely contained within the combustion chamber or stack

1.4.30**flue**

pipe or *duct* ([1.4.18](#)) through which *combustion products* ([1.4.12](#)) are conveyed from a *gas appliance* ([1.4.1](#)) to a discharge point

Note 1 to entry: Discharge points include draught diverters, slip joints and associated ducts, barometric devices, fans or other fittings in the duct.

Note 2 to entry: For information on flue types, refer to AS 3814 and AS/NZS 5601.

1.4.31**flue gases**

combustion products ([1.4.12](#)) plus all diluents and contaminants

EXAMPLE Excess air, dilution air, process air, and waste products from the process.

1.4.32**flue system**

passage through which *flue gases* ([1.4.31](#)) are conveyed from an *appliance* ([1.4.1](#)) to a discharge point

Note 1 to entry: Discharge points include draught diverters, barometric devices, and fans.

1.4.33**fresh air**

air at the point of usage that is essentially free from solid particles, fibres, liquid droplets, or gaseous contaminants

1.4.34**fundamental burning velocity** **S_u**

burning velocity of a laminar flame under stated conditions of composition, temperature and pressure in the unburned *gas* ([1.4.36](#))

Note 1 to entry: The reported S_u is usually the maximum value measured for the fastest burning composition at standard conditions.

1.4.35**fuel-to-air ratio control**

simultaneous control of the flow of fuel and air to one or more *burners* ([1.4.6](#))

Note 1 to entry: The ratio is generally air-rich but in certain processes a fuel-rich ratio is desired.

1.4.36**gas**

combustible fuel that is a gas at normal temperature and pressure

1.4.36.1**biogas**

mixture of primarily methane and carbon dioxide produced by bacterial degradation of organic matter and used as a fuel

Note 1 to entry: Examples include landfill gas and sewage gas, and the like. Its constituents are considered flammable, corrosive and potentially toxic.

1.4.36.2**liquefied petroleum gas****LP gas**

gas ([1.4.36](#)) that is composed predominantly of any one or combination of propane, propene (propylene), butane and butene (butylene) in the vapour phase

Note 1 to entry: Dimethyl ether is similar to liquefied petroleum gas and stored in a similar way.

Note 2 to entry: Commercially supplied liquefied petroleum gas conforms to AS 4670.

1.4.36.3**natural gas****NG**

hydrocarbon *gas* ([1.4.36](#)) consisting mainly of methane

Note 1 to entry: Commercially supplied natural gas conforms to AS 4564.

1.4.36.4**simulated natural gas****SNG**

gas ([1.4.36](#)) comprising an approximate mixture of 55 % *liquefied petroleum gas* ([1.4.36.2](#)) and 45 % air

Note 1 to entry: Commercially supplied liquefied petroleum gas conforms to AS 4670.

1.4.37**gas consumption**

rate of energy consumed by an *appliance* ([1.4.1](#)) under specific conditions

Note 1 to entry: This is expressed in multipliers of joules per hour, e.g. megajoules per hour (MJ/h) or gigajoules per hour (GJ/h).

1.4.38**gas tight**

meets the leak testing requirements of the applicable standards

1.4.39**hazard**

source of danger or harm to people resulting in physical injury, death or damage to health or to equipment and its surroundings

Note 1 to entry: For appliances and associated equipment, this includes significant damage and adverse effects to equipment or its surroundings.

1.4.40**hazardous condition**

condition that may be a *hazard* ([1.4.39](#))

1.4.41**HAZOP**

structured and systematic technique by a multi-disciplinary team to examine the design of a system for potential *hazards* ([1.4.39](#)) and operability problems and then identify controls to minimize the *risk* ([1.4.77](#)) of those *hazards* ([1.4.39](#)) to acceptable levels

Note 1 to entry: The term takes its name from HAZard and OPerability study.

Note 2 to entry: A system may include an appliance, plant or equipment.

1.4.42**high pressure switch****high pressure detector**

sensing device that is actuated when pressure rises above a pre-set value

1.4.43**hose**

flexible tube or pipe of multiple layer construction

1.4.44**hose assembly**

hose ([1.4.43](#)) with end couplings

1.4.45**hot water boiler**

vessel in which water is heated to a temperature exceeding 99 °C by applying heat from *combustion products* ([1.4.12](#)) to the vessel without generating steam

1.4.46**ignition failure**

failure to establish flame within the flame-establishment period

1.4.47**installer**

person or organization who carries out the installation

1.4.48**interlock**

device or function that prevents items of equipment from operating unless predetermined conditions have been fulfilled by other items of equipment

1.4.49**light back**

transfer of a flame from any *burner* (1.4.6) port into the body of the *burner* (1.4.6) or back to the injector

1.4.50**limit device**

device that causes the fuel supply to *burners* (1.4.6) to shut off with *lockout* (1.4.53) when actuated by the approach of a *hazardous condition* (1.4.40)

Note 1 to entry: It includes a functional unit of hardware (including final elements and sensors) or software, or both, capable of accomplishing the specified purpose of implementing the physical action necessary to achieve a safe state.

1.4.51**limiting temperature**

eighty percent of the lowest solvent flammable *gas* (1.4.36) and vapour auto-ignition temperature

1.4.52**liquid fuel**

fuel that is a liquid at normal temperature and pressure

1.4.53**lockout**

safety shutdown (1.4.84) condition of the control system that requires a *manual reset* (1.4.58) to restart

1.4.54**lower explosive limit****LEL**

lowest concentration of a combustible *gas* (1.4.36) or vapour in a mixture with air (by volume) at a standard atmospheric pressure which is barely explosive at 20 °C

1.4.54.1**percentage lower explosive limit****%LEL**

amount of fuel, combustible vapour or dust concentration expressed as a percentage by volume of the fuel, vapour or dust in a mixture with air which is barely explosive

Note 1 to entry: For operating temperature (T) at standard atmospheric pressure, the limit is expressed as %LEL_T. At $T = 20\text{ °C}$ and standard atmospheric pressure, it becomes %LEL₂₀. If the pressure differs from the normal range of atmospheric pressures, the actual pressure is also stated.

1.4.55**low-pressure switch****low-pressure detector**

sensing device that is actuated when the pressure falls below a pre-set value

Note 1 to entry: A pressure transmitter may be a low-pressure switch or detector.

1.4.56**low fire rate**

main fuel-flow rate that is the lowest available in either a high-low or modulating rate *burner* (1.4.6)

1.4.57**manual ignition**

lighting of *gas* (1.4.36) flowing at a *burner* (1.4.6) by manual operation

1.4.58**manual reset**

reset of an *appliance* ([1.4.1](#)) by an operator

1.4.59**maximum pressure**

$P_{\max}$

pressure that develops in a contained deflagration of the optimum fuel-to-air mixture

1.4.60**may**

indicates the existence of an option

1.4.61**natural draught**

flow that is produced by the tendency of warmed gases to rise

1.4.62**no-flow**

flow condition below the proven air-flow level that provides a reliable and repeatable no-flow or low-flow signal from the flow device

1.4.63**non-return valve**

See *valve* ([1.4.101](#))

1.4.64**operating pressure**

gas pressure that the consumer piping or the *appliance* ([1.4.1](#)) may be subjected to under typical operating conditions

1.4.65**original equipment manufacturer****OEM**

person or company having design responsibility for the *appliance* ([1.4.1](#)), its sub-systems or parts

Note 1 to entry: The original equipment manufacturer may include —

- (a) a manufacturer that produces an appliance from components usually bought from other manufacturers or their agents and includes manufacturers of major sub-systems of an appliance (e.g. the burner management system);
- (b) importers and suppliers of appliances, agents of the OEM, manufacturers that modify an existing appliance or contractors who install an appliance whose OEM has ceased to exist; or
- (c) the manufacturer or packager of the appliance, its sub-systems or parts.

1.4.66**over-pressure protection**

prevention of the pressure in piping or an *appliance* ([1.4.1](#)) from exceeding a pre-set value

1.4.67**over-temperature cut-out device**

manual resetting ([1.4.58](#)) or non-resetting device that shuts off the fuel supply to a *burner* ([1.4.6](#)) to prevent the temperature from exceeding a pre-set level

1.4.68**percentage lower explosive limit**

%LEL

See *lower explosive limit* ([1.4.54](#))

1.4.69**pilot burner**

burner ([1.4.6](#)) that ignites the main *burner* ([1.4.6](#)), operates at a lower fuel-flow rate, and is alight before the main fuel is turned on

1.4.69.1**intermittent pilot burner**

pilot burner ([1.4.69](#)) that is automatically ignited each time the main *burner* ([1.4.6](#)) is started and automatically extinguished with the main *burner* ([1.4.6](#))

1.4.69.2**interrupted pilot burner**

pilot burner ([1.4.69](#)) that is automatically ignited each time the main *burner* ([1.4.6](#)) is started and automatically extinguished at the end of the main *flame establishment period* ([1.4.22](#))

1.4.69.3**permanent pilot burner**

pilot burner ([1.4.69](#)) that is permanently alight while the *appliance* ([1.4.1](#)) is in service and is controlled independently of the main *burner* ([1.4.6](#))

1.4.70**position-proving system**

means of checking that the *safety shut-off valves* ([1.4.101.2](#)) and *vent valves* ([1.4.101.4](#)) of a *safety shut-off system* ([1.4.85](#)) are in the correct position

1.4.71**process after-burner**

gas-fired *appliance* ([1.4.1](#)) used to incinerate exhaust gases containing combustible gases or dust in concentrations below the *lower explosive limit* ([1.4.54](#))

1.4.72**programmable electronic system****PES**

system based on one or more central processing units that is connected to sensors and actuators for the purpose of control, protection or monitoring

1.4.73**proved**

sensed and registered as being correct

Note 1 to entry: Sensing is either by automatic control equipment or the result of visual or other personal verification by an operator.

1.4.74**purge volume**

content of the combustion chamber and any areas where *combustion products* ([1.4.12](#)) and fuel accumulate in the *appliance* ([1.4.1](#))

Note 1 to entry: This may include the process up to the vertical connection of a *flue* ([1.4.30](#)) or *chimney* ([1.4.11](#)) that discharges directly to atmosphere.

1.4.75**purging**

using air or inert *gas* ([1.4.36](#)) to remove or dilute a potentially dangerous atmosphere to a *safe* ([1.4.78](#)) level

1.4.76**relief device**

safety device to forestall the development of a dangerous condition by preventing pressure, temperature or vacuum build-up

1.4.77**risk**

effect of uncertainty on objects

Note 1 to entry: An effect is a deviation from the expected. It can be positive, negative or both, and can address, create or result in opportunities and threats.

Note 2 to entry: Objectives can have different aspects and categories, and can be applied at different levels.

Note 3 to entry: Risk is usually expressed in terms of risk sources, potential events, their consequences and their likelihood.

[SOURCE: AS ISO 31000:2018, 3.1]

1.4.78**safe**

<installations, fittings, components, *appliances* ([1.4.1](#)), and associated equipment> free of *risk* ([1.4.77](#)) to a person or property from a *hazard* ([1.4.39](#))

Note 1 to entry: Hazards may arise, directly or indirectly, from the operation, use, or passage of fuel, combustion products or process flows through and from the installation, fittings, components, appliances or associated equipment.

1.4.79**safety function**

function to achieve or maintain a *safe* ([1.4.78](#)) state for the *appliance* ([1.4.1](#))

Note 1 to entry: This is implemented by a safety-related system or other risk-reduction measures.

Note 2 to entry: Appliances can have multiple safety functions that relate to specific hazards.

1.4.80**safety integrity**

probability of a safety-related system satisfactorily performing the required *safety functions* ([1.4.79](#)) under the stated conditions within a stated time period

1.4.81**safety integrity level****SIL**

discrete level corresponding to a range of *safety integrity* ([1.4.80](#)) values

Note 1 to entry: SIL is expressed as one of three possible discrete integrity levels (SIL 1, SIL 2, SIL 3) defined by quantitative or qualitative methods with SIL 3 having the highest level of safety integrity for fuel-fired appliances.

Note 2 to entry: For further information, refer to the AS 61508 series, the AS IEC 61511 series and AS/NZS 62061.

Note 3 to entry: It is possible to use several lower safety integrity level systems to satisfy the need for a higher level function (for example, using a SIL 2 and a SIL 1 system together to satisfy the need for a SIL 3 function).

Note 4 to entry: SIL 4 is not considered in this document as it is not relevant to the risk-reduction requirements normally associated with industrial and commercial fuel-fired appliances.

1.4.82**safety control system**

system used to implement *safety functions* ([1.4.79](#))

Note 1 to entry: Safety control systems are composed of any combination of sensors, logic solvers and final elements and may include software.

Note 2 to entry: Safety control systems are referred to as safety-related systems in the AS 61508 series, as safety instrumented systems in the AS IEC 61511 series and as safety-related electrical, electronic and programmable electronic control systems in AS/NZS 62061.

1.4.83**safe-start check**

check of a flame safeguard system to prevent an ignition attempt from occurring if the system is in the *flame-proved* ([1.4.73](#)) condition before any fuel valves ([1.4.101](#)) are energized during an ignition attempt

1.4.84**safety shutdown**

action of shutting off all *gas* ([1.4.36](#)) and ignition energy by a safety control that prevents restart without a full start cycle

[SOURCE: AS 3814:2018, 1.4.120, modified.]

1.4.85**safety shut-off system**

arrangement of valves ([1.4.101](#)) and associated control systems that shuts off the supply of fuel when required by a device that senses an *unsafe* ([1.4.100](#)) condition

1.4.86**safety shut-off valve**

See *valve* ([1.4.101](#))

1.4.87**self-checking flow device**

device that causes *lockout* ([1.4.53](#)) or prevents an ignition attempt unless it is in the *no-flow* ([1.4.62](#)) condition prior to the start of the flow

1.4.88**shall**

indicates that a statement is mandatory

1.4.89**should**

indicates a recommendation

1.4.90**shutdown**

cessation of all *appliance* ([1.4.1](#)) functions when the *appliance* ([1.4.1](#)) is intended to remain out of use for a period

Note 1 to entry: The period may be overnight or a weekend. Generally, a complete restarting procedure would then be required, which may necessitate the resetting of some of the lockout provisions.

See also *safety shutdown* ([1.4.84](#))

1.4.91**start flame**

flame resulting from ignition at the start rate

1.4.92**start fuel rate**

fuel flow rate when initial ignition occurs at a *pilot burner* ([1.4.69](#)) or, when no *pilot burner* ([1.4.69](#)) is fitted, at a main *burner* ([1.4.6](#))

1.4.93**start gas**

gas ([1.4.36](#)) flowing at a *pilot burner* ([1.4.69](#)) or, when no *pilot burner* ([1.4.69](#)) is fitted, at a main *burner* ([1.4.6](#)) during the *flame establishment period* ([1.4.22](#)) for initial ignition

[SOURCE: AS 3814:2018, 1.4.127]

1.4.94**stoichiometric**

theoretical amount of fuel in air or oxygen such that no combustible agent or residual oxygen remains in the *combustion products* ([1.4.12](#))

1.4.95**supervised burner**

burner ([1.4.6](#)) fitted with a *flame safeguard system* ([1.4.27](#))

1.4.96**Technical Regulator**

government authority with jurisdiction over *appliance* ([1.4.1](#)) and equipment safety legislation

1.4.97**temperature limit device**

device that automatically causes the fuel supply to be interrupted when the temperature at the control point reaches a pre-set limit

1.4.98**test firing valve**

See *valve* ([1.4.101](#))

1.4.99**tolerable**

acceptable within a given context where the benefit to be derived from further improvement or refinement is outweighed by the cost

Note 1 to entry: A tolerable level of risk may be defined in terms of work, health and safety legislation, current societal values and corporate policy.

Note 2 to entry: Risks that are considered tolerable are identified as “controlled” and “as low as reasonably practicable (ALARP)”.

Note 3 to entry: See [Appendix N](#) for a discussion on tolerable risk.

1.4.100**unsafe**

<installations, fittings, components, appliances, and associated equipment> *risk* ([1.4.77](#)) of harm to people or property from *hazards* ([1.4.39](#))

See also *safe* ([1.4.78](#))

Note 1 to entry: Hazards may arise directly or indirectly from the operation, use or passage of fuel, combustion products or process flows through and from, the installation, fittings, components, appliances or associated equipment.

1.4.101**valve**

device to control or shut-off flow

1.4.101.1**non-return valve**

valve ([1.4.101](#)) designed to operate automatically to prevent reversal of flow in a pipe

1.4.101.2**safety shut-off valve**

valve ([1.4.101](#)) in the *safety shut-off system* ([1.4.85](#)) that automatically and completely shuts off the fuel when de-energized

1.4.101.3**test firing valve**

manual shut-off *valve* ([1.4.101](#)) that turns a *burner* ([1.4.6](#)) on or off to test for satisfactory ignition, flame stability, and the like

1.4.101.4**vent valve**

valve ([1.4.101](#)) in a *vent line* ([1.4.102](#)) that automatically opens when de-energized and automatically closes when energized

Note 1 to entry: A vent valve is typically found in a double block and vent safety shut-off system.

1.4.101.5**valve-proving system****leakage detection system**

means of checking that any *safety shut-off valves* ([1.4.101.2](#)) and *vent valves* ([1.4.101.4](#)) of a *safety shut-off system* ([1.4.85](#)) are leak tight

1.4.102**vent line**

pipe to convey *gas* ([1.4.36](#)) to a *safe* ([1.4.78](#)) location that is connected to a gas pressure regulator, relief *valve* ([1.4.101](#)) or a *double block and vent* ([1.4.17](#)) *safety shut-off system* ([1.4.85](#))

1.4.103**water heater**

appliance ([1.4.1](#)) for the supply of water at a temperature not exceeding 99 °C

1.5 New designs and innovations

This document does not prevent the use of materials, methods of assembly, procedures and the like that do not conform with the specific requirements of this document or are not mentioned in it provided that the minimum dimensional and performance requirements specified herein are met.

NOTE 1 Specific approval may be required from the relevant Technical Regulator.

NOTE 2 Unusual installations may require review by the Technical Regulator e.g. where the variations involving biogas treatment systems and associated flares result from the various sources of biogas from landfill, digesters and sewerage lagoons. Refer to AS 3814:2018 Appendix P for additional guidance on biogas installations.

For the evaluation of non-conformance, risk assessment shall be conducted in accordance with [Clause 2.1.1.2](#).

NOTE 3 The written evidence should include documentation from the HAZOP, and a CHAZOP if applicable, or a risk assessment (see [Clause 2.1.1.1](#)) or a layer of protection analysis verifying an equivalent or better level of safety, i.e. an equal or lower level of risk.

NOTE 4 Where a safety instrumented system is involved, a safety integrity level analysis would be expected to verify an equivalent or better level of safety, i.e. an equal or lower level of risk.

NOTE 5 The written evidence and analysis would be expected to use standards such as the AS 61508 series, the AS IEC 61511 series, AS/NZS 62061, AS ISO 31000, AS/NZS IEC 31010, AS IEC 61882, ISO 12100 or AS IEC 61160.

NOTE 6 Specific approval remains the prerogative of the Technical Regulator.

NOTE 7 See [Appendix P](#) for guidance on fitness-for-purpose, conformance assessment of legacy appliances, and reports.

NOTE 8 Due to their unique nature, science and research projects should be subject to an approved specific safety case or risk assessment.

NOTE 9 See Appendix T for guidance on new designs and innovations using hydrogen and hydrogen–natural gas.

Section 2 Appliance design and construction

2.1 General design

2.1.1 Appliance design

2.1.1.1 General

The appliance design shall conform to the safety requirements of this document.

HAZOP and risk assessments shall be conducted on the appliance and associated installation so that measures to mitigate or eliminate the hazards identified may be implemented.

NOTE Such risk analysis may include CHAZOP, FMECA or similar methodologies.

2.1.1.2 Risk assessment requirements

Risk assessment of the design and installation of the appliance at its installed location shall —

- (a) be performed using risk criteria to determine whether the appliance and associated equipment has the potential to cause injury or fatality, collateral damage or other adverse effects to personnel, the installation or its surrounds. The risk assessment shall include the hazardous consequences of an appliance failure, taking into account the location of the appliance and occupancy in the vicinity of the appliance; and

NOTE 1 See [Appendix O](#) for hazards covered by this document. These should be reviewed to identify if the appliance process or location creates a requirement for additional safety measures for these or other identified hazards.

NOTE 2 See [Appendix N](#) for information on risk criteria.

NOTE 3 A simple qualitative risk assessment to establish that the mitigation measures selected to reduce risk to ALARP are implemented may be applicable for low-risk installations of industrial fuel-fired appliances with a gas consumption of 20 GJ/h or less. Low-risk industrial fuel appliances are generally those that do not have flammable gases and vapours, dusts or other process conditions that present additional hazards. Low-risk installations are in locations that have low occupancy in the vicinity of the appliance (e.g. low-risk installations are roof-top or remote plant rooms, industrial premises or outdoor locations but do not include installations in basements or at schools, hospitals or aged care facilities). Refer to the NCC for building classifications.

NOTE 4 Industrial fuel-fired appliances are hazardous with associated consequences and levels of risk that are dependent on location. Additional mitigation actions may therefore be necessary after assessing the specific site hazards and risks associated with the appliance installation and its operation at its site location.

- (b) identify all reasonable risks and risk-reduction measures to achieve a tolerable level.

NOTE 5 Refer to AS ISO 31000 for guidance on both qualitative and quantitative methods for risk management and achieving a tolerable level of risk.

NOTE 6 Refer to AS/NZS 2885.6:2018 Appendix I for guidance on demonstrating ALARP and whether the implementation costs are significantly disproportionate to the reduction in, or avoidance of, risk Ref. [54].

NOTE 7 Operational and incident history of similar appliances and their installation assists in evaluating hazards, their likelihood and their consequences.

2.1.1.3 Improper use

Equipment and protective systems shall be designed and integrated into the end product to prevent dangerous situations resulting from improper use.

NOTE Protective systems may include —

- (a) tool required to gain entry to the control enclosure;
- (b) password protected controls;
- (c) locking devices;
- (d) a work permit system; and
- (e) operating instructions and signage warning against improper use of the equipment.

One or more of these may be required after all improper uses have been assessed.

2.1.2 Ladders or steps

Any ladder or step which may be needed to reach valves or other operating controls on the appliance should be an integral part of the appliance.

NOTE Refer to AS 1657 for requirements and guidance on ladders and stairways.

2.1.3 Protection of equipment

Guard rails or equivalent protection shall be provided where necessary to protect controls and equipment from damage or from alteration of settings by traffic, mechanical equipment, or similar.

2.1.4 Accumulation within cavity walls

Cavity walls in an appliance structure, whether or not they contain insulating material, shall be designed so that combustible dusts, flammable gases and vapours or condensable products of combustion cannot accumulate within them.

2.1.5 Insulation

Insulation shall meet the following requirements:

- (a) Supports shall be provided to prevent the settling of, or occurrence of voids in, insulating materials.
- (b) The material used for insulating an appliance shall be non-corrosive to those parts with which it is in contact. It shall be resistant to the temperature conditions of the application.
- (c) Insulation shall be protected from contamination.
- (d) Insulation on a part requiring regular inspection, e.g. a boiler pressure shell shall be arranged to facilitate such inspection.

Insulation should be protected against vermin.

2.1.6 Ignition hazards

Appliances shall be designed to minimize the risk of accidental ignition of flammable vapour, dust, or fuel-air mixture. The following requirements shall be met:

- (a) Hazardous areas shall be classified in accordance with AS/NZS 60079.10.1 for gas and vapour hazards and AS/NZS 60079.10.2 for combustible dust hazards.

NOTE 1 AS/NZS 60079.10.1 provides examples of hazardous area classification that may be applicable to the installation.

- (b) Electrical equipment and installations in hazardous areas shall conform to AS/NZS 60079.14.
- (c) Where there is any danger that static electricity charges could cause an explosion, electrical bonding and earthing shall conform to AS/NZS 1020.
- (d) Belt drives used in proximity to flammable fuel–air mixtures, vapours, or dusts shall be of the antistatic type.
- (e) Fans, conveyors and other mechanical equipment shall be designed to prevent frictional sparking risks (e.g. striking fan blades) and overheating (e.g. bearing failures) in hazardous areas.

NOTE 2 Refer to AS/NZS 60079.14 for guidance on frictional sparking.

2.1.7 Strength of doors

The strength of fasteners and mountings of doors and covers over access ports or openings shall prevent explosion pressures from causing them to open before explosion reliefs operate unless the doors or covers themselves form part of the designed explosion relief.

2.1.8 Prevention of accidental fires

An appliance shall be designed and the heating source located to prevent accumulations of combustible waste or similar material on a scale likely to cause accidental fires.

2.1.9 Free circulation

Shelves, loading arrangements, and internal design shall not impair the circulation of dilution air, the exhaust of vapours, and purging.

2.1.10 Adjusting devices

Any appliance adjustment device that affects the safe operation and use of the appliance shall be designed so that —

- (a) it can be readily and conveniently reset as required;
- (b) it is protected against tampering;
- (c) it will not be thrown out of adjustment by changes in ambient conditions;
- (d) it is not susceptible to sticking or seizing under normal conditions of use;
- (e) it incorporates locking or holding arrangements, which prevent subsequent movement through accident, vibration, or expansion; and
- (f) the tightening of any locking device shall not significantly alter any setting.

2.1.11 Air inlet guards

Each appliance air inlet shall be guarded, screened or located so that it is not obstructed.

2.1.12 Systems for heating by hot fluids

Components which contain heated fluids shall be designed to be safe and withstand the maximum temperatures and pressures to which they are likely to be subjected, including identified fault conditions over their specified life when maintained in accordance with the OEM's instructions.

2.1.13 Electrical equipment

Electrical equipment and its wiring shall conform to AS/NZS 3000 and to any relevant electrical product Standard.

2.1.14 Piping, fittings and components

Piping, fittings and components used to convey or isolate the fuel shall be compatible with all environmental and operating conditions, including those that may lead to brittle failure at low temperature.

Gas piping, fittings and components that form part of the appliance shall conform to the AS/NZS 5601 series.

NOTE 1 Refer to the Technical Regulator for any other requirements.

NOTE 2 For gases other than those covered in the AS/NZS 5601 series, there may be additional requirements for piping, fittings and components, depending on the gas being used. For gas installations where the design pressure is greater than 200 kPa_g, gas piping is usually designed in accordance with AS 4041.

2.2 Materials

2.2.1 Suitability

Material used in the construction and installation of an appliance shall meet the following conditions of use:

- (a) Material used to convey fuel shall be compatible with the particular fuel.

NOTE 1 Refer to [Appendix J](#) for information on suitability of materials for liquid fuels.

- (b) Insulating material shall be specified for use at the temperature and other conditions of the particular application.

- (c) Material subject to heat or corrosion shall be specified as resistant to such heat or corrosion to achieve the specified equipment life.

NOTE 2 Fuel piping supports, fuel piping in concealed locations, underground fuel piping and fuel piping insulation are areas of particular concern in terms of corrosion and require regular inspection.

2.2.2 Combustibility

Combustible materials should not be used in the construction of an appliance. Where their use is unavoidable, these materials shall not be used in applications where their temperature could continuously exceed 70 °C unless the material is rated for continuous service at a higher temperature.

Ladders, steps, walkways, handrails, and similar shall not be made of combustible material.

2.3 Safety of personnel

2.3.1 Working inside appliances

Where people are required to enter a potentially hazardous location in the normal course of their duties, they shall be provided with a means to prevent being injured by any hazard. The means provided shall be under the sole control of that person.

NOTE Occupational health and safety requirements may apply for confined space entry.

2.3.2 Door handles

Any door which may be used as an entry for personnel shall be designed so that it can be opened from both inside and outside.

NOTE This requirement does not apply to hatches used infrequently for maintenance purposes.

2.3.3 Injury or burns

The method of ignition and the location of burner controls shall not render the operator liable to injury or burns while carrying out the lighting procedure. Door handles or knobs shall be designed to obviate accidental contact with hot surfaces. Handles, removable parts of components, shelves, racks, and the like, shall have no sharp points or edges of a nature likely to cause injury. Inspection ports shall be designed to minimize the risk of injury.

2.3.4 Projections

Appliances shall be designed so that projections likely to cause injury to personnel are provided with guards to protect personnel.

2.3.5 Explosion reliefs

Any explosion relief, vent or closure shall be designed and located on the appliance in accordance with [Clause 5.3.6](#).

2.4 Operation and maintenance

2.4.1 Control and safety equipment

Each appliance will have unique process and operational constraints that will present hazards for operators and the equipment itself. A HAZOP (see [Appendix I](#)) and risk assessment (see [Appendix N](#)) shall be conducted on the appliance and associated installation to provide the relevant safe measures additional to this document. Controls and indicating devices shall provide complete control of the appliance. Controls and indicating devices that require frequent observation or manipulation shall be in locations accessible to operators and maintenance personnel.

Where a direction of motion is contrary to the norm, a notice shall be displayed indicating the direction. The following recommendations also apply:

- (a) Gauges and meters should be at a convenient viewing level, well illuminated and free from glare or reflections.
- (b) Where direct access to controls from floor level is not possible, remote control devices should be provided in preference to steps.
- (c) Method of operation and direction of motion of manual controls should conform to accepted practice.

NOTE 1 Standards and regulations may also apply.

- (d) Controls should be located and arranged to facilitate operation in a safe and orderly sequence.

Safety controls that are required to initiate a safety shutdown shall operate independently from operating controls. This means that devices that are used for interlocking and control systems shall not be used for safety shutdown systems.

The layers of protection implemented for the appliance safety system shall follow the principles set out in either the AS 61508 series or the AS IEC 61511 series.

Where the layers of protection implemented do not achieve the determined risk reduction and a safety instrumented system is required to achieve the identified risk reduction, a SIL analysis shall be carried out in accordance with either the AS 61508 or the AS IEC 61511 series so that the safety instrumented function achieves the necessary risk reduction.

The level of detail required in a risk assessment or HAZOP or both is commensurate with the complexity of the device in question and level of risk associated with its use. Devices that present a higher potential level of risk demand a more rigorous assessment in order to determine the controls required. Simpler devices, presenting a lower level of risk, may not require the rigour of a HAZOP.

Programmable electronic system (PES) based burner safety systems shall be designed to conform to either the AS 61508 series or the AS IEC 61511 series, as applicable. For any burner management system using a PES, the HAZOP and risk assessment shall be carried out in accordance with [Clauses 2.1.1.2](#) and [2.1.1.3](#) to ascertain that risk has been reduced to a tolerable level.

NOTE 2 For burner management systems, the safe state is complete burner shutdown with fuel isolated and, where the automatic reset of the fault may cause an unacceptable hazard, with lockout.

2.4.2 Automatic appliance management systems

An appliance that is intended to operate automatically shall be equipped to generate and transmit the following signals to the burner management system:

- (a) Any equipment condition signals that may require to be established before start-up can be permitted.
- (b) Signals to initiate normal start-up and shutdown procedures as necessary for the normal operating demands of the appliance.
- (c) Any shutdown or lockout signals or both in the event of an abnormal appliance condition.

2.4.3 Manual functions

An appliance that is intended to be manually controlled shall conform to [Clauses 3.3.1](#) and [3.3.3](#).

2.4.4 Flame to be visible to maintenance personnel

Personnel who maintain or adjust equipment shall be able to view a flame, either by direct sight or via a remote viewing device equivalent to direct sight, at a safe location.

NOTE 1 The removal of a panel or part to allow viewing is permissible provided that there is no hazard involved and combustion is not significantly affected, see [Clause 3.6.1](#).

NOTE 2 The location of a viewing device in or adjacent to an explosion relief panel or other similar area designed to relieve pressure or allow the passage of flame, gas or combustion products is not considered to meet this requirement.

2.4.5 Visual indication of the burner flame to operator

An operator shall be able to —

- (a) visually check that the main and pilot burners are alight and remain safe while doing so; and
NOTE Reflected glare, indicator lamps or indication on control screens may be used for this purpose.
- (b) have a clear view of the main and pilot burner flames, where manually operated final burner controls are fitted.

2.4.6 Removable components

Designs that require the removal or dismantling of panels or components during routine operation should be avoided. Where unavoidable, their design should be such that replacement does not require undue force, and incorrect replacement is either impossible or completely obvious.

2.4.7 Special tools

The use of special tools for operating or maintaining equipment should be avoided. Where unavoidable, the special tools shall be in accordance with the equipment specifications.

2.4.8 Cleaning

Interior surfaces and auxiliary equipment, such as conveyors, racks, shelves, baskets, and hangers, should be finished smooth and designed to facilitate cleaning.

2.4.9 Maintenance provisions

Each appliance shall be designed and constructed to enable maintenance to be carried out without undue risk to personnel, damage to the appliance or components, or incorrect replacement of component parts.

Design and construction shall include —

- (a) isolation of fuel and power sources to the appliance;
- (b) ability of personnel to carry out maintenance safely when the equipment is operating;
- (c) access panels for control equipment and for appliance internal spaces shall open or be able to be removed without causing wiring or piping connections to be stretched, kinked, or otherwise damaged;
- (d) installation of test points where necessary to facilitate the testing of pressure, temperature or combustion products;
- (e) construction or marking of handles, pointers, knobs, or spindles, so that incorrect re-assembly after dismantling is prevented;
- (f) access for servicing and replacement of any filters;
- (g) adjustment of components; and
- (h) safe access for general cleaning and removal of unwanted residues, accumulations etc.

2.5 Explosion damage protection

2.5.1 Provision of protection

Where an appliance is required by [Clause 3.4.2\(d\)](#) or [Clause 4.2.3](#) to incorporate explosion damage protection, it shall prevent injury to personnel by —

- (a) containing the maximum explosion pressure for the specific fuel, vapour, or dust; or
- (b) providing explosion damage protection in accordance with [Clauses 2.5.2](#) and [2.5.3](#); or
- (c) in the case of smoke ovens —
 - (i) meeting the requirements of [Clause 2.5.3](#) and the explosion relief being 0.2 m² per cubic metre of oven volume and; and

- (ii) having an oven with a high-temperature limit device to shut off and lockout the fuel supply if the temperature exceeds 230 °C. For solid fuel-only smoke ovens, this temperature limit device shall emit an audible alarm and light to alert the operator.

NOTE 1 A door which needs to be open to carry out the ignition procedure may constitute all or part of the explosion relief required during ignition.

NOTE 2 Refer to the Technical Regulator for any additional requirements or exemptions to the requirements in this clause.

2.5.2 Explosion relief operation

The design of an explosion relief, its effective vent area, its closure and its location shall be such that under the worst attainable conditions of explosion, the products of combustion of the explosion can be relieved through the explosion vent so that the pressure within the appliance is below the level which will endanger personnel.

NOTE 1 [Appendix E](#) gives a guide for the calculation of explosion vent areas.

NOTE 2 The design guide described in [Appendix E](#) is based on a number of independent experiments; therefore, the validity of the procedures becomes uncertain outside the limits of the original experiments.

NOTE 3 Care should be taken not to overlook weak points in other areas of the appliance besides the combustion space; a contained internal explosion may damage weaker portions of the equipment, such as flues or ducts, or dislodge auxiliary equipment, such as burners, fans, or inspection doors.

NOTE 4 If a negative internal pressure is likely to cause damage, the closure of the relief opening should be designed to remain open until pressures have stabilized.

Where an appliance is installed in a building or enclosure, the operation of explosion relief vents shall not cause damage to the building or enclosure.

2.5.3 Explosion relief location

The location of any explosion relief on an appliance should provide optimum effectiveness and be located —

- (a) as close as practicable to any potential source of ignition;
- (b) facing the direction of flow of products of combustion;
- (c) so that shelves, racks or similar obstructions do not impair the flow of explosion products; and
- (d) on the appliance in accordance with [Clause 5.3.5](#).

2.6 Temperature hazards

2.6.1 Components, floors and walls

The temperatures specified in [Table 1](#) shall not be exceeded when, with all controls working normally, the appliance operates in conditions where the heat rate and operating cycles will cause surrounding materials to reach maximum equilibrium temperature.

NOTE 1 The limits specified for knobs, handles, surfaces, etc. are intended to provide a degree of personnel protection. It is recognized that equivalent protection may be achieved by the provision of such measures as special protective clothing, gloves, guards, and the like. In any such case the appliance would be exempt from the relevant rule.

NOTE 2 While temperatures of the same order as those specified in [Table 1](#) are in widespread use and are well established as limits, the method of expression varies. Some standards such as this specify in the form of absolute temperatures while others specify lower temperatures but on an above-ambient basis. Each form of expression has advantages and disadvantages and neither is considered to be markedly superior.

Table 1 — Maximum temperatures of surfaces and components

Surface or component	Max. temperature °C
Adjacent combustible materials, floors, walls and the like	70
Surfaces to be handled, i.e. handles, knobs and the like, when made of —	
(a) metals or materials with similar high conductivity;	55
(b) porcelain, vitreous enamel or similar medium conductivity material; or	65
(c) plastic, wood, rubber or similar low conductivity material	80
Surfaces likely to be accidentally touched, except those that are obviously hot, including —	
(a) metals or materials with similar high conductivity;	100
(b) porcelain, vitreous enamel or similar medium conductivity material; or	115
(c) plastic, rubber or similar low conductivity material	120
Bodies of valves, cocks, and the like	In accordance with the product specification
Controls and components containing non-metallic bellows, diaphragms, and the like (unless specifically designed for higher temperature)	65
Electrical and electronic components	In accordance with the product specification
Copper fuel piping	70
NOTE 1 The above values are based on the temperature limits in the gas appliance standards. The limits given are as above ambient values. An ambient of 20 °C should be used for comparison purposes.	
NOTE 2 The limits specified for knobs, handles, surfaces etc. are intended to provide a degree of personal protection. It is recognized that equivalent protection may be achieved by the provision of measures such as special protective clothing, gloves, guards. The need for such protection should be indicated by a notice.	

2.6.2 Power failure

Appliances that incorporate power-assisted heat transfer, such as the air-circulating fan of a furnace or the pump of a circulating boiler, shall be designed or fitted with protective devices to meet the requirements of [Clause 2.6.1](#) with the pump or fan inoperative.

2.7 Instructions

2.7.1 General

Instructions shall be supplied in English with appliances. They shall permit safe and correct installation, commissioning, operation and maintenance.

Instructions shall include a schedule of safety checks for equipment.

NOTE See [Appendix B](#) for guidance on maintenance and testing and [Appendix H](#) for commissioning.

Detailed instructions should cover—

- (a) start-up;

- (b) normal operation;
- (c) normal shutdown;
- (d) emergency operation (where applicable);
- (e) emergency shutdown;
- (f) required actions before and after defined periods of shutdown;
- (g) warnings against improper use; and
- (h) maintenance and safety checks and procedures.

The instructions should be readily available to operators and maintenance staff.

2.7.2 Additional information

Where an appliance has been designed to operate under specific conditions or to handle a specific material, sufficient information and instructions shall be supplied so that the limits of safe operation for which the equipment was designed are clearly understood.

This information should be marked on the equipment and warn operators and others of the hazards of unsafe conditions if the operating procedures are altered or not followed.

NOTE A typical form for recording of such information is set out in [Appendix A](#).

2.8 Marking

2.8.1 Appliance data

All appliances shall be legibly and indelibly marked with —

- (a) manufacturer's name;
- (b) model identification;
- (c) nominal fuel consumption (MJ/h);
- (d) fuel type;
- (e) maximum and minimum fuel supply pressures (kPa_g);
- (f) purge times (min);
- (g) fuel pressure at the burner head, for the nominal fuel consumption (kPa_g);
- (h) combustion chamber volume (m³);
- (i) maximum appliance design temperature (°C);
- (j) total volume swept by the combustion products in passing from the burner to the flue connection (m³);
- (k) electrical supply voltage (V) and frequency (Hz);
- (l) serial number;
- (m) date of manufacture (dd/mm/yyyy);
- (n) purge volume for combustible atmospheres (m³) (where applicable);

NOTE 1 This includes as a minimum the combustion chamber volume, the volume of recirculation ducts and exhaust (flue) ducts, and that portion of the work chamber in which free circulation occurs, excluding the chimney.

- (o) dilution air volume (m^3/min at $20\text{ }^\circ\text{C}$) (where applicable); and
- (p) design flammable gas and vapours — type and maximum quantity (L/h), where applicable.

NOTE 2 Units of measurement should conform to the SI system.

2.8.2 Special purpose appliance data

In addition to [Clause 2.8.1](#), special purpose appliances shall be legibly and indelibly marked with at least the following information:

- (a) A notice stating “This appliance is designed for use under the following conditions specified. Any deviation from these conditions may create hazards”.
- (b) Type or purpose of appliance.
- (c) Type of material handled.
- (d) Dilution air volume (m^3/min at 20°C).
- (e) Design flammable gas and vapours — type and maximum quantity (L/h).
- (f) Batch time (for batch oven) (min).
- (g) Type of heating system.
- (h) Purge volume for combustible atmospheres (m^3).

NOTE This includes as a minimum the combustion chamber volume, the volume of recirculation ducts and exhaust (flue) ducts, and that portion of the work chamber in which free circulation occurs, excluding the chimney.

- (i) Hazardous areas associated with an appliance classified in accordance with AS/NZS 60079.10.1 for flammable gas/vapour hazards and AS/NZS 60079.10.2 for combustible dust hazards.

2.8.3 Indicators, gauges, and controls

Dials, gauges and indicators shall be indelibly marked with the applicable scale and unit, and the function should be identified. Wherever practicable, the function of operating controls should be identified and the direction of operation indicated.

NOTE Units of measurement should conform to the SI system.

2.8.4 Emergency stops

Emergency shutdown devices shall be clearly indicated together with concise instructions and signage on their method of operation.

2.8.5 Colour code

Appliance piping should, where applicable, be labelled or colour coded.

Section 3 Combustion system

3.1 General

3.1.1 General suitability

The overall design of the appliance, its air supply and fuel–air proportioning provisions, in the ambient conditions likely to be encountered, shall maintain stable flames and minimize deposits detrimental to the combustion process, irrespective of variations to fuel input rate, fuel characteristics, or ambient conditions.

NOTE 1 Requirements for stable and satisfactory combustion for gas-fired appliances are contained in AS 3814.

For stable and satisfactory combustion of oil-fired appliances in normal operation, the following actions should apply:

- (a) The carbon monoxide should not exceed 400 ppm unless special process atmospheres are required.

NOTE 2 This excludes start-up for cold appliances, operation of appliances outside their specified parameters, and rapid or short transient conditions when up to 2 000 ppm can occur.

- (b) Smoke-spot readings should be less than one for No. 2 oil (diesel) and less than four for No. 6 oil (bunker oil, which usually requires preheating) or coal. Smoke should not be confused with water vapour, sulfur, or dust plumes that are usually white or grey in appearance.

NOTE 3 For oil firing, the smoke limit rather than the carbon monoxide limit is used to define the minimum oxygen level, since smoke will generally appear before carbon monoxide emissions rise significantly.

For direct-fired appliances that use the combustion products and/or low oxygen levels to achieve product, process or environmental emissions requirements may not meet the requirements of [Clause 3.1.1](#). These systems are acceptable provided they are designed, commissioned, operated and maintained as specified by the OEM.

EXAMPLES Atmosphere generators, metal heat treatment, some food processes (such as coffee roasting) and some low NO_x and SO_x firing systems.

3.1.2 Burner — retracted or swivelled

A burner (with the exception of a hand-held torch or lighting torch) that can be retracted or swivelled from the operating position without the use of tools shall prevent —

- (a) inadvertent movement from the operating position;
- (b) unsafe leakage of fuel if the supply is disconnected; and
- (c) start-up or continued operation in other than the operating position.

3.1.3 Fuel remaining in burner

Where there is a possibility that fuel remaining in the burner head after shut-off could lead to an unsafe condition, means shall be provided for its safe expulsion.

3.1.4 Leak tightness

The fuel valve train shall be leak tight for leakage to the atmosphere.

NOTE Standards that cover leak tightness of fuel gas valve trains include AS/NZS 5601.1 for fuel gas valve trains, AS 4041 for fuel valve trains, and UL 296 for oil burner assemblies.

3.2 Ignition system construction

3.2.1 Location and fixing

Every component in an ignition and flame supervision system shall be located and fixed so that —

- (a) a flame detector does not indicate the presence of a pilot burner flame unless it is the correct size and shape, and in the correct position, to provide ignition for the main burner;
- (b) the position of each component relative to another and to the main flame is maintained;
- (c) the accumulation of carbon or other deposits, and the distortion, dislocation, or burning of parts, is minimized; and
- (d) electrodes can be locked in position after the spark gap and spark location have been set.

3.2.2 Spark-ignition system

Insulators and leads used in spark-ignition systems shall be—

- (a) specified for use at the temperature at their installed location;
- (b) impervious to oil and moisture; and
- (c) resistant to tracking of the electrical current causing a loss of ignition spark.

3.2.3 Manual ignition systems

3.2.3.1 Manually inserted gas torch

A manually inserted gas lighting torch shall be connected by a hose assembly that —

- (a) conforms to AS/NZS 1869, ASTM F1120-87, BS EN 16617, BS EN 1762, UL 21 or ISO 10380 Type 1;
- (b) is of the minimum practicable length for the application; and

NOTE 1 Fixed piping should always be used to minimize lighting hose lengths. As a guide to a maximum length, AS 4839 limits oxy gas system hose lengths to a maximum of 15 m. This length should not be exceeded unless there are no practical alternatives and the risks to operators are assessed as ALARP.

- (c) has a manual isolating valve immediately upstream of the hose assembly.

NOTE 2 Approval from the Technical Regulator may be required for manual isolating valves.

3.2.3.2 Point of ignition accessibility

The point of ignition of a manually ignited burner shall be readily accessible while the applicable gas controls are being operated.

3.2.3.3 Explosion relief for manually ignited burner

Where a manually ignited burner fires into an enclosure in which an explosive accumulation of gas can occur, the enclosure shall have a fixed area for explosion relief.

NOTE [Appendix E](#) provides guidance on explosion relief techniques.

3.3 Supervision, control and safe procedures

3.3.1 Introduction

Combustion control systems for burners may be operated in one of the following ways:

- (a) *Manually* — The fuel is lit manually and the fuel flow is controlled manually under the observation of an operator.
- (b) *Automatically* — Self-lighting provisions, supervision of the main and pilot burner flames, and purging facilities if necessary, in addition to such heat output control devices as may be necessary to the process are incorporated. Automatic firing systems usually operate in repeated cycles of purge, ignite, prove, on, off, purge, re-ignite, etc., unless shut down and locked out by a safety device. They may incorporate intermediate checking functions between stages, alarm systems, and may even incorporate duplicated safety features if this is considered necessary to achieve a higher degree of reliability.
- (c) *Part-automatically* (also called semi-automatically) — These may combine a number of manual and automatic operations, e.g. initial lighting of a main and pilot burner flames may be manual, followed by temperature-controlled operation with the possible addition of some degree of flame-failure protection as determined by the degree of risk and the quality of operator supervision.

The extent to which manual or automatic controls are used should be determined by the quality of supervision that can be expected of an operator, the relative ability of operators or automatic control devices to respond quickly and reliably, and the degree of risk that would arise from any failure to respond. In many instances, the regulatory requirements will specify that particular controls be used in particular circumstances.

3.3.2 General requirements

Supervision, operating procedures, and control equipment shall be such that the appliance is capable of fulfilling its required function effectively, and unsafe conditions are prevented from occurring. Operation, supervision and control of a manual burner, part automatic burner or an automatic burner shall ensure that —

- (a) each action or response is carried out in the correct relative order or sequence;
- (b) pre-starting checks and procedures are carried out;
- (c) a combustion air supply is available, sized for the application, and correctly treated, prepared and presented;
- (d) a fuel supply is available that —
 - (i) is sized for the flow rate of the application;
 - (ii) is in accordance with the fuel quality specification; and
 - (iii) meets the application fuel pressure range requirements.
- (e) a fuel supply safety shut-off system is fail-safe in operation when de-energized, or on failure of the actuating medium, or on power failure (i.e. block valves closed, vent valves open);
- (f) a fuel supply safety shut-off system is designed so that a single component failure does not result in a hazardous condition (two block valves in series would be a minimum requirement);
- (g) each valve in the safety shut-off system closes not more than 1 s after it has been de-energized;
- (h) gaseous fuels in a liquid state (e.g. liquid petroleum gases) require safety shut-off valves to be designed for the application and to be fit-for-purpose;

NOTE 1 Approval from the Technical Regulator may be required for safety shut-off valves.

NOTE 2 See [Clause 7.4](#) for recommendations regarding the arrangement of safety shut-off valves for fuels when in a liquid state.

- (i) any necessary services such as electricity, compressed air, steam or hydraulic power, are available and ready for operation;
- (j) any residual flammable gases, vapours, or airborne dusts are removed from the combustion chamber or are diluted to below the LEL or rendered inert before ignition is attempted;
- (k) fuel is not admitted into the combustion chamber before any necessary combustion or atomizing airflow has been established;
- (l) fuel is not admitted into the combustion chamber before the means of ignition has been energized;
- (m) ignition is accomplished within the critical time as calculated using [Appendix D](#);
- (n) fuel supply is shut off promptly if a stable flame is not established;
- (o) fuel supply is shut off promptly in the event of main flame failure after a period of stable operation;
- (p) no attempt at reignition is made until it has been established that it is safe to do so;
- (q) the appliance is rendered safe if any essential auxiliary should fail;
- (r) the appliance responds correctly to normal operating demands;
- (s) in the event of an abnormal or safety shutdown, the appliance is placed in a safe stand-by condition ready to re-start when permitted to do so, or in the lockout condition applicable to the situation; and
- (t) the cause of an abnormal or safety shutdown can be identified.

3.3.3 Automatic systems

Any automatic function of a partly or fully automatic burner management system that falls within the scope of AS 3814 shall conform to that Standard.

Any other automatic burner management systems or functions, such as vaporizing and atomizing liquid fuel burners, shall conform to [Clause 3.3.2](#) and meet the following requirements:

- (a) Essential safety devices or system features shall not be able to be bypassed or rendered inoperative except when closely supervised maintenance or procedure checking is performed.
- (b) Any equipment that incorporates sequential start-up shall be designed so that with the main heat system locked out all operations prior to the initiation of main heat or main flame can be initiated for the purpose of checking.
- (c) The system shall incorporate air supply controls to maintain the specified air flows over the operating range.
- (d) The burner management system shall incorporate the following:
 - (i) An ignition system.
 - (ii) A flame supervision system.
 - (iii) Provision for receiving and responding to any equipment condition signals from the appliance it serves.

- (iv) Provision for stopping and starting in response to the demand signals from the appliance it serves.
- (v) Provision for receiving and implementing any “abnormal-condition” shutdown signals and lockout signals from either the appliance management system or the burner management system.
- (vi) Any other feature or function necessary to achieve conformance to this document.

Any function that causes an abnormal shutdown shall be identified for operator action.

EXAMPLES Operating instructions, an error code in the burner management system or control system, alarm annunciations (either visual or audible via lights or screen annunciations) and manual lockout of a component.

3.3.4 Manual systems

Where operating procedures are under manual control, operators shall be trained to carry out tasks in a safe and reliable manner. Instructions, notices, indicators and other procedural aids shall be supplied to operators.

NOTE Refer to the Technical Regulator for additional requirements on instructions and notices.

3.3.5 Interlocking controls

Safe operating conditions or correct sequences and procedures as specified in [Clause 3.3](#) shall be achieved by providing interlocks and using a person trained in the operation of the plant or appliance.

3.4 Starting and ignition

3.4.1 Ignition procedures

The starting and ignition procedure shall conform to [Clause 3.3.2](#).

NOTE [Appendix C](#) describes typical starting and ignition procedures for gas but AS 3814 provides comprehensive requirements for gas-fired appliances. For liquid fuel, refer to [Appendix L](#).

3.4.2 Performance

When the normal ignition procedure has been carried out, the following shall apply:

- (a) The pilot burner or, where a low fire start is used, the main burner shall ignite completely and quietly and stabilize before the critical time for the start fuel rate has elapsed.
- (b) If the ignition attempt fails, the fuel shall be shut off at the end of the ignition attempt time within 5 s of the first flow of fuel unless the time does not exceed 70 % of the critical time for the start rate as calculated using the methods in [Appendix D](#).

NOTE 1 The shut-off time for fuel after an ignition attempt failure is 1 s. Flame failure in operation is typically 3 s but can extend to 5 s for valves over 150 mm nominal bore. The safety shut-off valve closure time is typically 1 s but for valves over 150 mm nominal bore, it can extend to 3 s.

NOTE 2 The Technical Regulator may provide exemption from this requirement.

- (c) Where ignition is initiated by an automatic device rather than by an operator, the ignition failure-sensing and shut-off function shall be automatic and lock out in the event of ignition failure.
- (d) Where the response time of the supervisory system exceeds the critical time for the start fuel rate explosion, damage protection in accordance with [Clause 2.5](#) shall be provided.

NOTE 3 The explosion damage protection may take the form of openings that are provided for the initial ignition of the burner. Examples of openings include doors or openings provided by removal of panels such as walls, roofs or floors such as occurs for some batch heat treatment furnaces where these components are removed to allow loading and unloading of the furnace. The creation of these openings should be interlocked with the burner start up sequence.

NOTE 4 [Appendix D](#) specifies how to calculate critical time and provides guidance on ways of extending the critical time by judicious design.

3.4.3 Attempted reignition

When a start fuel ignition attempt has failed, no further attempts shall be made without establishing that it is safe to do so.

3.4.4 Ignition during purging

No means of ignition shall be introduced during a purge period.

3.4.5 Safe-start check

The burner management system shall be checked to prevent an ignition attempt from occurring if the system is in the flame-proved condition before any fuel valves are energized as part of an ignition attempt.

3.4.6 Appliances with multiple main burners

An appliance with multiple main burners shall, wherever practicable, be ignited in sequence rather than simultaneously. In either case, the following requirements apply:

- (a) The start sequence for the appliance shall require that the fuel supply to all burners be shut off before the start is initiated.
- (b) Design of the ignition system or the ignition procedure shall provide for the smooth, safe and reliable ignition of each individual burner.
- (c) Any flame-failure safeguard system for a single burner shall respond to the main or pilot burner flame of that burner only.

3.4.7 Sequential ignition of multiple main burners

Where each main burner in an appliance with multiple main burners is ignited sequentially, the following requirements apply:

- (a) Each burner and its associated ignition system shall conform to [Clauses 3.4.1](#) to [3.4.6](#).
- (b) Each single burner shall be alight and stable before the ignition of the next burner.
- (c) Any preferred or essential lighting sequence shall be either specified in operating instructions or marked on the appliance. Where ignition of the main burners is initiated automatically, the sequences shall be controlled automatically.

3.4.8 Simultaneous ignition of multiple main burners

Where any group of main burners in an appliance with multiple main burners are ignited simultaneously, the following requirements shall apply:

- (a) The group of main burners shall be considered a single burner for the purposes of this document and particularly when the critical time is to be calculated.

- (b) Each burner shall be supervised by an ignition failure protection system that is specific to the burner unless it can be shown that a common ignition protection system will lock out all burners in the group from being ignited if any of the burners fail to ignite.

NOTE The Technical Regulator may provide exemption from this requirement.

- (c) Flame failure on any one burner shall cause shut down with lock out of—
 - (i) the failed burner, when each burner is individually supervised; or
 - (ii) all burners in the group, when a common supervision system is used.
- (d) Flame simulation on any one burner in a group of main burners during a start-up check shall lead to the lock out of all the burners in the group unless each burner is provided with its own ignition and flame safeguard system.

3.5 Flame failure during operation

3.5.1 Flame supervision and failure protection

During operation, main and pilot burners shall be supervised by an automatic flame-failure device unless specifically exempted. Such devices shall be arranged to shut off the fuel supply in the event of flame failure at the point being monitored.

Exemption may be considered if —

- (a) a manually ignited burner of up to 500 MJ/h (140 kW) is firing into an open area or open combustion chamber and a flame abnormality or flame failure is obvious to the operator so that remedial action can be taken;
- (b) the appliance is in continuous operation and —
 - (i) is manually ignited and supervised in a safe manner until a temperature in excess of 750 °C is reached after annual shutdown or any unplanned outage;

NOTE The Technical Regulator may provide exemption from this requirement.
 - (ii) the combustion chamber surfaces operate continuously at a temperature in excess of 750 °C; and
 - (iii) the heat retention of the combustion chamber surfaces ensures the time for surfaces to cool to a temperature of 750 °C is in excess of 1 h; or
- (c) the burner ignites smoothly and reliably under all conditions from another burner which is provided with a flame failure safeguard system, and the unsupervised burner cannot be started unless the supervised burner is already operating.

3.5.2 Flame failure response time

Fuel shall be shut-off immediately upon detection of loss of flame.

NOTE 1 The following are typical of the time limits specified in AS 3814:

- (a) Automatic burners — 3 s.
- (b) Atmospheric main burners over 275 kW — 3 s.
- (c) Atmospheric main burners between 140 kW and 275 kW — 15 s.
- (d) Atmospheric main burners up to 140 kW — 45 s.

NOTE 2 For further details refer to AS 3814:2018 Clause 2.25.5.

3.5.3 Relighting after flame failure

No attempt shall be made to re-ignite automatically after flame failure unless it can be shown that it is safe to do so. Otherwise the appliance shall shut down to a condition that requires a manual reset followed by the complete procedure for initiating ignition. For gas-fired burners, reignition attempts shall conform to AS 3814:2018 Clause 3.5.5.

NOTE Typically, this would require that all premissives are met, limits remain safe and a full start cycle, including a pre-purge, is carried out. Depending on the type of appliance and the relevant risk assessment, the number of restart attempts is limited to between one and four before lockout occurs.

3.5.4 Extraneous ignition sources

No attempt shall be made to light a burner by means of hot refractory, hot brickwork, nearby burners, or other hot bodies, unless the specific case can be proven to be safe.

NOTE 1 Refer to [Clause 2.1.1](#) for assessment requirements.

NOTE 2 Acceptance of proof may be the prerogative of the Technical Regulator.

3.6 Multi-fuel firing

3.6.1 Application

This clause applies to firing systems using different fuels as follows:

- (a) Alternative firing, where two or more different fuels may be available for use, but never more than one is in use at a time. This may be through —
 - (i) separate burners for each fuel; or
 - (ii) the same burner, i.e. multi-fuel alternate burner.
- (b) Simultaneous firing, where two or more separate fuels are available and two or more may be fired simultaneously through—
 - (i) separate burners; or
 - (ii) the same burner, i.e. a multi-fuel simultaneous burner.

In Items (i) and (ii), one or more fuels may fire at a constant rate with the other(s) varying to adjust for load fluctuations, or all fuel rates may fluctuate simultaneously.

NOTE A burner that uses different fuels for main and pilot burner flames would not be a multi-fuel burner application for the purpose of this clause.

3.6.2 Alternative firing

Where two or more fuels are available but only one is used at a time in a multi-fuel alternative burner —

- (a) each fuel system shall conform to [Clauses 3.1](#) to [3.5](#);
- (b) an interlocking system shall be provided so that—
 - (i) only one fuel is supplied at any time; and
 - (ii) the shutdown procedure for one fuel is completed before the start-up procedure for the next fuel is initiated. This does not preclude the use of common components, e.g. air supply fans, provided that they fully satisfy all the needs of each fuel system and interlocks are provided as specified in this document for the component; and
- (c) for manual systems, operator procedures shall be in accordance with Item (b).

3.6.3 Simultaneous firing

Where two or more fuels are fired simultaneously using a multi-fuel simultaneous burner, the following requirements apply:

- (a) Operating procedures and safety systems for all fuels shall be similar to minimize the possibility of operator confusion.
- (b) If only one fuel is used through any burner, each such burner shall operate as a complete system.
- (c) If more than one fuel is used through any burner simultaneously, the system shall —
 - (i) provide a non-interruptible air supply that can cope with the total fuel (regardless of type or differing air/fuel ratios) being admitted through the burner and an air supply system that can cope with changes of fuel rate and fuel type;
 - (ii) control the firing rates of all the fuels to achieve stable combustion at safe levels at all times (see [Clause 3.1.1](#));
 - (iii) control the rate of change from one fuel to the other within safe bounds; and
 - (iv) provide a control which can function as designed if the supply of any of the fuels temporarily fails or is shut-off for any reason.

3.7 Shutdown procedures

3.7.1 Safety

Shutdown procedures, whether manual or automatic, shall leave the appliance, its contents and component parts in a safe condition.

NOTE Certain appliances may be vulnerable to the occurrence of unsafe conditions after an abnormal shutdown and before they can ultimately be made safe. Design and procedures should be based on a recognition of these possibilities where they occur, their elimination wherever possible, or their mitigation to the greatest extent possible.

3.7.2 Normal shutdown

The normal shutdown procedure shall leave the appliance ready to restart on receipt of a normal start-up signal. The following is a typical sequence:

- (a) Shut off the fuel supply.
- (b) Operate the post-purge system if provided.
- (c) Shutdown any other systems or controls necessitated by the shutdown signal.
- (d) Place any other appliance function or component, e.g. dampers, in the position for normal shutdown.

NOTE 1 Care should be taken to minimize the effects of residual heat which may cause a local temperature rise after shutdown.

NOTE 2 It is important that a supply of combustion air is maintained at the correct rate while the last of the fuel is being cleared from the burner.

NOTE 3 It is common practice to use an intended shutdown as a convenient opportunity to check the action of safety devices.

3.7.3 Abnormal shutdown

[Clause 3.7.2](#) shall apply whenever a shutdown signal is received, irrespective of the cause. Lockout shall occur when the abnormality can lead to a hazardous condition.

3.7.4 Remote isolation

Where the total fuel input to an appliance exceeds 20 GJ/h, the fuel supply to the appliance shall be able to be remotely isolated. The method of isolation shall not endanger the person isolating the fuel supply.

The use of the fuel supplier's emergency isolation valve at the point of fuel supply to the plant or appliance may be an acceptable form of remote isolation provided access is available.

NOTE 1 Automatic remote isolation should be used when the consequences of loss of containment of fuel could be significantly reduced by rapid isolation.

NOTE 2 Manual valves should never be used in situations where the person effecting the isolation would be endangered or could not achieve the isolation in the time required to prevent or contain a major accident. These are major considerations in deciding when to use an automatic valve. Manual valve isolation may be acceptable in some cases where rapid isolation is not required to prevent or contain a major accident.

NOTE 3 The need for remote isolation should be considered in the risk assessment regardless of the fuel input rate.

NOTE 4 The point of remote isolation should be located in accordance with a risk assessment.

NOTE 5 An appliance isolation valve is typically not an acceptable form of remote isolation due to the need to locate it in close proximity to the appliance.

3.8 Purging

3.8.1 When to purge

An appliance in which an explosive mixture of fuel and air may accumulate shall have a pre-ignition purge carried out immediately before —

- (a) a source of ignition is introduced into or energized within the appliance at the commencement of every firing cycle;
- (b) any attempt to restart automatically after ignition failure or flame failure (purging after shutdown is optional); and
- (c) the entry of any personnel into the appliance using air.

NOTE In a multi-burner installation incorporating sequential ignition, after the first burner has been ignited further purging before igniting additional burners is not required.

3.8.2 Method of purging

Mechanical purging shall be provided for —

- (a) direct fired appliances where flammable gases, vapours or combustible dusts other than unburnt fuel may be present; and
- (b) appliances in which the combustion chamber, burner or any associated recirculation ducts, compartments or flue-ways operate under forced- or induced-draught.