

Australian/New Zealand Standard

Gas installations

Part 2: LP Gas installations in caravans and boats for non-propulsive purposes

Superseding AS/NZS 5601.2:2010







AS/NZS 5601.2:2013

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Part 2: LP Gas installations in caravans and boats for non-propulsive purposes

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ISBN (Print) 978-1-77551-098-7 ISBN (PDF) 978-1-77551-099-4 This Standard was prepared by the Standards Australia/Standards New Zealand Committee AG-006, Gas Installations, to supersede AS/NZS 5601.2:2010. General gas installation requirements for other than caravans and boats can be found in AS/NZS 5601.1.

The objective of this Standard is to provide essential requirements and deemed-to-comply solutions, to promote uniform standards of gas installation and to provide a stand-alone Standard for LP Gas installations in caravans and boats for non-propulsive purposes.

This Standard is based on the general installation requirements of AS/NZS 5601.1.

This Standard is not to be regarded as a design specification or an instruction manual for untrained persons.

This Standard has no legal standing in its own right, but may acquire legal standing in either of the following circumstances:

- (a) Where adopted by a Government or other authority having jurisdiction over relevant installations.
- (b) Where adopted as part of an installation specification.

Regulatory bodies (Technical Regulators) may adopt this Standard.

Matters of an advisory or explanatory nature are indicated in the following manners:

- (i) The word 'NOTE(S)' followed by a statement(s).
- (ii) By inclusion in an informative appendix.
- (iii) By the inclusion of them in examples, Warning or Caution statement.

Terms or words that are indicated by italics in the body of the text are defined terms or words. This indication of italics does not apply to the text in the Preface, headings or figures. Section 1 contains the definitions of such terms or words as they apply to this Standard.

All the Australian and New Zealand Technical Regulators agree that this Standard should provide for particular appliances and components to be certified. It was also agreed that this Standard include a statement that this requirement would not apply retrospectively.

Section 2 of this Standard details the various aspects of a gas installation that contribute to its safety, stating performance criteria for compliance with legislative requirements for safety of gas installations. Sections 3 to 9 provide more detailed information as a means of compliance with the performance criteria.

The means of compliance in Sections 3 to 9 are not the only means of compliance with the performance criteria in Section 2.

Major changes from AS/NZS 5601.2:2010 include the following:

- (A) Clarification of drainage and ventilation requirements for LP Gas cylinder compartments and lockers (see Clause 3.4.1(f)).
- (B) Clarification of refrigerator installations (see Clause 6.11.3).
- (C) Guidance on increase in ventilation area where mesh is installed (see Clause 7.3.1).
- (D) New warning label for vents (see Clause 7.4.4).
- (F) Mandatory requirements for consumer instructions in Appendix G.
- (G) New informative Appendix I for gas appliance commissioning.
- (G) New informative Appendix J for symbols used in gas control system diagrams.

(H) New informative Appendix K with a gas installation checklist.

The terms 'pipe', 'piping', 'tube' and 'tubing' are used throughout this Standard. They are to be considered to have the same meaning.

Where the term 'installation' is used, it is deemed to include the appliances, flues, ventilation and other ancillary items.

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

CONTENTS

ON 1 SCOPE AND GENERAL	
SCOPE	7
APPLICATION	7
EXCLUSIONS	
NORMATIVE REFERENCES	
COMPLIANCE	
OCCUPATIONAL HEALTH AND SAFETY	
DEFINITIONS	
JN 2 PERFORMANCE BASED DESIGN, INSTALLATION AND OTHER	< C C C C C C C C C C C C C C C C C C C
ESSENTIAL REQUIREMENTS	1.7
GENERAL.	
GENERAL WORK	17
LP GAS CYLINDERS.	
LOCATION OF LP GAS CYLINDERS	
CYLINDER COMPARTMENTS AND LP GAS LOCKERS	
MATERIALS AND FITTINGS	
PIPING	
INSTALLING GAS APPLIANCES	
MATERIALS AND COMPONENTS—GENERAL	
HOSE ASSEMBLIES	
SHUT-OFF VALVES	
QUICK-CONNECT DEVICES	
ELECTRICAL REQUIREMENTS	
ON 3 MEANS OF COMPLIANCE—CYLINDERS	
GENERAL	
LOCATION OF LP GAS CYLINDERS	
CYLINDER ATTACHMENT	
CYLINDER COMPARTMENTS AND LP GAS LOCKERS	
NIA MEANS OF COMPLIANCE CAS DESSURE DECULATORS	
ON 4 MEANS OF COMPLIANCE—GAS PRESSURE REGULATORS	27
SUITABILITY OF PRESSURE REGULATORS	
MOUNTING AND SUPPORT OF RECULATOR	
WOUNTING AND SUPPORT OF REGULATOR	
ON 5 MEANS OF COMPLIANCE—PIPING AND FITTINGS	
GENERAL	
INSTALLATION OF PIPING	
	SCOPE APPLICATION

SECTIC	N 6 MEANS OF COMPLIANCE—GAS APPLIANCES	
6.1	PROHIBITED APPLIANCES	
6.2	RESTRICTION FOR STOWED APPLIANCES	
6.3	FLAME SAFEGUARD SYSTEM	
6.4	MANUFACTURER'S INSTRUCTIONS	
6.5	CLEARANCES	
6.6	DISTANCE FROM SOURCES OF FUEL	
6.7	RESTRICTION ON INSTALLATION OF AN APPLIANCE ON A PETROL-	-
	FUELLED BOAT	
6.8	ELECTRICAL REQUIREMENTS	
6.9	SPACE HEATERS	
6.10	COOKING APPLIANCES	
6.11	REFRIGERATORS	
6.12	INSTANTANEOUS WATER HEATERS	
6.13	SPA POOL HEATERS ON BOATS	
SECTIC	NI 7 MEANS OF COMPLIANCE VENTUATION	
	CENEDAL	50
7.1		
7.2	VENTLI ATION ODENINGS CADAVANS AND DOATS	
7.5	VENTILATION OPENINGS—CARAVANS AND BOATS	
/.4	POSITION OF OPENINGS—CARAVANS ONLY	
7.5	POSITION OF OPENINGS—BOATS ONLY	
/.6	GAS DETECTION SYSTEM REQUIRED—BOATS ONLY	
SECTIC	N 8 MEANS OF COMPLIANCE—FLUEING	
8.1	FLUE CONSTRUCTION AND CLEARANCES	
8.2	PROTECTION FROM ENVIRONMENTAL EFFECTS	
8.3	DISTURBANCES	
8.4	LOCATION OF FLUE TERMINAL	
8.5	FLUE MATERIALS	
8.6	PROPRIETARY FLUEING SYSTEMS	
an one		
SECTIC	ON 9 MEANS OF COMPLIANCE—TESTING AND COMMISSIONING	
9.1	TESTING FOR GASTIGHTNESS	
9.2	COMMISSIONING	
APPEN	DICES	
А	NORMATIVE REFERENCES	
В	CONVERSION FACTORS	61
С	FIRE RESISTANT MATERIAL	
D	PIPE SIZING	
Е	COMBUSTIBLE GAS DETECTION SYSTEMS FOR BOATS	
F	TESTING GAS INSTALLATIONS	
G	CONSUMER INSTRUCTIONS	
Н	METHOD OF LOCATING GAS PRESSURE REGULATORS	
I	GUIDELINES FOR GAS APPLIANCE COMMISSIONING	
Ĵ	SYMBOLS USED IN GAS CONTROL SYSTEM DIAGRAMS	
ĸ	GAS INSTALLATION CHECKLIST	
Ĺ	APPLIANCES IN OUTDOOR AREAS	
-		
BIBLIO	GRAPHY	
INDEX		

5

SECTION 1 — CONTENTS SCOPE AND GENERAL

Page

1.1	SCOPE	.7
1.2	APPLICATION	.7
1.3	EXCLUSIONS	. 8
1.4	NORMATIVE REFERENCES	. 8
1.5	COMPLIANCE	. 8
1.6	OCCUPATIONAL HEALTH AND SAFETY	. 8
1.7	DEFINITIONS	. 8

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard Gas installations

Part 2: LP Gas installations in caravans and boats for non-propulsive purposes

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard provides the mandatory requirements and means of compliance for the design, installation and commissioning of *LP Gas installations* in *caravans* and *boats* for non-propulsive purposes.

1.2 APPLICATION

The terms '*caravan*' and '*boat*' are used to include various types of vehicle or marine craft. The user of this Standard is expected to be familiar with the properties and characteristics of *LP Gas* and the principles of combustion, ventilation and flueing applicable to the safe installation and operation of *gas appliances*.

The requirements cover—

- (a) *caravans*;
- (b) mobile holiday homes, campervans and motor homes;
- (c) trucks and trailers incorporating fixed gas installations;
- (d) *boats*;
- (e) houseboats;
- (f) floating restaurants, whether fixed or mobile; and
- (g) catering vehicles, whether self-propelled or towed.

NOTE: Where commercial catering equipment is to be installed, refer to AS/NZS 5601.1.

Where the term 'installation' is used it is deemed to include the pipework, *appliances*, *flues*, air ducts and other ancillary items.

Section 2 of this Standard contains the mandatory performance requirements for the design, installation, and commissioning of *gas installations*. It includes, in Clauses 2.9.1 and 2.10.1, some specific prohibitions, as the performance requirements cannot be reliably met if those prohibitions are breeched.

Sections 3 to 9 of this Standard contain a means of compliance for installations designed to operate with a *gas* supply *pressure* not exceeding 3 kPa. In Australia, approval for any variation to the requirements of Sections 3 to 9 or the normative appendices may need to be obtained from the appropriate *Technical Regulator*.

In New Zealand, the *Technical Regulator* does not provide approvals for variations to the means of compliance in Sections 3 to 9. References to approval by the *Technical Regulator* are not applicable to New Zealand. The installation certifier is responsible for ensuring that the installation, including any variations, meets the requirements in Section 2.

For the application of this Standard in New Zealand only, where a Standard is cited as part of a means of compliance or in an Appendix, any Standard with equivalent performance requirements may be used as an alternative means of compliance.

8

International System of Units (SI) is used in this Standard.

NOTE: Appendix B provides a list of conversion factors for other commonly used units.

1.3 EXCLUSIONS

This Standard does not apply to—

- (a) installations covered by statutory requirements such as the New Zealand Maritime Transport Act 1994 and the Australian Uniform Shipping Laws Code;
- (b) the use of *LP Gas* as a fuel for automotive or propulsion purposes;
- (c) installations in transportable homes and mobile classroom units; and
- (d) installation of commercial catering equipment.

NOTE: Where commercial catering equipment is to be installed, refer to AS/NZS 5601.1.

1.4 NORMATIVE REFERENCES

The normative documents referenced in this Standard are listed in Appendix A.

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

1.5 COMPLIANCE

The requirements of this Standard shall be used in conjunction with, but do not take precedence over, statutory regulations that may apply in any area. Where no requirement is given, good practice shall apply. In a matter of uncertainty, advice should be sought. This Standard applies to new installations, alterations and extensions commenced after its publication date or the date of adoption by the relevant *Technical Regulator*. It does not apply retrospectively to existing installations, but any repairs or modifications to existing installations shall comply with the requirements of this Standard.

1.6 OCCUPATIONAL HEALTH AND SAFETY

Only safe working practices shall be employed when working on *gas installations*. The process of installing *gas appliances* shall take into consideration relevant occupational health and safety (OHS) requirements. These requirements pertain to all aspects of access, installation, operation and maintenance. Persons installing *gas appliances* shall be aware of their responsibilities and be adequately trained and qualified in accordance with local OHS requirements.

SAFETY PRECAUTIONS NEED TO BE OBSERVED WHEN CUTTING INTO PIPEWORK OR DISCONNECTING FITTINGS AND DEVICES ON PIPEWORK. THERE HAVE BEEN FATALITIES AND INJURIES THAT HAVE BEEN ATTRIBUTED TO GAS SERVICES CARRYING AN ELECTRICAL CURRENT.

1.7 DEFINITIONS

For the purposes of this Standard, the following definitions apply.

1.7.1 Accessible

Access can be gained without hazard or undue difficulty for inspection, repair, testing, renewal, or operational purposes.

1.7.1.1 Readily accessible

Access can be gained without hazard, undue difficulty, or use of a tool.

1.7.2 Appliance

In New Zealand, has the same meaning as 'gas appliance' in the Gas Act 1992.

In Australia, an assembly, other than a vehicle refuelling *appliance*, part of which uses *gas* to produce flame, heat, light, power or special atmosphere.

1.7.2.1 *Type A appliance*

An appliance for which a certification scheme exists (applicable in Australia only).

1.7.2.2 *Type B appliance*

An *appliance*, with *gas consumption* in excess of 10 MJ/h, for which a *certification* scheme does not exist (applicable in Australia only).

1.7.2.3 Flueless appliance

An appliance designed to operate without a flue.

1.7.2.4 Freestanding cooking appliance

A cooking *appliance*, comprising an oven or ovens, a number of open *burners* and usually a grill, which is designed to be installed on a floor.

1.7.2.5 Room-sealed appliance

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

1.7.3 Authorized person

A person authorized under the legislation of the appropriate jurisdiction.

1.7.4 Bedroom or sleeping area

A room or cabin used or intended to be used for sleeping including any combined living/sleeping area.

1.7.5 Boat

Any seagoing or inland water craft including, but not limited to, a motorboat, yacht, cabin cruiser, launch, runabout, trailer-sailer, houseboat, motor-sailer or work-boat.

1.7.6 Burner

A device that positions a flame in the desired location by delivering *gas* and air to that location in such a manner that controlled, continuous combustion is accomplished.

1.7.7 Caravan

A structure that was designed or adapted to be moved from one place to another, whether towed or transported, which is intended for human habitation or use as a workplace, and includes a self-propelled recreational vehicle or mobile home. Included is any associated annex and the like, whether permanently or temporarily attached to or adjoining the main portion of the structure.

NOTE: A large structure assembled in a factory and transported to a permanent location is not considered a *caravan*, e.g., portable school classrooms or transportable homes.

1.7.8 Carbon monoxide detector

A device capable of detecting carbon monoxide (CO), and which provides an alarm signal.

1.7.9 Certified/certification

In Australia, assessed by a *certifying body* and having a certificate number to demonstrate compliance with a Standard.

In New Zealand, a product satisfying the performance requirements of the cited Standard or an equivalent Standard.

1.7.10 Certifying body

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

1.7.11 Combustible material

A material that will ignite and burn, and includes material that has been flame-proofed.

1.7.12 Combustible surface

Any material or object made of, or surfaced with, materials that are capable of being ignited and burned.

1.7.13 Combustion products

Constituents resulting from the combustion of a fuel with air, oxygen or mixture of the two, including the inert *gases* associated with the fuel and the air but excluding any other diluent or contaminant.

1.7.14 Competent person

A person or body who, through training, qualification or practical experience, or a combination of these, and understanding of the equipment and processes, is able to verify compliance with this Standard.

1.7.15 Cylinder

A container for the storage of *LP Gas* that has a capacity of more than 120 mL but not more than 500 L, and does not include an aerosol container.

NOTE: Capacity is often referred to as 'water capacity' and is the total internal volume.

1.7.16 Cylinder compartment

A compartment, an enclosed area or a partitioned-off space primarily used for the installing of a *gas cylinder*, *pressure* regulator and other associated equipment.

1.7.17 Deck (see Figure 1.1)

A floor or platform extending from side to side of a *boat* and includes the following:

- (a) *Upper deck* That part of the decking designed to prevent water entering the hull of a *boat*, generally at the gunwale line.
- (b) *Main deck* The level immediately below the *upper deck*.
- (c) Lower deck The level immediately below the main deck.



FIGURE 1.1 VIEWS OF BOAT SHOWING DECKS

1.7.18 DN (diametre nominale)

See 'nominal size'.

1.7.19 Exhaust fan

A mechanical device other than a *range hood* for moving contaminated air from one interior space to another, or to outside of the space.

1.7.20 Explosive limit

1.7.20.1 Upper explosive limit (UEL)

The upper percentage of *gas* in air at which combustion can be self-sustaining at standard temperature and *pressure*.

LP Gas : nominal UEL 10%

1.7.20.2 Low explosive limit (LEL)

The lower percentage of *gas* in air at which combustion can be self-sustaining at standard temperature and *pressure*.

LP Gas : nominal LEL 2%

1.7.21 Fire resistant material

A material having thermal and physical properties suitable for use in protecting a *combustible surface*, as specified in Appendix C.

1.7.22 Flame safeguard system

A system consisting of a flame detector(s) plus associated circuitry, integral components, valves and interlocks, the function of which is to shut off the *gas* supply to the *burner*(s) in the event of ignition failure or flame failure.

1.7.23 Flue

The passage through which *flue gases* are conveyed from an *appliance* to a discharge point. Types of *flue* include:

- (a) *Natural draught flue* A *flue* in which the draught is provided by the buoyancy effect of the hot *gases* in it.
- (b) Open flue A flue system containing a draught diverter or canopy.
- (c) *Power flue* A *flue* system in which *combustion products* are removed from the *gas appliance* by a fan in the *flue*.

1.7.24 Flue cowl

A device placed at the end of a *flue* designed to prevent the entry of rain and minimize the disturbing effect of wind while not hindering the discharge of *flue gases*.

1.7.25 Flue gases

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

1.7.26 Flue terminal

A point at which *flue gases* discharge from a *flue*.

1.7.27 Gas consumption

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

1.7.28 Gas detector

An intrinsically safe electronic device capable of indicating the presence of *LP Gas* at specified concentrations, which provides an audible or visual warning.

1.7.29 Gas installation

A combination of the following used or intended to be used in the supplying and utilization of *gas*, taken as separate items or as a whole: *piping*, fittings, components, *appliances*, *flues*, apparatus or other devices and associated requirements.

1.7.30 Gas/Liquefied petroleum gas (LP Gas)

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

1.7.31 Gas load

The total gas consumption of all downstream appliances.

1.7.32 Gas pressure regulator

A device that automatically regulates the outlet *pressure* of the *gas* passing through it to a predetermined value and includes the following:

- (a) Automatic changeover regulator A combination valve/gas pressure regulator, fitted to an LP Gas multiple-cylinder installation, which will automatically change over from a cylinder(s) in use to a reserve cylinder at a predetermined pressure.
- (b) *Piping gas pressure regulator* A *gas pressure regulator* installed in the *piping* to reduce the *gas pressure* to a section of *piping*.
- (c) Cylinder regulator A gas pressure regulator on a cylinder installation that is subjected to the gas pressure directly from the cylinder.

1.7.33 Gastight

Tested to the appropriate requirement and any *pressure* drop or leakage rate does not exceed a limit specified by the *Technical Regulator*. The condition of a *gas installation* or *gas* pipework that meets the criteria of Appendix F.

1.7.34 Hob

That part of a cooking *appliance* that supports the *trivet*, and is usually constructed of enamelled steel, stainless steel or toughened glass.

1.7.35 Hose assembly

A flexible tube or pipe complete with end couplings.

1.7.36 Ignition source

A source of energy sufficient to ignite a flammable mixture and includes, but is not limited to, naked flames, exposed incandescent material, electrical welding arcs, and any electrical or mechanical equipment not suitable for use in hazardous locations.

1.7.37 LP Gas locker

A fully enclosed compartment for the storage of *LP Gas cylinders* and associated equipment. See '*cylinder compartment*'.

1.7.38 Main run

The run of *piping* from the outlet of the first *pressure* regulator at the *LP Gas cylinder* to the furthest *appliance* position.

1.7.39 Manual shut-off valve

A manually operated valve that allows an *appliance* or a section of *piping* to be shut off.

1.7.40 Manufacturer's specifications/instructions/recommendations

A document supplied with the *appliance* or equipment that provides authoritative instructions on matters such as installation, commissioning, testing, maintenance and operation of the *appliance* or equipment.

1.7.41 May

Indicates the existence of an option.

1.7.42 Nominal size/Nominal diameter (DN)

A numerical designation of size, in millimetres, which is common to all components in a *piping* system other than components designated by outside diameters or by thread size. It is a convenient round number for reference purposes and is only loosely related to manufacturing dimensions.

1.7.43 Operating pressure

The *gas pressure* that the *piping* or the *appliance* is or will be subjected to under normal operating conditions.

1.7.44 **Outdoor(s)**

An above-ground open-air situation with natural ventilation, without stagnant areas, and where *gas* leakage and products of combustion are rapidly dispersed by wind and natural convection.

NOTE: Appendix L provides diagrammatical representations of *outdoor* areas.

1.7.45 Oxygen-depletion sensor (ODS) or device

A device designed and installed to shut off the *gas* supply to a *gas appliance* when the oxygen content of the ambient air is depleted to a specified concentration.

1.7.46 Pigtail

A short length of small bore copper pipe or a *hose assembly* (to allow flexibility) used for the high-*pressure* connection between an *LP Gas cylinder* and the *cylinder* regulator or the *cylinder* manifold.

1.7.47 Piping

A system of pipes, fittings, components and equipment, within the scope of this Standard, that conveys *gas* from a *cylinder* regulator to the *appliance* inlet.

1.7.48 POL fitting (Prest-o-lite fitting)

The common name for a standard union with left-hand thread, used for connecting to an *LP Gas cylinder* valve.

1.7.49 Pressure

Pressure above atmospheric pressure, or gauge pressure.

1.7.50 Proprietary system

A manufacturer-specific system using matched components, which may require special tools for installation.

NOTE: *Proprietary systems* may be incompatible with those of other manufacturers and may include *piping*, *flues*, and fittings.

1.7.51 Quick-connect device

A two-part mating plug and socket assembly for connecting a *gas appliance* to a *gas* supply without the use of tools.

NOTE: Quick-connect devices are sometimes referred to as 'bayonet fittings'.

1.7.52 Range hood

A mechanical extraction unit to collect contaminated air from above a *gas* cooking *appliance*, pass the air through a filtration system and then either discharge it from the area or recirculate it back into the room.

1.7.53 Rated working pressure

The maximum allowable inlet *pressure* of any *gas appliance*, or pipe fitting, or any section of *gas* pipework.

1.7.54 Room-sealed appliance

See 'Appliance'.

1.7.55 Safety shut-off valve

A valve within a safety shut-off system that stops gas flow.

1.7.56 Shall

Indicates that a statement is mandatory.

1.7.57 Should

Indicates a recommendation.

1.7.58 Technical Regulator

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

1.7.59 Trivet

A grid located over the open *burners* of a *gas* cooking *appliance* to support vessels being heated.

1.7.60 Vent line

A pipe that is connected to a *gas pressure regulator*, relief valve or a safety shut-off system, and will convey escaping *gas* to a safe location.

1.7.61 Water heater

An appliance for the supply of water at a temperature not exceeding 99°C.

SECTION 2 — CONTENTS

15

PERFORMANCE BASED DESIGN, INSTALLATION AND OTHER ESSENTIAL REQUIREMENTS

Ρασρ	
I uge	

		-	uge
2.1	GENER	AL	17
2 2	CENEDAL WORK		
2.2		Varification of and supply	17
	2.2.1	Werlt on a conjugation	1 /
	2.2.2	work on a gas installation	1 /
	2.2.3	Sealing of open ends	18
	2.2.4	Testing of gas installations	18
	2.2.5	Acceptable substances for testing	18
	2.2.6	Methods of locating gas leaks	18
	2.2.7	Decommissioning	18
2.3	LP GAS	S CYLINDERS	18
	2.3.1	Cylinders	18
	2.3.2	Corrosion	18
	2.3.3	Cylinder orientation	18
	2.3.4	Use of in-situ fill cylinders in boats	. 18
	235	Multi-cylinder installations	18
~ .	2.5.5		10
2.4	LOCAT	ION OF LP GAS CYLINDERS	19
	2.4.1	Restriction on location of cylinders	19
	2.4.2	Required clearances around a cylinder	19
	2.4.3	Mounting and stowage	19
	2.4.4	Cylinder restraint	19
2.5	CYLIN	DER COMPARTMENTS AND LP GAS LOCKERS	19
	2.5.1	Design and construction	19
	2.5.2	Identification of cylinder compartment or LP Gas locker	19
2.6	MATE	RIALS AND FITTINGS	19
	2.6.1	Material and components to be suitable	. 19
	2.0.1	Proprietary systems	19
	263	I conting	19
	2.0.5 2.6.4	Condition of pine and fittings	20
	2.0.7	Prohibition of earthing through pining	20
	2.0.5	Condition of pine during installation	20
	2.0.0	Postriction on use of thread scalant	20
	2.0.7	Restriction on use of thread seatant	20
	2.6.8	Bending pipe	20
2.7	PIPING	······	20
	2.7.1	General	20
	2.7.2	Design	20
	2.7.3	Pipe size	20
	2.7.4	Pipe size for piping supplying a Type A appliance	20
	2.7.5	Location	21
	2.7.6	Support of piping	21
	2.7.7	Corrosion control	21
	2.7.8	Gas pressure regulator	21
	2.7.9	Over-pressure protection	
	2.710	Pressure test points	21
	2.7.10 2 7 11	Gas venting	21
	4./.11	Ous venting	41

Page

2.8	FLUES		21
	2.8.1	General	21
	2.8.2	Design	22
	2.8.3	Materials	22
	2.8.4	Installation	22
	2.8.5	Location	22
	2.8.6	Flue terminals	22
2.9	INSTAI	LLING GAS APPLIANCES	22
	2.9.1	Prohibition on installation	22
	2.9.2	Pre-installation	23
	2.9.3	General installation requirements	23
	2.9.4	Requirements for gas appliances	24
		2.9.4.1 New Zealand requirements	24
		2.9.4.2 Australian requirements	24
	2.9.5	Gas appliance location	24
	2.9.6	Ventilation of the gas appliance space and air supply to gas appliances	24
	2.9.7	Gas appliance connection and isolation	25
	2.9.8	Commissioning	25
2.10	MATER	RIALS AND COMPONENTS—GENERAL	25
	2.10.1	Prohibited fittings	25
	2.10.2	Fire resistant material	25
	2.10.3	Flue materials	25
	2.10.4	Jointing compounds and materials	25
2 11	HOSE A	ASSEMBLIES	25
2.11	2 11 1	General	25
	2.11.2	Use of a hose assembly	26
	2.11.3	Hose assembly—Operating conditions.	26
	2.11.4	Hose assembly connecting an appliance	26
2 12			
2.12	SHUT-0	OFF VALVES	- 26
	SHUT-(OFF VALVES	26
2.13	QUICK	OFF VALVES -CONNECT DEVICES	26
2.13	QUICK- 2.13.1	OFF VALVES -CONNECT DEVICES General	26 26 26
2.13	QUICK- 2.13.1 2.13.2	OFF VALVES -CONNECT DEVICES General Restriction on installation	26 26 26 26

SECTION 2 PERFORMANCE BASED DESIGN, INSTALLATION AND OTHER ESSENTIAL REQUIREMENTS

2.1 GENERAL

Where *gas installations* are designed based on the performance requirements of this Section, rather than by using the means of compliance under Sections 3 to 9, the level of safety, convenience and efficiency of operation shall be not less than an installation carried out according to Sections 3 to 9. Such designs shall be capable of being independently verified. Any justification for compliance using Section 2 shall be documented and kept for 7 years.

NOTES:

- 1 The *Technical Regulator* may require to be consulted prior to work commencing.
- 2 Written design specification and drawings together with justification for the deviation of the means of compliance may be required by the *Technical Regulator*.
- 3 Where the installation is of a complex nature, the *Technical Regulator* may require the design to be verified by a suitably qualified professional engineer.
- 4 See Appendix J for a list of symbols for use in diagrams of gas control systems.

2.2 GENERAL WORK

2.2.1 Verification of gas supply

Before commencing an installation, the LP Gas type and pressure shall be verified to ensure the gas is—

- (a) suitable and safe for the gas appliances and pipe fittings to be installed; and
- (b) available at an adequate flow rate to meet the anticipated maximum gas load.

2.2.2 Work on a gas installation

Any gas installation, or part affected, that contains gas shall be isolated and, if necessary, safely purged before any gasfitting commences on that gas installation.

During work on the *gas installation*, all parts of an unattended *gas installation* shall be left in a safe condition.

All air and contaminants shall be purged from the *piping* after work on the *piping* has been completed, and before any attempt to commission the *gas installation* or operate any connected *gas appliance*.

Piping shall be free of debris or other harmful material before that *piping* is connected to a *gas appliance*.

Immediate steps shall be taken to make safe any unsafe *gas installation* or *gas appliance* that may be discovered. The consumer or operator shall be notified.

NOTES:

- 1 In New Zealand, the Gas (Safety and Measurement) Regulations 2010 require that when a licensed person has reasonable grounds to believe that an installation presents an immediate danger to life and property they shall notify the owner or occupier of the property and the *Technical Regulator*.
- 2 In Australia, the *Technical Regulator* may require to be informed.

All open ends of *piping* and outlets intended for future connections of *gas appliances* shall be suitably sealed to be *gastight* and prevent ingress of deleterious materials.

18

NOTE: The closing of a valve will not satisfy this requirement unless the outlet of the valve is sealed.

2.2.4 Testing of gas installations

Gas installations shall be tested and confirmed to be *gastight* before connection to the *gas* supply.

2.2.5 Acceptable substances for testing

Air, the *gas* for which the system is designed, or an inert *gas* shall be the only substances used within *piping* for testing purposes. Oxygen is not to be used as a substitute for air.

2.2.6 Methods of locating gas leaks

Soap and water solution applied externally or other suitable *gas* detecting equipment shall be the only methods used to locate a *gas* leak. Naked flames shall not be used.

CAUTION: THE AMMONIA PRESENT IN SOME SOAPS AND DETERGENTS CAN REACT WITH BRASS FITTINGS AND CAUSE SUCH FITTINGS TO CRACK AFTER A SHORT PERIOD OF TIME. CAUTION SHOULD THEREFORE BE EXERCISED WHEN USING SOAP SOLUTIONS ON BRASS FITTINGS, AND ALL CONNECTIONS SHOULD BE RINSED THOROUGHLY WITH FRESH WATER AS SOON AS POSSIBLE AFTER THE APPLICATION OF THE SOAP SOLUTION.

2.2.7 Decommissioning

Every gas installation, or part of a gas installation, that is permanently decommissioned shall be physically disconnected from the gas supply, purged and sealed.

2.3 LP GAS CYLINDERS

2.3.1 Cylinders

Cylinders and *cylinder* valves shall be suitable for their purpose and for the environment in which they are used.

In Australia, *cylinders* shall comply with AS 2030.1.

NOTE: In New Zealand, *cylinders* are required by the Hazardous Substances (Compressed *Gases*) Regulations 2004 to be of a registered type.

2.3.2 Corrosion

Cylinders should be protected from corrosion.

2.3.3 Cylinder orientation

A *cylinder* shall be installed upright unless specifically designed for horizontal installation with vapour withdrawal.

2.3.4 Use of in-situ fill cylinders in boats

In-situ fill *cylinders* shall not be installed in a *boat* unless it can be demonstrated that by its design or location *LP Gas* vapour cannot enter or accumulate in or on the *boat*.

2.3.5 Multi-cylinder installations

In multi-*cylinder* installations, service and reserve *cylinders* shall be connected to a common manifold fitted with non-return valves, or changeover valves, which permit one *cylinder* to be removed without shutting down the system.

NOTE: Solenoid valves may be used if suitably rated.

2.4 LOCATION OF LP GAS CYLINDERS

2.4.1 Restriction on location of cylinders

LP Gas cylinders shall not be installed nor shall provision be made for installing or storing any *LP Gas cylinders* inside any *caravan* or *boat* except as permitted in Clause 3.4.5.1.

19

2.4.2 Required clearances around a cylinder

Sufficient clearance shall be maintained to ensure adequate separation from *ignition* sources.

2.4.3 Mounting and stowage

LP Gas cylinders and all high *pressure piping* shall be located in a position which is protected from impact and minimizes the risk of *LP Gas* entering the interior of the *caravan* or *boat*.

2.4.4 Cylinder restraint

Cylinders shall be restrained to restrict movement of the cylinders and their attachments.

2.5 CYLINDER COMPARTMENTS AND LP GAS LOCKERS

2.5.1 Design and construction

Cylinder compartments and gas lockers shall be designed and constructed to-

- (a) be of adequate size to house the *cylinders* and their associated equipment;
- (b) allow safe removal and reconnection and be capable of securing the *cylinder/s*; and
- (c) allow sufficient ventilation of the compartment or locker to prevent buildup of LP Gas in case of a leak.

Cylinder compartments and *gas* lockers shall be constructed of a material that is water and corrosion resistant.

2.5.2 Identification of cylinder compartment or LP Gas locker

Cylinder compartments and lockers shall have durable identification on the outside indicating the storage of *LP Gas*.

2.6 MATERIALS AND FITTINGS

2.6.1 Material and components to be suitable

Materials, fittings and components shall be free of damage and defects.

Materials, fittings and components selected for a *gas installation* shall be compatible and suitable for use with—

- (a) the gas being conveyed;
- (b) the *pressure* to which they may be subjected; and
- (c) the environment in which they will be installed.

2.6.2 **Proprietary systems**

Proprietary systems shall be suitable for their intended use and shall be installed as a complete entity in accordance with the relevant *manufacturer's instructions*.

2.6.3 Jointing

All interconnecting materials of jointed fittings and *piping* shall be compatible. Jointing compounds and sealing materials shall be suitable for their application.

2.6.4 Condition of pipe and fittings

Pipe and fittings shall be clear and free from cutting burrs, defects in structure or threading, cutting oil or grease, weld or braze deposits, flux residues and other such contaminants.

2.6.5 Prohibition of earthing through piping

Piping shall not be used as an earth for any electrical supply system.

NOTE: This Clause does not preclude the application of equipotential bonding in accordance with AS/NZS 3000.

2.6.6 Condition of pipe during installation

Precautions shall be taken to prevent the entry of dirt or other foreign matter from entering the pipe during installation.

2.6.7 Restriction on use of thread sealant

Thread sealant, or any other sealing material, shall not be applied to a compression joint.

NOTE: A compression joint includes a flare, a union, and a POL connection to a cylinder valve.

2.6.8 Bending pipe

Every bend and offset in a pipe shall be free from any buckle, crack, or other evidence of physical damage to the pipe or its protective coating.

2.7 PIPING

2.7.1 General

Piping shall be designed and installed to-

- (a) convey gas at a predetermined pressure and volume;
- (b) avoid leakage of gas; and
- (c) avoid damage by corrosion, stress or other means.

Piping shall be installed in a manner that does not adversely affect the structural strength and fire resistance of any craft or vehicle.

2.7.2 Design

Piping shall be-

- (a) designed to ensure an appropriate gas velocity to minimize adverse impacts;
- (b) installed to avoid any obstruction to the gas flow; and
- (c) installed to safely supply an adequate flow of *gas* at the *pressure* required or reasonably foreseen.

2.7.3 Pipe size

The diameter(s) of *piping* shall be sufficient to ensure adequate *gas* supply to the *appliance*(s) and shall be determined by calculation using recognized formulae, tables or graphical methods.

2.7.4 Pipe size for piping supplying a Type A appliance

The diameter of *piping*, intended to supply a *Type A* or domestic-type *appliance*, shall be such that the minimum *pressure* of 2.75 kPa is available at the *appliance* inlet.

The minimum *pressure* shall be available at each *appliance* with all *appliances* connected to the *piping* operating at maximum gas consumption.

2.7.5 Location

Piping shall-

- (a) be installed in a manner and in a location that protects it from damage;
- (b) be designed and located to avoid any hazardous buildup of gas if leakage occurs;
- (c) not be placed in any location where it would prejudice egress from a *boat* or *caravan* in an emergency, or interfere with any emergency response;

21

- (d) be sufficiently clear of other services to ensure they can be safely operated and maintained and to minimize any hazard arising from the failure of either the *gas piping* or any other service; and
- (e) when passing through partitions, be installed in a manner that avoids any escaping *gas* passing from one space to another.

2.7.6 Support of piping

Piping shall be securely supported throughout its length and appropriately restrained to minimize stress from differential movements, with particular regard to those caused by vibration and flexing effects.

2.7.7 Corrosion control

Piping shall be suitably protected from corrosive environments and galvanic corrosion potentials.

2.7.8 Gas pressure regulator

A suitable gas pressure regulator shall—

- (a) be installed wherever the *pressure* supplied to any part of a *gas installation* may exceed the *rated working pressure* of that part;
- (b) where installed, provide and maintain adequate control of the *operating pressure* to all parts of the *gas installation* that they are intended to control; and
- (c) be positioned in a safe location, *readily accessible* for maintenance and adjustment.

2.7.9 Over-pressure protection

Over-*pressure* protection shall be provided to ensure a safe situation exists in the event of malfunction or failure of any *pressure* control device.

2.7.10 Pressure test points

A *pressure* test point shall be provided to ensure all parts of the *gas installation* can be safely tested, purged, commissioned, operated and maintained.

2.7.11 Gas venting

Gas venting devices, vents or *vent lines* shall be installed to ensure vented *gas* discharges freely to a safe location. Spaces that contain *gas* venting devices shall either be ventilated to prevent any hazardous accumulation of *gas* or be free from all sources of ignition. Any *vent line* shall not affect the performance of the device or *gas installation* to which it is connected and shall terminate at a safe location.

2.8 FLUES

2.8.1 General

Every gas appliance that requires a *flue* for safe operation shall be fitted with a *flue*. *Flues* shall be designed and installed to safely discharge *combustion products* from all connected *appliances*. The construction of a *flue* shall in no way impair the design strength or the fire resistance of the *boat* or *caravan*.

2.8.2 Design

Flues shall be appropriately designed, constructed and installed to permit all connected *appliances* to operate safely and effectively, taking into account the types of *appliance* to be connected, their location and energy input.

If condensate is likely to accumulate, a suitably designed and *accessible* means of safely draining the *flue* shall be provided.

2.8.3 Materials

Only suitable materials and jointing methods shall be used for the construction of the *flue*.

2.8.4 Installation

Flues shall be supported independently of the *gas appliance* unless the *gas appliance* has been designed to support the weight of the *flue*.

Flues shall be suitably fastened to a robust structure capable of ensuring stability and to prevent stressing of joints.

Any penetration of the *boat* or vehicle shall be sealed to prevent ingress of water.

2.8.5 Location

The *boat* or vehicle shall be suitably protected from the thermal effects of *flues*.

Flues shall be located to prevent damage or interference to or by any other utility or service.

2.8.6 Flue terminals

Flue terminals shall be—

- (a) constructed of material suitable for the environment;
- (b) constructed to prevent ingress of any material or substance that could impair the performance of either the *flue* or any connected *gas appliance*;
- (c) constructed to prevent ingress of any material or substance that could impair the performance or place at risk the safety or integrity of the *boat* or vehicle;
- (d) located to minimize entry of *combustion products* into any *boat* or vehicle and to minimize the effects of adverse draught on the performance of the *gas appliance*; and
- (e) located so as to prevent harm to persons.

2.9 INSTALLING GAS APPLIANCES

2.9.1 Prohibition on installation

Except as provided below, the following *appliances* and equipment shall not be installed inside a *caravan* or *boat*:

- (a) An *appliance* which is designed to operate on an unregulated *gas* supply or at a *pressure* exceeding 2.75 kPa.
- (b) In Australia, a *water heater*, other than a room-sealed type.

In New Zealand, *water heaters* other than room-sealed types shall only be installed in *caravans* or *boats* subject to the following requirements:

- (i) The input of any flueless *water heater* shall not exceed 0.4 MJ/h/m³ of room volume (100 W/m³).
- (ii) Flueless *water heaters* shall not be fitted underneath projecting shelves or cupboards, nor with a clearance less than 150 mm from side walls, and the *flue terminals* shall not be less than 300 mm below ceilings.

(iii) Instantaneous water heaters shall not be installed in bedrooms or areas used for sleeping unless the water heater is of the room-sealed type. There shall be no ventilation openings or other connections between any area used for sleeping and any compartment in which an instantaneous water heater is located if the water heater is not of the room-sealed type.

NOTE: An area used for sleeping includes any combined living/sleeping area.

(c) A space heater, other than a room-sealed type, and see Note below.

NOTE: In Australia, for a space heater installation on a houseboat, the *Technical Regulator* should be contacted, as a flueless space heater may be permitted in the living area of the houseboat where the area can be isolated from the *sleeping area*. The heater needs to be fitted with a flame safeguard, tilt safety switch and *oxygen depletion device*. The maximum *gas* consumption of the heater is not to exceed 0.2 MJ/h for each cubic metre of room volume.

2.9.2 Pre-installation

Gas appliances shall be checked before they are installed to ensure they are suitable to operate on the gas being supplied.

2.9.3 General installation requirements

General installation requirement are as follows:

- (a) Gas appliances and equipment shall be installed in accordance with the written manufacturer's instructions.
- (b) The space in which a *gas appliance* is installed shall be ventilated to the extent required to ensure the safe and effective operation.
- (c) *Gas appliances* shall be installed so that their operation is not affected by the operation of mechanical devices used to displace air, either within the same space or within a connected space.
- (d) All *manufacturer's instructions* accompanying the *gas appliance* shall be given to the owner or occupier of the *boat* or vehicle in which the *gas appliance* is installed.
- (e) Consumer instructions shall include the information specified in Appendix G.
- (f) *Gas appliances* shall be installed so that adjacent *combustible surfaces* do not exceed 65°C above ambient during operation.
- (g) *Gas appliance* shall be connected to existing *gas piping* only if that *gas appliance* does not affect the safety or effectiveness of any existing connected *gas appliance*.
- (h) Any safety device or system that permits a *gas appliance* to be operated remotely, automatically or unattended shall be of a type that ensures the *gas appliance* fails safe.
- (i) Electrical supplies to *gas appliances* shall have a *readily accessible* and identifiable means of isolation located adjacent to the *appliance*.
- (j) *Gas appliances* shall be suitably supported or secured to prevent stressing of the *gas piping* unless the *gas piping* has been specifically designed and constructed to safely support the *gas appliance*.
- (k) An *appliance* shall be in an *accessible* location with sufficient clearances to allow access to, and removal of, all serviceable components.
 NOTE: Removal of a panel or door to give access to a control compartment is acceptable.
- (1) An *appliance* shall be supported and secured so that the strain on any pipe connection is minimized.

NOTE: The weight and normal operation of the *appliance* needs to be considered in meeting this requirement.

- (m) Where the *appliance manufacturer's instructions* direct that an *appliance* be secured, the means of securing shall be suitable for the conditions of use.
- (n) An *appliance* shall not cause a hazard to walls, nearby surfaces, curtains, furniture or opened doors, and shall not obstruct the free movement of persons.
- (o) An *appliance* shall not be installed in a location where it may ignite flammable vapours or materials or where chemicals may combine with combustion air and cause corrosion or malfunction of the *appliance*.

NOTE: Such materials include some cleaning solvents and some chemicals used in drycleaning processes.

2.9.4 Requirements for gas appliances

2.9.4.1 New Zealand requirements

The gas appliance shall be checked to ensure that the gas appliance markings and instructions indicate that it is designed to operate on the gas to be supplied to the installation and at the range of *pressures* supplied.

NOTE: Gas (Safety and Measurement) Regulations 2010 cover requirements for *certification* or approval of *appliances*.

2.9.4.2 Australian requirements

Type A appliances shall comply with the current appropriate specifications, standards of performance and *certification* requirements. The *appliance* shall be suitable for the type of *gas* to be connected and—

- (a) be *certified*; or
- (b) be acceptable to the *Technical Regulator*.

Type B appliances shall comply with the requirements of AS 3814 and be acceptable to the *Technical Regulator*.

Before a second-hand gas appliance is installed, the appliance shall satisfy the safety requirements of the *Technical Regulator*.

2.9.5 Gas appliance location

Gas appliances shall be located to-

- (a) avoid or be suitably protected against the effects of corrosive and/or physical damage;
- (b) permit functional adjustment, safe ignition, access for operation and maintenance;
- (c) avoid any hazard to the *boat* or vehicle, or to the contents of the *boat* or vehicle;
- (d) avoid undue restriction of the movement of persons;
- (e) minimize the risks associated with the storage, use or release of hazardous or flammable substances in the vicinity or be suitably protected; and
- (f) minimize the risk of harm to persons.

A gas appliance shall be installed only in a location or on a structure capable of supporting the weight of the gas appliance.

2.9.6 Ventilation of the gas appliance space and air supply to gas appliances

Ventilation shall ensure proper operation of the gas appliance and flueing system and maintain safe ambient conditions.

The air supply to gas appliances shall be adequate to provide complete combustion of the gas.

The air supply to *gas appliances* shall be free of any substance that could adversely affect the safe operation or durability of the *gas appliance*.

Where the required air supply relies on a mechanical system, the *gas installation* shall include a suitable interlock to prevent the operation of the *gas appliance* if the mechanical air supply system fails.

2.9.7 Gas appliance connection and isolation

A suitable means of disconnection from the *piping* shall be provided for all gas appliances.

In Australia only, a shut-off valve shall be provided on the inlet connection of an *appliance*. The valve shall be *accessible* for operation.

2.9.8 Commissioning

Every gas appliance shall be commissioned upon installation to ensure safe start-up and operation, and shall include checks of safety and operating controls.

NOTES:

- 1 See Appendix I for guidelines for gas appliance commissioning.
- 2 See Appendix K for a checklist for checking compliance of the installation prior to and during commissioning.

2.10 MATERIALS AND COMPONENTS—GENERAL

2.10.1 Prohibited fittings

The following fittings or jointing systems shall not be used in *piping*:

- (a) Croxed joints.
- (b) Compression fittings with non-metallic olives.
- (c) Compression fittings with metallic olives if not approved for use with *gas* in the *manufacturer's instructions*.
- (d) Longscrew connectors.
- (e) Capillary fittings containing soft-solder.
- (f) Plain nipples, e.g., running nipples with parallel threads, except where no practical alternative is available.

NOTE: A brass external parallel thread to a brass internal parallel thread may be used, provided the joint is welded or a suitable permanent quick-setting thread compound is used and a means of disconnection is provided immediately downstream. Wherever possible, the fitting should be secured against disturbance.

2.10.2 Fire resistant material

Fire resistant material shall comply with the requirements of Appendix C.

2.10.3 Flue materials

Only suitable materials and jointing methods shall be used for the construction of the *flue*.

2.10.4 Jointing compounds and materials

Jointing compounds and materials shall be suitable for the intended use.

2.11 HOSE ASSEMBLIES

2.11.1 General

Hose assemblies shall be of a minimum practicable continuous length and installed so that—

- (a) they are protected from exposure to ultraviolet light; and
- (b) the possibility of damage by rodent attack is minimized.

2.11.2 Use of a hose assembly

In general, other than for *hose assemblies* between *cylinders* and regulators, *hose assemblies* shall be used only between the regulator and rigid *piping*, and between rigid *piping* and *appliances*. Flexible hose shall be one continuous length and as short as practicable for the intended application in order to prevent kinking and damage to the hose. Flexible hose inside a caravan or boat shall be accessible. The connection of *hose assemblies* to each other is not permitted.

For *caravans* with a slide out section (e.g., for additional living space), a *hose assembly* is permitted between the rigid *piping* of a caravan and the rigid *piping* of the slide out section.

Where the flexible hose is concealed (e.g., behind an *accessible* panel), information shall be supplied with the *caravan* instructions that state its location and the need for regular inspection by a *competent person*.

NOTE: For *boats*, hoses may be used for a one-*appliance* installation as corrosion considerations would favour such installation.

2.11.3 Hose assembly—Operating conditions

A hose assembly shall not be installed where, under normal operating conditions, it is-

- (a) exposed to a temperature exceeding the maximum temperature specified in the hose *manufacturer's instructions*;
- (b) subject to stress, abrasion, kinking or permanent deformation; or
- (c) subject to damage by vermin.

2.11.4 Hose assembly connecting an appliance

A hose assembly for an appliance shall be—

- (a) permanently connected to the *appliance* by a threaded or other metal connection; and
- (b) permanently connected to the *piping* by a threaded or other metal connection.

2.12 SHUT-OFF VALVES

Shut-off valves, whether manual or automatic, shall be suitable for the application.

2.13 QUICK-CONNECT DEVICES

2.13.1 General

A quick-connect device shall be installed so as to avoid entry of water, dust or other debris.

2.13.2 Restriction on installation

A quick-connect device socket shall not be installed inside a caravan or boat.

2.14 ELECTRICAL REQUIREMENTS

Electrical supplies to *gas appliances* shall have a *readily accessible* and identifiable means of isolation.

SECTION 3 — CONTENTS MEANS OF COMPLIANCE—CYLINDERS

Page

3.1	GENEF	RAL	
	3.1.1	Cylinders	
	3.1.2	Corrosion	
	3.1.3	Cylinder orientation	
	3.1.4	Use of in-situ fill cylinders in boats	
		3.1.4.1 General	
		3.1.4.2 Internal cylinders	
		3.1.4.3 Location of fill point	
		3.1.4.4 Safety valve discharge	
	3.1.5	Multi-cylinder installations	
37		TION OF LP GAS CVI INDERS	20
5.2	2 2 1	Restriction on location of culinders	
	3.2.1	Required clearances around a cylinder	
	2.2.2	Mounting and stowage	
	3.2.3	Stowage of spare evliptors	
	2.2.4	Heat shield	
	5.2.5		
3.3	CYLIN	DER ATTACHMENT	31
	3.3.1	Restraints	
	3.3.2	Structures	
34	CYLIN	IDER COMPARTMENTS AND LP GAS LOCKERS	31
5.1	341	Caravans	31
	3 4 2	Cylinders located in a combined storage compartment/locker	33
	3 4 3	Boats	34
	3.4.4	Ventilation openings	
	3.4.5	Access to cylinder compartments	
	01110	3 4 5 1 Cylinder compartments with internal access	34
		3.4.5.2 Obstructions.	
	3.4.6	Identification of cylinder compartment or LP Gas locker	
		······································	

SECTION 3 MEANS OF COMPLIANCE – CYLINDERS

3.1 GENERAL

3.1.1 Cylinders

See Clause 2.3.1.

3.1.2 Corrosion

To prevent corrosion of *cylinders* under anchor straps, a rubber strip or similar protection shall be positioned between *cylinders* and anchor straps.

NOTE: Checks should be made for the legislative requirements relating to the rendering safe, repair, retesting and disposal of faulty, damaged or severely corroded *cylinders*.

3.1.3 Cylinder orientation

A *cylinder* shall be installed upright unless specifically designed for horizontal installation with vapour withdrawal.

3.1.4 Use of in-situ fill cylinders in boats

3.1.4.1 General

In-situ fill *cylinders* shall not be installed in a *boat* unless it can be demonstrated that, by its design or location, *LP Gas* vapour cannot enter or accumulate in or on the *boat* and—

- (a) the *cylinder* does not require bleeding or venting to determine correct fill level;
- (b) liquid *LP* Gas is prevented from entering the appliance service line;
- (c) the *cylinder* and fill point are protected from accidental damage by their location or are enclosed in a locker; and
- (d) any leakage is directed away from any *ignition sources* and external to the *boat*.

3.1.4.2 Internal cylinders

Where a cylinder is located within the body of a boat, either—

- (a) the whole of the *cylinder* together with its attached components and fitting shall been enclosed in a compartment; or
- (b) the valves, fittings and pipe connections associated with or attached to the *cylinder* shall be enclosed in a localized sub-compartment, attached to the *cylinder* and vented to the atmosphere.

Provision shall be made for ready access to the service valve in all installation arrangements.

3.1.4.3 Location of fill point

The fill point shall be located so that the following conditions are satisfied:

- (a) The fill connection cannot be accessed from within the *boat*.
- (b) The fill connection can be supervised from the open *deck* of the *boat*.

3.1.4.4 Safety valve discharge

The discharge provisions for a safety valve shall be such that discharge *gas* shall not impinge directly on the container or on any adjacent craft, and shall not discharge into the interior of the *boat*. It shall either—

- (a) discharge into a locker complying with Clause 3.4; or
- (b) be piped away. Any fittings, *piping* attachments or deflectors that are attached to the outlet of the safety valve can interfere with the action of the valve or with *gas* flow so as to reduce the discharge flow rate. Such attachments shall not be made until the installer has confirmed with the equipment supplier that the flow rate remains adequate for the installation.

3.1.5 Multi-cylinder installations

See Clause 2.3.5.

3.2 LOCATION OF LP GAS CYLINDERS

3.2.1 Restriction on location of cylinders

LP Gas cylinders shall not be installed nor shall provision be made for installing or storing any *LP Gas cylinders* inside any *caravan* or *boat* except as permitted in Clause 3.4.5.1.

3.2.2 Required clearances around a cylinder

Minimum clearances around a cylinder shall comply with—

- (a) in respect to *ignition sources*, Figure 3.1; and
- (b) In respect to openings into a *boat*, Figure 3.2.

3.2.3 Mounting and stowage

LP Gas cylinders and all high pressure stage piping shall be-

- (a) installed in a *cylinder compartment* or *LP Gas locker* complying with Clause 3.4;
- (b) mounted externally on the chassis of a *caravan* in a protected position;
- (c) mounted externally on the chassis of a *caravan* under the skirt; or
- (d) mounted externally on the *upper deck* or cabin top of a *boat* but not within one metre of an opening into the *boat*, or in such a way as to impede movement on board the *boat* and at least—
 - (i) 1000 mm from any opening into the *boat* below the *cylinder* valve;
 - (ii) 150 mm from any opening into the *boat* above the *cylinder* valve; and
 - (iii) 1500 mm from any fixed source of ignition.

NOTE: See Figure 3.2.

3.2.4 Stowage of spare cylinders

Stowage requirements for unconnected or spare *cylinders* shall be the same as for connected *cylinders*.

3.2.5 Heat shield

Where the *cylinder* is mounted less than 200 mm from any heat source (for example exhaust or engine compartment), *cylinders* shall be adequately shielded from the source of heat. The heat shield shall be at least 25 mm from the shielded surface and from the heat source.



	Exchange cylinder, mm	In-situ fill cylinder, mm
А	500	1500
В	1500	3500

NOTE: See Clauses 2.3.4 and 3.1.4 if installation of in-situ fill cylinders is being considered.





DIMENSIONS IN MILLIMETRES

FIGURE 3.2 TYPICAL CYLINDER MOUNTING LOCATION FOR BOATS

3.3 CYLINDER ATTACHMENT

3.3.1 Restraints

Cylinders shall be restrained by attachments designed, constructed and secured in place so they shall withstand a load equal to 4 times the weight of the full *cylinder* and fittings in all directions. The method of attachment shall not cause undue stresses to the *cylinder*.

NOTE: A typical installation is shown in Figure 3.3. Other methods of installation are acceptable provided they comply with the intent of this Clause.

3.3.2 Structures

The structure to which the *cylinder* is attached shall be capable of withstanding the forces specified and reinforcement shall be added where necessary to ensure compliance with Clause 3.3.1.



FIGURE 3.3 TYPICAL DOUBLE CYLINDER MOUNTING ARRANGEMENT FOR A CARAVAN

3.4 CYLINDER COMPARTMENTS AND LP GAS LOCKERS

3.4.1 Caravans

A cylinder compartment or LP Gas locker shall comply with the following as appropriate:

- (a) Be designed to—
 - (i) house *cylinder*(s) and their associated equipment only;
 - (ii) allow the *cylinder*(s) to be positioned in the compartment without obstructing the drain in Item (f) below;
 - (iii) not have access from the inside of a *caravan* to a *cylinder* installed in a compartment except as provided under Clause 3.4.5.1; and
 - (iv) permit easy removal of the *cylinder*(s) and the operation of the *cylinder* valve(s) where required for exchange purposes.

NOTE: Consideration should be given to the location of the associated equipment when determining the compartment size.

(b) Be constructed of material that is water and corrosion resistant.

- (c) Be capable of securing the filled *cylinder*(s).NOTE: For requirements of securing method see Clause 3.3.1.
- (d) Be sealed to prevent gas vapour from entering the caravan.
- (e) The access door or opening shall be openable without the use of tools. NOTE: A key is not regarded as a tool.
- (f) Have a drain in, or within, 25 mm of the base, as per option 1 or 2 of Figure 3.4, with a minimum clear area of 500 mm². The drain outlet—
 - (i) shall not face the direction of travel and shall face away from any opening into the *caravan* which is less than 1 m away unless that opening is more than 150 mm above drain outlet; and
 - (ii) shall be at least 1.5 m from any source of ignition unless the *ignition source* is at least 500 mm above the drain outlet.

Alternatively, provide vents in the compartment/locker door at both high and low levels. Each opening shall provide a minimum of 5 000 mm^2 of free area for every *cylinder* enclosed and shall meet the clearances specified in Items (i) and (ii) above. The bottom edge of the lower vent shall be within 25 mm of the base.

(g) Not contain any electrical equipment other than a non-sparking shut-off device. NOTE: See Figure 3.4.



min. 500 mm² drain

FIGURE 3.4 TYPICAL LP GAS LOCKERS AND CYLINDER COMPARTMENTS SHOWING VENT AND DRAIN ALTERNATIVES

(h) Have a sign clearly indicating that only *cylinders* and their associated equipment are permitted in the cylinder compartment. The following wording shall be used:

WARNING: ONLY CYLINDERS AND THEIR ASSOCIATED EQUIPMENT ARE PERMITTED IN THE CYLINDER COMPARTMENT. ELECTRICAL EQUIPMENT, BATTERIES, OR IGNITION SOURCES MUST NOT BE INSTALLED IN THE CYLINDER (AND/OR STORAGE) COMPARTMENT.

NOTES:

- 1 The font size in warning sign should be a minimum of 10 mm in height.
- 2 See Figure 3.5 for an example of the warning sign and its location in the compartment.

3.4.2 Cylinders located in a combined storage compartment/locker

Where *cylinder*(s) are located in a combined external compartment also used for general storage, the *cylinder compartment* shall be separated from the general storage area by a vertical divider sealed to the sides and floor of the compartment and extending to the compartment lid.

33

The *cylinder compartment* space shall contain the *cylinder*(s) and associated *gas* equipment only and be vented at the base as described in Clause 3.4.1(f) and shown in Figure 3.5.

NOTE: Refer to Appendix H for the recommended location for the regulator to mitigate possible fouling of diaphragm by condensate.



NOTE: The font size in warning sign should be a minimum of 10 mm in height.

FIGURE 3.5 COMBINED CYLINDER COMPARTMENT/LP GAS LOCKER
3.4.3 Boats

A cylinder compartment shall comply with the following:

- (a) Not be *accessible* from an enclosed section of the *boat*.
- (b) Be designed to—
 - (i) house cylinders and their associated equipment only; and
 - (ii) allow the *cylinder* to be positioned in the compartment without obstructing the drain in Item (h); and

34

(iii) permit easy removal of the *cylinder*(s) and the operation of the *cylinder* valve(s).

NOTE: Consideration should be given to the location of the associated equipment when determining the compartment size.

- (c) Be constructed of material that is water and corrosion resistant.
- (d) Be capable of securing the *cylinder*(s) when full.NOTE: For requirements of securing method, see Clause 3.3.1.
- (e) Be sealed to prevent gas vapour from entering any enclosed section of the boat.
- (f) The access door or opening shall be openable without the use of tools.
- (g) Where the access opening into the compartment is other than at the top, a lower vertical return or lip of at least 100 mm shall be provided along the full length of the opening.
- (h) Have a drain in the base of not less than 19 mm diameter, which is led outboard, without pockets that could retain water, to a point lower than the locker bottom. The outlet shall be positioned such that it cannot be submerged.
- (i) Not contain any electrical equipment other than a non-sparking shut-off device.
- (j) Have a sign clearly indicating that only *cylinders* and their associated equipment are permitted in the cylinder compartment. The following wording shall be used:

WARNING: ONLY CYLINDERS AND THEIR ASSOCIATED EQUIPMENT ARE PERMITTED IN THE CYLINDER COMPARTMENT. ELECTRICAL EQUIPMENT, BATTERIES, OR IGNITION SOURCES MUST NOT BE INSTALLED IN THE CYLINDER (AND/OR STORAGE) COMPARTMENT.

NOTES:

- 1 The font size in warning sign should be a minimum of 10 mm in height.
- 2 See Figure 3.5 for an example of the warning sign and its location in the compartment.

3.4.4 Ventilation openings

Cylinder compartments and *LP Gas lockers* that are ventilated top and bottom shall have a combined free vent area of not less than 1000 mm²/kg of stored *LP Gas*.

3.4.5 Access to cylinder compartments

3.4.5.1 Cylinder compartments with internal access

NOTE: For *caravans* and *boats* where both external mounting of *cylinders* and penetration of the bodywork are structurally unacceptable, internal access to the *cylinder compartment* may be provided for removal and replacement of *cylinders*.

The compartment shall be able to contain no more than two 15 kg *cylinders*. The bottom edge of the door opening shall be no less than 100 mm above the compartment floor for *boats* and 50 mm above the compartment floor for *caravans*.

In New Zealand, where the compartment is *accessible* from within the *caravan* or *boat*, access to the compartment shall be provided only through a door that latches closed securely. The compartment shall be sealed to prevent flow of vapour into the *caravan* or *boat* when the door is closed.

3.4.5.2 Obstructions

Cylinders, equipment, pipework and cabling shall not obstruct any vents or drains from the compartment or *LP Gas locker*.

3.4.6 Identification of cylinder compartment or LP Gas locker

A durable label complying with Figure 3.6 (Australia) or Figure 3.7 (New Zealand) shall be applied to the outside of the *cylinder compartment* or *LP Gas locker* to indicate the presence of an *LP Gas cylinder*(s).



FIGURE 3.7 NEW ZEALAND LABEL FOR CYLINDER COMPARTMENT OR LP GAS LOCKER

36

MEANS OF COMPLIANCE—GAS PRESSURE REGULATORS

Page

4.1	SUITABILITY OF PRESSURE REGULATORS	37
4.2	OUTLET PRESSURE	37
4.3	MOUNTING AND SUPPORT OF REGULATOR	37

SECTION 4 MEANS OF COMPLIANCE – GAS PRESSURE REGULATORS

4.1 SUITABILITY OF PRESSURE REGULATORS

In Australia, *cylinder* regulators shall be *certified* to AS 4621 or UL 144 and provide over*pressure* protection to ensure the *pressure* downstream of the regulator will not exceed 14 kPa.

NOTE: In New Zealand, *cylinder* regulators and automatic changeover valves are required by the Hazardous Substances (Compressed *Gases*) Regulations 2004 to be of a registered type.

4.2 OUTLET PRESSURE

The outlet *pressure* shall be set to 3.0 kPa nominally to ensure correct simultaneous operation of all *gas appliances*.

4.3 MOUNTING AND SUPPORT OF REGULATOR

Gas pressure regulators shall—

- (a) be mounted in a well-ventilated location;
- (b) be mounted—
 - (i) directly to the structure of the *caravan* or *boat*; or
 - (ii) in New Zealand, directly on the *cylinder* valve, provided this does not unduly stress the *cylinder* valve.
- (c) be located so as not to obstruct the removal or replacement of *cylinders*;
- (d) be located to permit drainage of any liquid back into the *cylinder*; and NOTE: See Figure H1 in Appendix H for an example.
- (e) if located externally, have the vent positioned to avoid blockage by contaminants.

SECTION 5— CONTENTS

MEANS OF COMPLIANCE—PIPING AND FITTINGS

Page

5.1	GENER	RAL	39
	5.1.1	Location	39
	5.1.2	Size	39
	5.1.3	Construction	39
	5.1.4	Piping specification	39
		5.1.4.1 High pressure piping	39
		5.1.4.2 Low pressure	39
		5.1.4.3 Suitable piping	40
		5.1.4.4 Prohibited types of piping, joints and fittings	40
	5.1.5	Cylinder connections	41
52	INSTAL	LATION OF DIDING	11
5.2	5 2 1	General requirements	4 1 41
	5 2 2	Pining in caravans	- 1 41
	523	Pining in boats	42
	52.5	Rigid nining	42
	525	Hose assemblies	42
	5.2.6	Prohibition on earthing of piping	42
	5.2.7	Isolation valves	
	0.217	5.2.7.1 Manual isolation valves	
		5.2.7.2 Automatic shut-off valves	42
		5.2.7.3 Gas appliance connection and isolation	42
	5.2.8	Quick-connect devices	42
	5.2.9	Jointing compounds and materials	43
	5.2.10	Pipe supports and fixings	43
		5.2.10.1 Construction	43
		5.2.10.2 Support spacings	43
	5.2.11	Sealing of open ends	43
		5.2.11.1 Removal of debris	43
		5.2.11.2 Open ends to be sealed while work in progress	43
		5.2.11.3 Outlet provided for future connection to be sealed	43

SECTION 5 MEANS OF COMPLIANCE – PIPING AND FITTINGS

5.1 GENERAL

5.1.1 Location

Piping shall not be located where it could be subjected to damage.

5.1.2 Size

Piping shall be of sufficient size that the operation of *appliances* shall not be affected by the *pressure* drop in any pipe. With all *appliances* operating, the maximum *pressure* drop across the *piping* shall not exceed 0.25 kPa.

5.1.3 Construction

Materials, valves and fittings used for the construction, extension, alteration or repair of any *LP Gas piping* system shall be suitable for their intended purpose and free from defects. Any existing unsafe materials shall be replaced.

5.1.4 Piping specification

5.1.4.1 *High pressure piping*

Piping between *cylinders* and regulators (high *pressure piping*) shall be any one of the following:

- (a) Copper (*pigtail*), with a nominal wall thickness of 1.22 mm, complying with, or equivalent to, AS 1572 and with an alloy designation C12200 to AS 2738.
- (b) A hose assembly complying with AS/NZS 1869 Class C, D or F, or other Standard specifying hose assemblies for use with LP Gas with a minimum working pressure of 2.6 MPa in the temperature range -20° C to $+65^{\circ}$ C.
- (c) Stainless steel to ASTM A269 Grade 316 or 304.

5.1.4.2 *Low pressure*

Piping between the outlet of the *pressure* regulator and the inlet of a *gas appliance* (low *pressure piping*) shall be any one or a combination of the following:

- (a) Copper *piping* in the fully annealed condition complying with NZS 3501 or AS 1432 *Type A* or *Type B*. Copper *piping* in *boats* shall have a plastic coating applied by the manufacturer. Fittings shall be of the flared (to AS 3688 or AS D26) or capillary (to AS 3688) type, except that fittings with metallic olives may be used for connection to an *appliance* only in accordance with the relevant *manufacturer's instructions*.
- (b) A hose assembly with a minimum working pressure of at least 14 kPa and working temperature range of at least 65°C. Hoses certified to AS/NZS 1869 Class A, B, C or D, or complying with BS 3212 Type 2, ANSI UL 21 or other similar Standard shall be acceptable provided they satisfy this performance requirement.

Hose assemblies shall be provided with integral threaded metallic ends or secured to a nozzle by crimping or by the use of a suitable metallic clamp. Worm drive hose clips shall not be used.

(c) Stainless steel to ASTM A269 Grade 316 with flared compression fittings to AS 3688.

NOTES:

- 1 The possibility of galvanic corrosion should be investigated before different *piping* materials are combined in an installation.
- 2 For pipe sizing refer to Appendix D.

5.1.4.3 Suitable piping

Table 5.1 lists suitable *piping*.

TABLE5.1

Materials Section of piping system Pipe Fitting Copper tube to AS 1572 having an Copper alloy flared compression fitting to AS 3688 or AS D26 alloy designation C12200 to AS 2738 with a minimum wall Copper or copper alloy capillary thickness of 1.22 mm and size of fitting to AS 3688 DN 6 Hose assembly to AS/NZS 1869 Class C, D or F with an excess flow POL fitting and tail piece valve immediately upstream of the hose assembly Between cylinder and regulator (see Note) Stainless steel complying with ASTM A269 grade 316 or 304 assembly. Not to be used on boats or POL to quarter male NPT where high levels of chloride (salt) inverted flare can be expected. Assemblies using 316 stainless with a pitting resistance equivalent of 22 or greater may be used. Hose assembly to AS/NZS 1869 End couplings threaded to Class A, B, C or D AS ISO 7.1 Fittings to be compatible with Stainless steel to ASTM A269 pipe material and the Grade 316 manufacturer's specifications. From outlet of cylinder Copper alloy flared compression Fully annealed copper tube to regulator to appliances fitting to AS 3688 NZS 3501 or AS 1432 Type A or Type B. Copper or copper alloy capillary fitting to AS 3688 When used on boats, to include plastic covering applied by the Socket formed using an manufacturer appropriate tube expanding tool

MATERIALS FOR PIPING SYSTEMS IN CARAVANS AND BOATS

NOTE: The excess flow valve may be an integral part of the POL fitting.

5.1.4.4 Prohibited types of piping, joints and fittings

In Australia, multilayer (composite) piping systems shall not be used.

In New Zealand, multilayer (composite) *piping* system may be used if the product *certification* provides for their use in *boats* and *caravans*.

As specified in Clause 2.10.1, the following fittings and jointing systems shall not be used in *piping*:

- (a) Croxed joints.
- (b) Compression fittings with non-metallic olives.
- (c) Compression fittings with metallic olives if not approved for use with *gas* in the *manufacturer's instructions*.
- (d) Longscrew connectors.

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- (e) Capillary fittings containing soft-solder.
- (f) Plain nipples, e.g., running nipple with parallel threads, except where no practical alternative is available.

NOTE: A brass external parallel thread to a brass internal parallel thread may be used, provided that the joint is welded or a suitable permanent quick-setting thread compound is used and a means of disconnection is provided immediately downstream. *Wherever possible* the fitting should be secured against disturbance.

5.1.5 Cylinder connections

The high *pressure piping* between the *cylinder* and the regulator shall allow for vibration, either by including a suitable hose assembly at least 500 mm but not more than 600 mm long, or alternatively by providing loops or U-bends in the connecting *piping*.

Hose assemblies between the cylinder and the regulator shall have—

- (a) a maximum length of 600 mm; and
- (b) a nominal size of 6 mm.

Where the manifold or *pressure* regulator is mounted on a member integral to the *caravan* or *boat*, adequate flexibility shall be provided between the *cylinder*(s) and manifold/regulator assembly.

5.2 INSTALLATION OF PIPING

5.2.1 General requirements

Installed piping shall be-

- (a) substantially secured against vibration;
- (b) protected by a rubber grommet or equivalent protection at all points at which it passes through partitions or bulkheads, unless a bulkhead fitting is used;
- (c) designed, constructed and installed so that it has sufficient flexibility to avoid excessive stresses due to possible relative movement of the *piping* and the supporting structure;
- (d) at least 25 mm from any electrical service; and
- (e) protected against abrasion, kinking or permanent deformation.

5.2.2 Piping in caravans

The *main run* of the *piping* system shall be located outside the *caravan* regardless of the number of *appliances* connected to the pipework.

In addition to Clause 5.2.1, *piping* in *caravans* shall be—

- (a) firmly fastened in a protected location so that all unions and joints are *accessible*, and shut-off valves and hoses are *readily accessible*. Any void between the living space and a false bottom containing consumer *piping* shall be sealed from the living space and shall be provided with a minimum 500 mm² ventilation area adjacent to any unions and joints to allow leaking *gas* to escape to atmosphere;
- (b) arranged such that the branch pipe separately enters the interior of the *caravan* adjacent to each *appliance*; and
- (c) where the *piping* lies along the chassis, fastened to the side of a structural member and not beneath it.

In addition to Clause 5.2.1, *piping* in *boats* shall be—

(a) firmly fastened in a protected location outside any structure or false bottom. All unions and joints shall be *accessible*, and shut-off valves and hoses shall be *readily accessible*.

42

- (b) constructed from continuous lengths from regulator to branch points and from those points to the *appliance* unless it can be demonstrated that this is impracticable; and
- (c) continuous where passing through an engine room or sleeping accommodation space.

Penetrations of *decks* or bulkheads shall be vapour-proof.

5.2.4 Rigid piping

In all cases, installed rigid piping shall be-

- (a) protected from direct contact with metallic parts of the structure; and
- (b) at least 100 mm from exposed live parts of electrical fittings.

5.2.5 Hose assemblies

Hose assemblies shall be-

- (a) of a continuous length and as short as practicable for its application;
- (b) used only between the regulator and rigid *piping* and between rigid *piping* and *appliances*, or where there is only one *appliance*, directly between the regulator and the *appliance*; and
- (c) installed so that the possibility of damage by rodent attack is minimized and they are—
 - (i) not subjected to temperatures above 65°C;
 - (ii) at least 100 mm from components of the engine exhaust system; and
 - (iii) protected from exposure to ultraviolet light.

5.2.6 Prohibition on earthing of piping

Piping shall not be used as an earth electrode or earth continuity conductor.

5.2.7 Isolation valves

5.2.7.1 Manual isolation valves

Manual isolation valves shall be in a *readily accessible* position. These valves shall be of a suitable quarter turn type and constructed so as to indicate clearly whether the valve is in the open or closed position. If the purpose of the valve is not obvious from its location, the valve shall be appropriately labelled.

Manual shut-off valves shall comply with Type 1 requirements of AS 4617 or equivalent and be *certified*.

5.2.7.2 Automatic shut-off valves

Automatic shut-off valves shall comply with Class 1 requirements of AS 4629 or equivalent and be *certified*.

5.2.7.3 Gas appliance connection and isolation

In Australia only, a shut-off valve shall be provided prior to the inlet connection of each *appliance*.

5.2.8 Quick-connect devices

Quick-connect devices shall not be installed inside a *caravan* or *boat*.

5.2.9 Jointing compounds and materials

Jointing compounds shall not be used to compensate for ill-fitting joints and shall not be applied to compression joints, union joints, or *POL fittings*.

Jointing compounds and materials shall—

- (a) comply with AS 4623 or equivalent and, in Australia, be *certified*;
- (b) be suitable for the application; and
- (c) be used only with chemically compatible materials and where the surfaces have been prepared and cleaned strictly in accordance with the relevant *manufacturer's instructions* for the jointing compound or material.

5.2.10 Pipe supports and fixings

5.2.10.1 Construction

All *piping* shall be supported by prefabricated clips of either the same material as, or of a material compatible with, the pipe and fastened with nuts and bolts, rivets or screws.

5.2.10.2 Support spacings

Supports shall be provided within 150 mm of every bend, elbow, tee or branch fitting, excluding loops, and elsewhere at spacings not greater than specified in Table 5.2.

TABLE	5.2	

PIPING SUPPORT INTERVALS

Pipe material type	Vertical runs mm	Horizontal runs mm
Rigid	1250	600
Flexible	750	300

5.2.11 Sealing of open ends

5.2.11.1 Removal of debris

Before any section is permanently connected or sealed it shall be checked for debris and moisture and cleared and dried before sealing.

5.2.11.2 Open ends to be sealed while work in progress

Where alteration, repair or extension to *piping* necessitates the removal of fittings or a *gas appliance* or cutting of an installed pipe, all open ends, other than those at the immediate work area, shall be sealed prior to and for the duration of the work. When the work site is vacated all open ends shall be sealed.

NOTE: The closing of a shut-off valve will not satisfy this requirement unless the outlet of the valve is sealed.

5.2.11.3 Outlet provided for future connection to be sealed

Where an outlet has been provided for the connection of a *gas appliance* but is not to be used immediately, and the outlet is not fitted with a *quick-connect device*, it shall be sealed using a plug, cap, blank flange or a capped or plugged *manual shut-off valve*.

SECTION 6 — CONTENTS

MEANS OF COMPLIANCE—GAS APPLIANCES

6.1	PROHIBITED APPLIANCES		
6.2	RESTRICTION FOR STOWED APPLIANCES		
6.3	FLAME SAFEGUARD SYSTEM 45		
6.4	MANUFACTURER'S INSTRUCTIONS 45		
6.5	CLEARANCES 45		
6.6	DISTANCE FROM SOURCES OF FUEL 45		
6.7	RESTRICTION ON INSTALLATION OF AN APPLIANCE ON A PETROL-FUELLED BOAT		
6.8	ELECTRICAL REQUIREMENTS.466.8.1General6.8.2For Australian use only46		
6.9	SPACE HEATERS		
6.10	COOKING APPLIANCES466.10.1Clearances around gas cooking appliances466.10.2Protection of a combustible surface near a gas cooking appliance476.10.3Vapour seal476.10.4Warning label486.10.5Cooking appliances on boats48		
6.11	REFRIGERATORS 48 6.11.1 Flues 48 6.11.2 Vents 48 6.11.3 Clearances 48 6.11.4 Ventilation 48		
6.12	INSTANTANEOUS WATER HEATERS		
6.13	SPA POOL HEATERS ON BOATS496.13.1Prohibited locations496.13.2Supporting base496.13.3Control systems506.13.4Requirement for pool heater where flow and return water pipes are of plastic506.13.5Non-return valve required50		
	0.15.0 Restriction on fitting of a valve in water flow line		

SECTION 6 MEANS OF COMPLIANCE – GAS APPLIANCES

6.1 PROHIBITED APPLIANCES

Refer to Clause 2.9.1 for details of prohibitions and exemptions.

6.2 RESTRICTION FOR STOWED APPLIANCES

Appliances installed such that they can be stowed away whilst still connected to the *gas* supply shall be provided with means to ensure that *gas* cannot flow when the *appliance* is in the stowed position.

NOTE: A cooking *appliance* installed beneath an aftermarket lid or cover is considered a stowed *appliance*.

6.3 FLAME SAFEGUARD SYSTEM

All appliances shall be fitted with flame safeguard systems to all burners.

6.4 MANUFACTURER'S INSTRUCTIONS

Gas appliances shall be installed in accordance with the *manufacturer's instructions* using good installation practices.

NOTE: In Australia, where there is conflict between the *manufacturer's instructions* and the requirements of this Standard, the matter should be referred to the *Technical Regulator* for a ruling.

In New Zealand, where there is any conflict between the relevant *manufacturer's instructions* for installation and the requirements of this Standard, the matter should in the first instance be referred to the *gas appliance* manufacturer or the New Zealand representative for a ruling. This does not relieve any responsibility for compliance with performance requirements of Section 2.

6.5 CLEARANCES

Gas appliances shall be installed with clearances from *combustible materials* as specified in the *manufacturer's instructions*. In any case the temperature rise of surrounding *combustible materials* shall not exceed 65°C above ambient temperature.

6.6 DISTANCE FROM SOURCES OF FUEL

Except for *caravans* and *boats* fuelled by diesel, *gas appliances* fitted with a continuous source of ignition shall not be fitted, or vented, within 1000 mm (vapour path), of the fuel filler cap or fuel tank vent.

6.7 RESTRICTION ON INSTALLATION OF AN APPLIANCE ON A PETROL-FUELLED BOAT

Where an *appliance* with a continuously burning flame is to be installed below the *upper deck* of a petrol-fuelled *boat* and where there is a possibility of petrol vapour entering the space where the *appliance* is to be mounted, the *appliance* shall be installed so the air intake to the continuously burning flame is at least 600 mm above the *deck* on which the *appliance* is to be mounted.

6.8.1 General

A gas appliance connected to the electricity supply shall be provided with a means of electrical isolation that is adjacent to the *appliance* location and is *accessible* with the *appliance* in the installed position.

Where the *appliance* is installed in a location that is exposed to the weather, the electrical isolation shall be either a weatherproof type, or located in a position that is not exposed to the weather.

6.8.2 For Australian use only

In Australia, the means of isolation shall be—

- (a) a plug to a switched socket outlet;
- (b) a plug to a socket-outlet that may be located in an inaccessible position but has a separate switch operating in all live (active and neutral) conductors located in an *accessible* position; or
- (c) where hard-wired, a switch operating in all live (active and neutral) conductors.

6.9 SPACE HEATERS

Permanently fitted space heaters shall be of a room-sealed type.

6.10 COOKING APPLIANCES

6.10.1 Clearances around gas cooking appliances

Clearances around *gas* cooking *appliances* shall be in accordance with the cooking *appliance manufacturer's specifications*. In the event that clearances are not specified, clearances shall be as in Figure 6.1 and as follows:

(a) Requirement 1—Overhead clearances—(Measurement A)

Range hoods and exhaust fans shall be installed in accordance with the relevant *manufacturer's instructions*.

Clearance A, between the highest part of the highest *burner* of the *gas* cooking *appliance* and a range hood or exhaust fan (overhead clearance), shall be no less than 600 mm for a range hood, and no less than 750 mm for an exhaust fan. Any other downward facing *combustible surface* less than 600 mm above the highest part of the highest *burner* shall be protected for the full width and depth of the cooking surface area in accordance with Clause 6.10.2. However, this clearance to any surface shall not be less than 450 mm.

Where the required clearance to a *range hood* cannot be met, a *range hood* constructed of non-*combustible materials* may be installed at not less than 450 mm, provided that—

- (i) the *range hood* is suitable at the installed clearance; and
- (ii) the gas appliance is certified as a caravan/marine cooker at the installed clearance.

NOTE: This requirement does not apply to the installation of commercial catering equipment.

(b) Requirement 2—Measurements B (side clearances) and C (height)

Where *B*, measured from the periphery of the nearest *burner* to any vertical *combustible surface* is less than 200 mm, that surface shall be protected in accordance with Clause 6.10.2 to a height (*C*) of not less than 150 mm above the periphery of the nearest *burner* for the full dimension (width or depth) of the cooking surface area.

Where the *gas* cooking *appliance* is fitted with a 'splashback', protection of the rear wall is not required provided the splashback achieves protection of any *combustible surface* less than 200 mm from the periphery of the nearest *burner* to a height not less than 150 mm above the periphery of the nearest *burner*.

NOTE: Consideration is to be given to window treatments and painted surfaces on glass splashbacks when located near cooking *appliances*.

(c) Requirement 3—Additional requirements for freestanding and elevated gas cooking appliances—(Measurements D and E)

Where D, the distance from the periphery of the nearest *burner* to a horizontal *combustible surface* is less than 200 mm, then E shall be 13 mm or more, or the horizontal *combustible* surface shall be above the *trivet*. See Details I and II in Figure 6.1.



NOTES:

- 1 Details I and II relate to Requirement 3 of Clause 6.10.1(c).
- 2 In this case, any vertical combustible surface needs to be protected in accordance with Requirement 2 of Clause 6.10.1(b).

FIGURE 6.1 REQUIRED CLEARANCES AROUND GAS COOKING APPLIANCES

6.10.2 Protection of a combustible surface near a gas cooking appliance

In order to meet the requirements of Clause 2.9.3, any *combustible surface* within the clearance zone specified in Clause 6.10.1 shall be protected in accordance with Appendix C for the applicable facing and backing materials.

6.10.3 Vapour seal

When a *gas hob* is installed above a refrigerator, the shelf shall be vapour sealed so that if any *gas* should leak from the cooker it cannot be ignited by the refrigerator.

A permanent legible warning label with a minimum character height of 4 mm shall be affixed in a conspicuous position on, or adjacent to, the *appliance* and shall provide at least the following information:

WARNING

Ensure ventilation when the cooker is in use.

Do not use for space heating.

6.10.5 Cooking appliances on boats

Where *gas* cooking *appliances* are mounted on gimbals to provide a stable cooking surface the following requirements shall apply:

- (a) The *appliance* shall be connected by a flexible connection.
- (b) Limit stops that permit adequate movement during normal operating conditions shall be fitted to minimize stresses on the flexible connection.
- (c) The required clearances to *combustible surfaces* shall be maintained at all possible positions of the *appliance* or a suitable deflector shall be fitted.
- (d) Means shall be provided to positively retain the *appliance* within the gimbals at all angles of tilt.
- (e) Means shall be provided to prevent movement when the *appliance* is not in use.

NOTE: Where a cooking *appliance* is to be installed consideration should be given to the fitting of fiddle rails and potholders to the *appliance* to prevent unintentional movement of cooking vessels.

6.11 **REFRIGERATORS**

6.11.1 Flues

Refrigerators shall be *flue*d to the outside.

NOTE: Flues may be inclusive of the venting system as supplied by the manufacturer.

6.11.2 Vents

A wall vent measuring a minimum free area of 500 mm^2 shall be provided at the bottom level of the refrigerator compartment so that any accumulation of leaked *gas* can escape to outside.

NOTE: Ventilation as required in Clause 6.11.4 may satisfy this requirement.

6.11.3 Clearances

A refrigerator installed in a *caravan* or *boat* shall be installed in a sealed recess to prevent the infiltration of *combustion products* into the living space.

6.11.4 Ventilation

In addition to the requirements listed in Section 7, ventilation at the rear of the unit and to the exterior of the *caravan* shall be provided to ensure the proper functioning of the refrigeration unit.

In the absence of specific manufacturer's instructions—

- (a) the ventilation shall comprise openings located at the top and bottom levels of the enclosed space;
- (b) each opening shall be of a free area not less than specified in Table 6.1; and

(c) the upper ventilation opening shall be located entirely above the condenser/absorption fins.

 TABLE 6.1

 ADDITIONAL VENTILATION FOR REFRIGERATORS

NOTE: Typical installation diagrams are shown in Figure 6.2.

Refrigerator storage capacity, L	Free area for ventilation, mm ²
Up to and including 100	32 500
101 to 200	45 000
Greater than 200	65 000



FIGURE 6.2 TYPICAL INSTALLATIONS OF A GAS REFRIGERATOR

6.12 INSTANTANEOUS WATER HEATERS

See Clause 2.9.1 for prohibition on installation related to instantaneous water heaters.

6.13 SPA POOL HEATERS ON BOATS

6.13.1 Prohibited locations

A spa heater shall not be installed in the following locations:

- (a) Upstream of a filter or pump.
- (b) Downstream of an automatic chlorinator.
- (c) In a storage area for pool chemicals or flammable materials.

NOTE: Pool chemicals may contain chlorine which, when drawn into the heater *burner*, will quickly cause corrosion and damage to the heater.

6.13.2 Supporting base

A pool heater shall, unless otherwise stated in the *manufacturer's instructions* for installation, be installed on a stable non-combustible base.

Pool heaters for spa and therapeutic applications shall have the following controls:

- (a) A system that ensures the water temperature in the pool does not exceed 40° C.
- (b) A manual reset high temperature limit device independent of the control system required by Item (a) to prevent the water temperature in the pool exceeding 45°C.
- (c) Controls that ensure water is flowing through the heater before the main *gas* valve allows *gas* to the *burners*.

6.13.4 Requirement for pool heater where flow and return water pipes are of plastic

Where the water flow and return pipes are of plastic, these pipes shall be connected to the heater with a minimum of 1 m of un-lagged metallic pipe unless stated otherwise in the relevant *pool heater manufacturer's instructions*.

NOTE: This requirement prevents the plastic pipe being affected by residual heat when the pool heater is shut down.

6.13.5 Non-return valve required

A non-return valve shall be fitted in the water return line between the filter and the pool heater unless stated otherwise in the relevant pool heater manufacturer's instructions.

6.13.6 Restriction on fitting of a valve in water flow line

A valve shall not be fitted in the water flow line between the heater and the pool, unless there is an arrangement to vent the system when the valve is closed. Where a *pressure* relief valve provides such venting, that valve shall comply with AS 1357.1 and be fitted with an appropriately terminated drain.

51

MEANS OF COMPLIANCE—VENTILATION

Page

7.1	GENERAL	
7.2	APPROPRIATE VENTILATION SYSTEMS	
7.3	VENTILATION OPENINGS—CARAVANS AND BOATS	
	7.3.1 Minimum free area	
	7.3.2 Special requirements for camper trailers and boats	
	7.3.3 Special requirements for RVs (motorized caravans)	
7.4	POSITION OF OPENINGS—CARAVANS ONLY	
	7.4.1 Cross ventilation	
	7.4.2 Distance from ceiling	
	7.4.3 Distance from floor	
	7.4.4 Vent warning label	
7.5	POSITION OF OPENINGS—BOATS ONLY	
7.6	GAS DETECTION SYSTEM REQUIRED—BOATS ONLY	

7.1 GENERAL

All compartments shall have adequate ventilation to prevent excessive condensation, buildup of products of combustion, or other toxic conditions.

7.2 APPROPRIATE VENTILATION SYSTEMS

In order to ensure adequate flow of air for ventilation, high level and low level ventilation shall be provided. Such ventilation may be assisted by wind-actuated self-trimming cowls, rotary exhauster heads, or an interlocked, fan-assisted ventilation system.

7.3 VENTILATION OPENINGS—CARAVANS AND BOATS

7.3.1 Minimum free area

The free area of the total permanent ventilation for any space in which a *gas appliance* is installed shall be at least 4000 mm^2 or the value obtained from the formula below, whichever is the greater:

$$V = (610 \times U) + (650 \times P)$$

where

- V =minimum free area, in mm²
- U = input rating for all gas appliances, (other than room sealed) in the space, including cookers, in MJ/h, refer to rating plate
- P = number of sleeping spaces in the *caravan* or *boat*

Example calculation

For a *caravan* designed to sleep 3 people, and having a *gas* cooker rated at 29 MJ/h (8 kW), the minimum free area for ventilation, V, is $(610 \times 29) + (650 \times 3) = 19640 \text{ mm}^2$.

NOTES:

- 1 This formula applies to any space inside the *caravan* or *boat* where *gas appliances* are installed. If the space is a normally divided part of the *caravan* or *boat*, or can be divided temporarily by means of doors, curtains, etc., the ventilation openings should be located in that space.
- 2 The calculated ventilation area is strictly the minimum for safety and should be exceeded where possible. It does not in any way replace or reduce the normal adjustable ventilation provided by window, or the like.
- 3 A refrigerator installed in a sealed recess is considered a room-sealed *appliance* for the purpose of the above calculation.
- 4 For *appliances* with input ratings given in other units the following conversion factors may be used:

1 kW = 3.6 MJ/h

1000 BTU/h =1.055 MJ/h

5 The use of louvres and/or mesh screens will reduce the free area of an opening. Allowance should be made to ensure free areas are achieved. As a guide, where mesh is used, the area should be doubled.

7.3.2 Special requirements for camper trailers and boats

On pop-up type recreational vehicles and *boats*, ventilation shall be effective whether the top is up or down. For camper-trailers and *boats* of the fully collapsible type, ventilation need only be effective when the structure is erected.

7.3.3 Special requirements for RVs (motorized caravans)

In motorized *caravans*, regardless of the location of the vehicle exhaust, vents shall not be installed in the rear wall.

7.4 POSITION OF OPENINGS—CARAVANS ONLY

7.4.1 Cross ventilation

The ventilation shall be provided by at least two openings fitted at opposite ends or sides of the compartment in accordance with Clauses 7.4.2 and 7.4.3.

7.4.2 Distance from ceiling

Permanently open ventilation equal to a minimum of 50% of the required ventilation area shall be provided not lower than 150 mm from the ceiling, except that, if the ventilation is provided by an externally vented stove *range hood*/extractor, the vent shall be not lower than 400 mm from the ceiling.

7.4.3 Distance from floor

Ventilation equal to a minimum of 50% of the required ventilation area shall be provided as low as possible but not more than 150 mm from the compartment floor.

NOTE: Ventilation through the floor of a *caravan* may contravene road traffic authority requirements.

7.4.4 Vent warning label

A permanent legible warning label with a minimum character height of 4 mm shall be affixed or adjacent to the upper and lower vents (see Clauses 7.4.2 and 7.4.3) and shall state—

WARNING

This vent must remain permanently open, clean and unrestricted to provide ventilation when gas appliances are in use.

7.5 POSITION OF OPENINGS—BOATS ONLY

Effective, unrestricted, permanent ventilation shall be provided, comprising at least two (2) openings fitted at opposite ends or sides of the cabin, or preferably, at the *deck* head to the underside of the *deck*.

NOTE: Where a *boat* otherwise meets the requirements of this section but it is impractical to use the *boat* without covering the permanent ventilation, a *carbon monoxide detector* capable of detecting low concentrations of CO and having an audible alarm should be installed.

7.6 GAS DETECTION SYSTEM REQUIRED—BOATS ONLY

Where an *appliance* with a continuously burning flame is to be installed below the *upper deck* of a *boat* and there is no low level ventilation in the area where the *appliance* is to be installed, a combustible *gas* detection system complying with Appendix E shall be installed.

NOTE: If 50% of the total ventilation required by Clause 7.3 is supplied at low level the requirement of this Clause will be satisfied.

SECTION 8 — CONTENTS MEANS OF COMPLIANCE—FLUEING

Page

8.1	FLUE CONSTRUCTION AND CLEARANCES	
8.2	PROTECTION FROM ENVIRONMENTAL EFFECTS	
8.3	DISTURBANCES	
8.4	LOCATION OF FLUE TERMINAL	
	8.4.1 General	
	8.4.2 Termination of a flue under a cover	
8.5	FLUE MATERIALS	
8.6	PROPRIETARY FLUEING SYSTEMS	

SECTION 8 MEANS OF COMPLIANCE – FLUEING

8.1 FLUE CONSTRUCTION AND CLEARANCES

Unless the *flue* is designed to prevent adjacent *combustible materials* exceeding 50° C above ambient where a *flue* passes through a wall or a roof, it shall be fitted with a protective sleeve of *fire resistant material*, and be adequately secured. Where the structure includes *combustible material*, a minimum clearance of 25 mm shall be provided between the *flue* and the *combustible material*. The effective internal cross-sectional area of the *flue* shall be not less than the outlet of the *gas appliance*. *Flues* shall not be fitted with dampers.

8.2 PROTECTION FROM ENVIRONMENTAL EFFECTS

Every *flue* shall be fitted with a suitable 'effective *cowl*' which prevents the ingress of rain.

Flues shall be constructed of materials that are suitable to withstand the effects of the environment.

8.3 DISTURBANCES

Flues shall be secured to withstand vehicle movement and weather conditions.

8.4 LOCATION OF FLUE TERMINAL

8.4.1 General

Flue terminals shall not be located within 300 mm of a ventilator, opening port, hatch or window, or within 500 mm of a refuelling point or fuel tank vent outlet.

There shall be at least 50 mm clearance between the lowest opening of a *flue cowl* and the roof of a *caravan*.

8.4.2 Termination of a flue under a cover

Where the *flue terminal* of a balanced *flue appliance, room-sealed appliance*, a fan-assisted *appliance* or the *flue terminal* of an *appliance* designed for outdoor installation is to be installed under a covered area, where *combustion products* might not readily disperse or a nuisance could occur, either—

- (a) the covered area shall be open on at least two sides and the terminal shall be located to ensure a free flow of air across it is achieved; or
- (b) in the case of a fan-assisted *flue appliance* only, when one side is open, the terminal shall be within 500 mm of the opening, discharging in the direction of the opening and there shall be no openings into the *caravan* or *boat* along the wall within that distance and the terminal shall be located to ensure that a free flow of air across it is achieved.

NOTE: These requirements do not apply to domestic gas barbecues and radiant gas heaters designed for outdoor use. For these appliances, refer to Appendix L.

8.5 FLUE MATERIALS

Materials for a *flue* shall comply with Table 8.1.

TABLE 8.1

56

FLUE MATERIALS

Material	Protective finish	Application and limitations
Low temperature applications	(not exceeding 300°C)	
Aluminium alloy 1100, 3003 complying with AS/NZS 1734 Minimum thickness 0.7 mm	None	Only where <i>accessible</i> for inspection and renewal
Mild steel Minimum thickness 0.6 mm	Aluminized 122 g/m ² , or Z275 zinc to AS 1397, or aluminium zinc complying with AS 1397	Only where <i>accessible</i> for inspection and renewal
High temperature applications	s (up to 500°C)	·
Stainless steel Minimum thickness 0.5 mm	300 and 430 Series Grade	

8.6 PROPRIETARY FLUEING SYSTEMS

Proprietary flueing systems shall be suitable for the application and installed according to the *manufacturer's instructions*.

SECTION 9 — CONTENTS

MEANS OF COMPLIANCE—TESTING AND COMMISSIONING

Page

9.1	TESTI	NG FOR GASTIGHTNESS	
9.2	COMN	MISSIONING	
	9.2.1	Commissioning of appliance	
	9.2.2	Other commissioning checks	

SECTION 9 MEANS OF COMPLIANCE – TESTING AND COMMISSIONING

9.1 TESTING FOR GASTIGHTNESS

A gastightness test in accordance with Appendix F shall be carried out on all new installations and modifications to existing installations.

9.2 COMMISSIONING

9.2.1 Commissioning of appliance

The commissioning of an *appliance* shall take full account of special design features, the *manufacturer's instructions* and the *appliance* safety requirements.

The commissioning of an *appliance* shall include all of the following:

- (a) Testing and purging of the *appliance* and installation as appropriate.
- (b) Checks to ensure the *appliance* is in safe working order.
- (c) Ignition of each *burner* of the *appliance* and, where necessary, adjustment in accordance with the *manufacturer's instructions*.
- (d) Testing of *flue* performance.
- (e) Testing of all safety devices for correct operation.
- (f) Instruction of the consumer, where available, on the safe and correct operation of the *appliance* and any auxiliary equipment.
- (g) Handing of the *appliance* operating instructions to the consumer, or if the consumer is not present, leaving the instructions in a suitable location on the premises.

NOTES:

- 1 See Appendix I for guidelines for gas appliance commissioning.
- 2 See Appendix K for a checklist for checking compliance of the installation prior to and during commissioning.

9.2.2 Other commissioning checks

Appliance operating instructions, the label on the LP Gas locker or cylinder compartment, and any cautionary labels shall be checked to ensure they are displayed in prominent positions.

Cylinders and cylinder restraints shall be examined for damage or corrosion.

APPENDIX A

59

NORMATIVE REFERENCES

(Normative)

The following are the normative documents referenced in this Standard.

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

- AS
- 1357 Valves primarily for use in heated water systems
- 1357.1 Part 1: Protection valves
- 1397 Continuous hot-dip metallic coated steel sheet and strip—Coatings of zinc and zinc alloyed with aluminium and magnesium
- 1432 Copper tubes for plumbing, gasfitting and drainage applications
- 1530 Methods for fire tests on building materials, components and structures
- 1530.1 Part 1: Combustibility test for materials
- 1572 Copper and copper alloys—Seamless tubes for engineering purposes
- 2030 Gas cylinders
- 2030.1 Part 1: General requirements
- 2738 Copper and copper alloys—Compositions and designations of refinery products, wrought products, ingots and castings
- 3688 Water supply—Metallic fittings and end connectors
- 3814 Industrial and commercial gas-fired appliances
- 4617 Manual shut off gas valves
- 4621 Regulators for use with liquefied petroleum—Vapour phase
- 4623 Jointing compounds and materials for use in gas pipe joints
- 4629 Automatic shut off valves and vent valves
- D26 Tube fittings with Dryseal American standard taper pipe and unified threads for automotive and industrial use

AS ISO

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

AS/NZS

- 1530 Methods for fire tests on building materials, components and structures
- 1530.3 Part 3: Simultaneous determination of ignitability, flame propagation, heat release and smoke release
- 1596 The storage and handling of LP Gas
- 1734 Aluminium and aluminium alloys—Flat sheet, coiled sheet and plate
- 1869 Hose and hose assemblies for liquefied petroleum gases (LP Gas), natural gas and town gas
- NZS
- 3501 Specification for copper tubes for water, gas, and sanitation
- ANSI
- UL 21 LP Gas Hose
- UL 144 LP Gas Regulators

ASTM

A269 Specification for seamless and welded austenitic stainless steel tubing for general service

BS

3212 Specification for flexible rubber tubing, rubber hose and rubber hose assemblies for use in LPG vapour phase and LPG/air installations

NEW ZEALAND LEGISLATION

Gas Act 1992

APPENDIX B

61

CONVERSION FACTORS

(Informative)

The units of measurement used in this Standard are those based on the metric system and in common use within the gas industry. The listing in Table B1 is presented as a ready reference for conversion between different units of measurement.

TABLE B1

CONVERSION FACTORS

Multiply	By	To give	
Length			
metres (m)	3.281	feet (ft)	
feet (ft)	0.3048	metres (m)	
Area			
square millimetres (mm ²)	0.01	square centimetres (cm ²)	
square millimetres (mm ²)	0.00155	square inches (in ²)	
square inches (in ²)	645.16	square millimetres (mm ²)	
square metres (m ²)	10.764	square feet (ft ²)	
square feet (ft ²)	0.0929	square metres (m ²)	
Volume			
cubic metres (m ³)	35.315	cubic feet (ft ³)	
cubic feet (ft ³)	0.0283	cubic metres (m ³)	
Energy			
British thermal units (BTU)	1.055	kilojoules (kJ)	
therms	105.5	megajoules (MJ)	
kilowatt hour (kWh)	3.6	megajoules (MJ)	
megajoules (MJ)	0.2778	kilowatt hour (kWh)	
Power			
megajoules per hour (MJ/h) 0.2778		kilowatts (kW)	
kilowatts (kW)	3.6	megajoules per hour (MJ/h)	
British thermal units per hour (BTU/h)	0.001055	megajoules per hour (MJ/h)	
therms per hour	105.5	megajoules per hour (MJ/h)	
Pressure			
millibar (mbar)	0.1	kilopascals (kPa)	
kilopascals (kPa)	10.0	millibar (mbar)	
pounds per square inch (lb/in ²) (psi)	6.895	kilopascals (kPa)	
kilopascals (kPa)	0.145	pounds per square inch (lb/in ²) (psi)	
inches water gauge (in.WG) @ 15°C	0.2488	kilopascals (kPa)	
kilopascals (kPa) @ 15°	4.016	inches water gauge (in.WG)	
Miscellaneous			
square millimetres per kilowatt (mm ² /kW)	0.2778	square millimetres per (megajoule per hour) (mm ² /(MJ/h))	

APPENDIX C

FIRE RESISTANT MATERIAL

(Normative)

C1 GENERAL

The primary purpose of *fire resistant material* is to provide thermal protection for a *combustible surface* and, in certain applications, to support a load whilst maintaining its protective properties.

Therefore, the material shall provide thermal insulation, which shall not be combustible, and, if required, the material shall have physical properties that will enable it to support a known load with acceptable deformation.

In the following specification for *fire resistant material*, the required minimum thermal and physical properties are stated and a simple formula is given for calculating the thickness of material to provide for minimum thermal protection.

C2 SPECIFICATION FOR FIRE RESISTANT MATERIAL

Fire resistant material shall have the following properties of (a) or (b) and, in addition, the properties of (c), (d), and (e):

- (a) When tested to AS 1530.1, be deemed not combustible.
- (b) When tested to AS/NZS 1530.3, have an index as follows:
 - (i) Ignitability—zero (0).
 - (ii) Spread of flame—zero (0).
 - (iii) Heat evolved—zero (0).
 - (iv) Smoke developed—zero to one (0 to 1).
- (c) A minimum thickness of 6 mm and a resulting coefficient of heat transfer (U) not more than 20 W/m²K.

NOTE: The heat transfer coefficient (U), in W/m²K, thermal resistance (R), in m²K/W, thermal conductivity (k), in W/mK, and thickness (t), in metres, of materials are related by the following formulas:

- U = 1/R
- R = t/k
- U = k/t
- (d) If required to support a load, a compressive strength of not less than 1.5 MPa.
- (e) If required to support a load, deform not more than 2% of its thickness when subjected to a compressive stress of 350 kPa.

C3 EXAMPLES TO DETERMINE REQUIRED THICKNESS OF FIRE RESISTANT MATERIAL

Example 1

Fire resistant material from supplier 'A' has a thermal conductivity of 0.21 W/mK.

What minimum thickness of the material should be used?

t = k/U= 0.21/20 = 0.0105 m = 10.5 mm

Example 2

Fire resistant material from supplier 'B' has a thermal conductivity of 0.11 W/mK.

What minimum thickness of the material should be used?

t = k/U= 0.11/20 = 0.0055 m = 5.5 mm

In Example 2, as the value of t is less than the minimum thickness requirement of 6 mm, material of at least 6 mm is required.

C4 ACCEPTABLE METHODS OF PROTECTION

The methods detailed in Table C1 may be used for the protection of *combustible surfaces*.

All toughened safety glass used as a cooker splashback shall be marked as 'toughened safety glass' to indicate that it is fit for purpose.

TABLE C1

ACCEPTABLE METHODS FOR PROTECTION OF COMBUSTIBLE SURFACES

Facing material	Minimum thickness mm	Backing material	Minimum thickness mm
Ceramic tiles	r.	Gypsum-based wall board	10
	5	Fibre cement board	6
Toughened safety glass (See Note)	5	Gypsum-based wall board	10
		Fibre cement board	6
Sheet metal	0.4	Fibre cement board	12
		Fibre cement board over 10 mm gypsum-based wall board	6
Any other system	Satisfying the temperature requirement in Clause 6.5		

NOTE: Toughened safety glass should comply with AS/NZS 2208.

APPENDIX D

PIPE SIZING

(Informative)

D1 INTRODUCTION

D1.1 General

The flow graphs and tables in this Appendix have been compiled through consistent application of the flow formulas used and make allowances for *pressure* losses that occur due to fittings. The 'longest length' or 'index length' method of pipe sizing has been used.

The pipe sizing table indicates the flow of gas, in megajoules per hour, through copper pipes to AS 1432 and NZS 3501. The heating value quoted in each table is a nominal figure typical of *LP Gas*.

The method described in this Appendix is suitable for *LP Gas* where the allowable *pressure* drop is 0.25 kPa. The sizing of *piping* for materials or conditions other than those in the pipe sizing table of this Appendix should be determined using recognized formulae, graphs or tables such as those in Appendix F of AS/NZS 5601.1.

D1.2 Pipe conditions

The flows have been calculated assuming pipes of minimum internal diameter (which comply with the relevant Standard) that are horizontal and free from defects, deterioration and/or the accumulation of foreign matter. Pipes are taken to be smooth, that is, zero roughness.

D1.3 Fitting allowance

A fitting allowance equivalent to a 50% extension of the length for each point calculated is made. For example, when calculating the flow for a given type of *gas* in a pipe 20 m in length and a set of conditions (diameter, *pressure* drop, roughness), the flow has been calculated for 30 m (being 1.5×20) and the value obtained entered in the 20 m column.

D1.4 Equations used

For low flow rates, the theoretically derived laminar equation is used. For higher flows, the International Fuel Gas Code (IFGC) equations (low *pressure* and high *pressure*) are employed. The properties of the *gas* are assumed as HHV 96 MJ/m³, SG 1.5 and viscosity 8 μ Pa.s.

D1.5 Excessive gas velocities

Values shown in Tables D5 and D6 shaded in grey are not recommended and should not be used unless verified by a *competent person*. These would fall above the grey dotted lines 'velocity threshold' on the pipe sizing graphs. High *gas* velocity through *piping* may cause noise and, over time, accelerated erosion of the pipe or fittings.

D2 NEW PIPING SYSTEMS

When sizing a new *piping* system, consideration should be given to foreseeable future needs.

D3 EXISTING PIPING SYSTEMS

Where an additional *appliance* is to be connected to an existing *piping* system, the existing *piping* and regulator should be checked to ensure that adequate capacity is available for the additional load.

D4 INFORMATION REQUIRED

When determining the size of *piping* to be used in an installation using the graphs or tables in this Appendix, the following information should first be obtained:

65

- (a) The gas consumption of each appliance (MJ/h) and the required input pressure.
- (b) The diversity, if any, arising from use of different gas appliances at different times.
- (c) The proposed layout of the *piping* system including all pipe lengths and the location of each *appliance*.
- (d) The *pressure* available at the start of the *piping*.
- (e) The allowable *pressure* drop. The *pressure* drop should ensure that at least the minimum inlet *pressure* required by the *appliance* is available at the *appliance*.

NOTE: The tables and graphs in this Appendix include an allowance for the number of fittings that could be expected to be used in good practice.

D5 DESIGN PROCEDURE USING PIPE SIZING GRAPHS

D5.1 Introduction

A worked example is given to explain a graphical method of pipe sizing for a typical *piping* system using *LP Gas* with a *pressure* of 3 kPa at the start of the *piping*. Design graphs for *LP Gas* (propane) in copper pipe to AS 1432 or NZS 3501 are given in Figure D3 or D4, respectively. Multiply any input ratings in kW by 3.6 to convert to MJ/h if necessary.

D5.2 Sketch the *piping* layout

Sketch the intended *piping* layout (see Figure D1), include the *appliance* positions and allocate a letter to each *gas appliance* position and each pipe junction.



FIGURE D1 EXAMPLE OF PIPING LAYOUT

D5.3 Tabulate the pipe runs

Draw up a table with a row for each pipe run, as shown in Table D1.

TABLE D1

INSTALLATION DETAILS

Pipe section	Length, m	Gas flow, MJ/h	Pipe size, mm (see Note)
A–B	7	60 + 135 + 80 + 188 = 463	
В-С	4	60 + 135 = 195	
C–D	2	135	
С-Е	1	60	
B–F	6	80 + 188 = 268	
F–G	3	188	
F–H	2	80	

NOTE: Pipe size is to be determined according to Paragraph D5.6.

D5.4 Determine the length of the longest pipe run

The longest run of *piping* from the meter to the furthest *gas appliance* position is pipe section A–G. The length of this section is 16 m (AB + BF + FG).

D5.5 Determine the allowable pressure drop per metre

The design *pressure* drop is 0.25 kPa. Divide this by the length of the longest pipe run, 16 m, to give the allowable *pressure* drop of 0.0156 kPa/m.

D5.6 Determine the required pipe size from the pipe sizing graphs

Select the pipe sizing graph in Figure D3 or D4 appropriate to the type of *gas* available and the chosen *piping* material. For example, if copper pipe to NZS 3501 is being used, the applicable graph is Figure D4 (reproduced in Figure D2). Mark the *pressure* drop value of 0.0156 kPa/m on the graph. Find the value of *gas* flow for each pipe section on the graph and read off the size of the pipe required and enter this in the installation table (Table D1).



FIGURE D2 EXAMPLE OF PIPE SIZING FOR LP GAS IN COPPER PIPE TO NZS 3501

Section A–B has a total flow rate of 463 MJ/h. Find 463 on the *gas* flow axis and draw a line up to the line at 0.0156 kPa/m for *pressure* drop. These lines intersect between the curves for 20 mm and 25 mm pipe sizes. The required pipe size is 25 mm, the larger size.

Repeat this procedure for each of the other pipe sections, entering the values in the table that has been drawn up to give Table D2.

TABLE D2

Pipe section Length, m Gas flow, MJ/h Pipe size, mm 60 + 135 + 80 + 188 = 463A–B 7 25 B-C 4 60 + 135 = 19520 C–D 2 20 135 С-Е 1 60 15 80 + 188 = 26825 B-F 6 F-G 3 188 2.0 F-H 2 80 15

INSTALLATION DETAILS

D5.7 Pipe sizing graphs

Pipe sizing graphs for *LP Gas* (propane) in copper pipe to AS 1432 or NZS 3501 are given in Figure D3 or D4, respectively.



FIGURE D3 PIPE SIZING FOR LP GAS THROUGH COPPER PIPE (AS 1432)





D6 DESIGN PROCEDURE USING PIPE SIZING TABLES

D6.1 General

A worked example is given to explain a method of pipe sizing using *pressure* drop tables for a typical *piping* system that using *LP Gas* with a *pressure* of 3 kPa at the start of the *piping*.

D6.2 Sketch the piping layout

Sketch the intended *piping* layout (see Figure D1), include the *appliance* positions and add the following:

- (a) All pipe lengths (in metres) and the gas consumption of each appliance (in MJ/h).
- (b) Allocate a letter to each branch, commencing at the regulator with the letter 'A'.
- (c) Allocate a letter to each *appliance* position.

D6.3 Determine the main run

The *main run* is the length of *piping* from the *cylinder* regulator to the furthest *appliance* position. The *main run* length is a critical measurement that will be used throughout the pipe sizing calculations.

The *main run* in Figure D1 is from the *cylinders* to the instantaneous *water heater*, length A to G which is 16 m.

The distance covered by the *main run* of the installation is then used to size all branch pipework for their respective loads as if they were all as long as the *main run*.

D6.4 Select the piping material

Select the material that will be used in constructing the *piping* system.

AS 1432 Type C copper *piping* is used for the example.

D6.5 Tabulate the pipe runs

Draw up a table with a row for each pipe run, as in Table D3, as follows:

(a) Indicate, in the column marked 'Pipe section', each section of *piping* including each branch.

69

- (b) Indicate, in the column marked 'Gas flow', the amount of *gas* (MJ/h) flowing through each section.
- (c) The column indicating *nominal size* will be completed in Paragraph D6.6 and Table D4.

TABLE D3

Nominal size DN **Pipe section** Main run, m Gas flow, MJ/h A–B 60 + 135 + 80 + 188 = 463B-F80 + 188 = 268B-C 60 + 135 = 19516 C–D 135 (see Paragraph D6.3) С-Е 60 F-G 188 F-H 80

INSTALLATION DETAILS

D6.6 Selecting the pipe size

Refer to Table D5, select the pipe size as follows:

- (a) Determine *main run* length (see Paragraph D6.3).
- (b) If the *main run* falls between two figures, use the greater.
- (c) Section A to B has a total flow rate of 463 MJ/h. Follow the 16 m column down until the value of 463 or the next larger value is reached, in this case, 718.
- (d) Read across to the column ('Nom. dia. DN') to obtain the pipe size, 32 mm in this example.
- (e) Insert the pipe size in the prepared table (see Table D4).
- (f) Determine the pipe size of the remaining sections, continuing to use the *main run* length (16 m in the example), not the individual length of each section.

TABLE D4

INSTALLATION DETAILS

Pipe section	Main run, m	Gas flow, MJ/h	Nominal size DN
A–B		60 + 135 + 80 + 188 = 463	32
B–F		80 + 188 = 268	25
В-С		60 + 135 = 195	25
C–D	16	135	20
С-Е		60	20
F–G		188	25
F–H		80	20

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D6.7 Pipe sizing tables

Pipe sizing table for *LP Gas* (propane) in copper pipe to AS 1432 or NZS 3501 are given in Table D5 or D6, respectively.

70

TABLE D5

PROPANE—FLOW THROUGH—COPPER PIPE (AS 1432 Type B) (MJ/h) (Pressure drop of 0.25 kPa; suitable for supply pressures around 3 kPa)

Nom.	Length of straight pipe, m										
dia. DN	2	4	6	8	10	12	14	16	18		
15	159	109	88	75	67	60	55	52	48		
20	525	361	290	248	220	199	183	170	160		
25	1153	793	637	545	483	437	402	374	351		
32	2212	1520	1221	1045	926	839	772	718	674		
40	3722	2558	2054	1758	1558	1412	1299	1208	1134		
50	8564	5886	4727	4045	3585	3249	2989	2780	2609		
65	15862	10902	8754	7493	6641	6017	5535	5150	4832		
80	25220	17334	13920	11913	10559	9567	8801	8188	7683		
	20	25	30	35	40	45	50	55	60		
20	151	134	121	112	104	97	92	87	83		
25	332	294	266	245	228	214	202	192	183		
32	636	564	511	470	437	410	388	368	351		
40	1071	949	860	791	736	691	652	620	591		
50	2464	2184	1979	1820	1694	1589	1501	1426	1360		
65	4564	4045	3665	3372	3137	2943	2780	2640	2519		
80	7257	6432	5828	5361	4988	4680	4420	4198	4005		
100	16039	14215	12880	11849	11023	10343	9770	9279	8852		
125	29394	26051	23604	21716	20202	18955	17905	17005	16223		
150	47281	41904	37968	34930	32496	30490	28800	27353	26095		

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Please refer to Paragraph D1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE	D6

PROPANE—FLOW THROUGH—COPPER PIPE (NZS 3501) (MJ/h) (Pressure drop of 0.25 kPa; suitable for supply pressures around 3 kPa)

Nom.		Length of straight pipe, m												
DN	2	4	6	8	10	12	14	16	18					
10	123	85	68	58	52	47	43	40	38					
15	264	181	146	125	110	100	92	86	80					
20	759	521	419	358	318	288	265	246	231					
25	1625	1117	897	767	680	616	567	527	495					
32	2929	2013	1617	1384	1226	1111	1022	951	892					
40	4706	3234	2597	2223	1970	1785	1642	1528	1433					
50	10008	6878	5524	4727	4190	3796	3493	3249	3049					
	20	25	30	35	40	45	50	55	60					
10	35	31	28	26	24	23	22	20	20					
15	76	67	61	56	52	49	46	44	42					
20	218	193	175	161	150	141	133	126	120					
25	467	414	375	345	321	301	285	270	258					
32	843	747	677	623	579	543	513	488	465					
40	1354	1200	1087	1000	931	873	825	783	747					
50	2880	2552	2312	2127	1979	1857	1754	1666	1589					

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Please refer to Paragraph D1 where further, detailed explanation is provided on these values and the use of the tables in general.

APPENDIX E

COMBUSTIBLE GAS DETECTION SYSTEMS FOR BOATS

(Normative)

E1 GENERAL

This Appendix specifies the minimum requirements for a combustible *gas* detection system that is to be installed in a *boat* where Clause 7.6 applies.

NOTE: Some local marine regulations require petrol-fuelled boats to have a bilge blower.

E2 GAS DETECTION SYSTEM

The gas detection system shall comply with all of the following:

- (a) Be suitable for the marine environment.
- (b) Be waterproof, resistant to corrosion and the entry of dust.
- (c) Be capable of continuous operation from a low voltage source (i.e., wired direct to a battery) and indicate the operational status within 30 s of power being supplied.
- (d) Components within the minimum clearance zone defined in AS/NZS 1596 to be suitable for that location.
- (e) Have at least two outlets for connection of external equipment (e.g., *gas* solenoid valve, audible alarm, bilge blower etc.).
- (f) Activate the alarm function and cause a solenoid value to close off the gas supply whenever the concentration of LP Gas in air exceeds 25% of the lower explosive limit.
- (g) Have a latching system that continues to indicate an alarm condition until cancelled.
- (h) Be self-checking and indicate both normal and fault conditions.
- (i) Have fully serviceable units and be supplied with full installation and operating instructions.
- (j) All switches shall indicate their operational position. This indication shall be permanently marked.

NOTE: The use of adhesive labelling will not satisfy this requirement.

(k) Markings on the fascia of the unit, including the manufacturer's name and address, shall be permanent.

NOTE: The use of adhesive labelling will not satisfy this requirement.

E3 INSTALLATION OF THE SYSTEM

E3.1 Solenoid valve

The solenoid valve shall be located between the *cylinder* and the first-stage *gas pressure regulator*.

The solenoid valve shall be suitable for the pressure rating.

E3.2 Position of audible alarm

The alarm of the *gas* detection system shall be positioned to ensure that it is audible from all locations on the *boat* when the *boat* is under normal operating conditions.

E3.3 Sensors

A minimum of two sensors shall be fitted. One sensor shall be fitted in the bilge or at the lowest level where *gas* would be likely to accumulate and one in the vicinity of the *appliance*, but below the level of the lowest flame.

73

Each sensor shall have the following:

- (a) A visual indication of the condition of the sensor—'safe or malfunction'.
- (b) A visual indication of an alarm condition. This shall be separate from Item (a) above.

E3.4 Operation of the system when gas is detected

When gas is detected at or above the minimum set level, all of the following shall occur:

- (a) The *gas* supply shall be automatically shut off by the solenoid valve and shall not be re-opened until the alarm has been manually cancelled and the system reset.
- (b) The audible alarm shall sound.
- (c) The visual alarm shall be activated.

APPENDIX F

TESTING GAS INSTALLATIONS

(Normative)

F1 GENERAL

A gastightness test shall be carried out using one of the methods specified in Paragraphs F2 and F3.

F2 METHOD 1—MEASURING PRESSURE LOSS

F2.1 Test procedure

The procedure shall be as follows:

- (a) Ensure the installation is disconnected from the *cylinder*.
- (b) Ensure all open ends are plugged or capped.
- (c) Ensure all *gas appliances* are turned off at the *appliance* valve(s).
- (d) Connect a suitable *pressure* gauge (a manometer, for example).
- (e) Pressurize the *piping* to 14 kPa.
- (f) Isolate the *pressure* source and allow a suitable period (2 min) for the temperature of the testing medium within the *piping* to stabilize.
- (g) Measure the loss of *pressure* during a test period of 5 min.

F2.2 Test result

The pipework shall be considered *gastight* if there is no loss of *pressure* during the test period.

F3 METHOD 2—USING BUBBLE LEAKAGE DETECTOR

F3.1 Test procedure

The procedure shall be as follows:

- (a) Connect the bubble test set between the *LP Gas cylinder* valve and the *LP Gas* regulator.
- (b) Ensure all open ends are plugged or capped.
- (c) Ensure all *gas appliances* are turned off at the *appliance* valve(s).
- (d) Open the LP Gas cylinder valve or apply pressure using compressed air or inert gas.
- (e) Allow the system to pressurize for 5 s then depress the 'diversion valve' so that the *gas* stream passes through the liquid bowl.
- (f) While depressing the 'diversion valve' observe the liquid bowl for evidence of bubbles through the liquid.

F3.2 Test result

The pipework shall be considered *gastight* if there are no bubbles through the liquid for a period of 10 s.

If bubbles are detected, any leakage shall be located and rectified, and the installation shall be retested.

APPENDIX G

CONSUMER INSTRUCTIONS

(Normative)

This Appendix specifies the information, including warning labels where appropriate, together with the *appliance manufacturer's instructions*, which shall be provided to the customer.

Consumer instructions for *gas installations* shall be as follows:

NOTE: The following are applicable to both *caravans* and *boats* except where indicated otherwise.

- (a) Close *appliance* valves before opening *cylinder* valve.
- (b) Check connection at the *appliances*, regulators and *cylinders* periodically for leaks with soapy water, or its equivalent.
 NOTE: This should be done at least annually.
- (c) Never use a match or flame when checking leaks.
- (d) Close *cylinder* valve when *appliances* are not in use or whilst refuelling is in progress.
- (e) No *appliance* with a continuously burning flame shall be left operating in any petrol driven *boat* when left unattended for a period of, or in excess of, 12 h.
- (f) Never use cooking *appliances* for comfort heating.
- (g) When the *boat* is fitted with a flammable gas detector, the gas detector shall be checked for the presence of flammable vapours and the *boat* shall be cleared of flammable vapour before lighting any LP Gas appliance or starting the motor.
- (h) In the event of fire, immediately close *cylinder* valve if safe to do so.
- (i) Ensure valve is closed and fit *gastight* sealing plug to all spare *cylinders* not connected, whether full or empty.
- (j) All additions or alterations to the LP Gas system shall be performed by an authorized person (consult your LP Gas supplier).
 NOTE: Appliances should not be altered without the authorization of the manufacturer.
- (k) All permanent ventilators, *flues* and vents shall be checked regularly to ensure they are clear, open and unrestricted.
- (1) In the event of an accidental *gas* leak, close *cylinder* valve and ventilate the area using a safe method until the air is clear.
- (m) Gas or carbon monoxide detection systems shall be maintained to the manufacturer's recommendations.

NOTE: Persons should familiarize themselves with the odour of unburnt *LP Gas* to assist in the early detection of leaks.

APPENDIX H

METHOD OF LOCATING GAS PRESSURE REGULATORS

(Informative)

Figure H1 illustrates a recommended method of locating a cylinder regulator.



NOTES:

- 1 Only copper *pigtails* or flexible hoses with low extractable content should be used.
- 2 The regulator should be located to permit drainage of any liquid back into the *cylinder*.

FIGURE H1 LOCATION OF CYLINDER REGULATOR

APPENDIX I

GUIDELINES FOR GAS APPLIANCE COMMISSIONING

(Informative)

I1 GENERAL

The following procedures should be used for the commissioning of domestic and small commercial *gas appliances* in the absence of the *manufacturer's relevant instructions*:

- (a) Remove or loosen test screw, connect a manometer and light the *gas appliance*. (Electronic *gas appliances* require a digital manometer, as water gauge manometers are not accurate or sensitive enough).
- (b) If a pilot light is used, check that pilot impinges on flame failure device. (Thermocouples should not glow red, as this indicates the pilot flame is set too high and will reduce the life of the thermocouple).
- (c) Check *gas pressure*, against rating plate. (Remember that some *gas appliances* have both a cold and hot pressure).
- (d) Adjust *gas pressure* to specifications. (Remember some *gas appliances* have both a low and high-pressure setting.)
- (e) Lock off the *gas appliance* regulator.
- (f) Remove the manometer and replace the test screw, test for leaks.
- (g) Turn *gas appliance* off and on, and up and down (if modulating type) several times, to ensure correct operation and smooth ignition.
- (h) Observe operation of safety and operating devices (such as fan proving, ODS and tilt switch if mobile or portable type).
- (i) Test that spillage of *combustion products* is not occurring.
- (j) Replace panels or covers.
- (k) Instruct householder in correct operation and regular maintenance requirements.

The same procedures should be followed to re-commission the *appliance* after maintenance or repair.

12 STOVES, COOKERS AND HOT PLATES

In addition to the procedures in Paragraph I1, for stoves, cookers and hot plates-

- (a) check ventilation to the *gas appliance* (especially if inbuilt);
- (b) check distances from the *burners* to combustible surfaces comply with Figure 6.1;
- (c) check that the *gas appliance* is level;
- (d) check the restraining device (chain for example) on freestanding cookers;
- (e) check the flexible hose for wear and damage, and ensure it is not kinked; and
- (f) check operation of the oven thermostat and adjust low flame by-pass if necessary.

I3 INSTANTANEOUS WATER HEATERS

In addition to the procedures in Paragraph I1, for instantaneous water heaters-

- (a) determine incoming water temperature;
- (b) check and, if necessary, adjust maximum water flow rate. Use a flow meter, or a measured receptacle and a stopwatch;
- (c) light the gas appliance and check the outlet temperature against rating plate;
- (d) subtract inlet temperature from outlet temperature, to calculate temperature rise;
- (e) if all is correct, the water heater will have raised the temperature of the water by the specified amount, at the flow rate indicated. If not, re-check *gas pressure*, and then injector sizes; and
- (f) if still not correct, check with the manufacturer.

NOTE: Electronically operated and controlled instantaneous water heaters have the same information on their rating plate, but the commissioning and checking procedures differ, and the *manufacturer's relevant instructions* should be followed.

I4 STORAGE WATER HEATERS

In addition to the procedures in Paragraph I1, for storage water heaters-

- (a) check operation of the water valves;
- (b) check that the temperature-pressure relief valve or pressure relief valve is not dripping, or the open vent is not overflowing; and
- (c) check operation of the thermostat.

APPENDIX J SYMBOLS USED IN GAS CONTROL SYSTEM DIAGRAMS (Informative)

1	\square	Manual gas valve
2		Filter
3	<u></u>	Pressure point
4	Υ¢	Pressure regulator
5	₽₽	Pressure regulator with over-pressure protection
6	O	Over-pressure protection slam shut valve
7		Slow-opening fast-closing value
8		Slow-opening fast-closing two stage valve
9	H	Fast-opening fast-closing valve <i>shut-off valves</i>
10	Y	Fast-opening fast-closing two stage valve
11	Ha	Manual reset valve
12		Vent valve
13	\downarrow	Closed position indicator (CPI) switch on valve
14	\mathbb{A}	Proof of closure switch on valve (e.g., mechanical over-travel)
15	LG	Low gas pressure detector
16	HG	High gas pressure detector
17	Н	Flow rate control valve
18	S	Flow limiting valve



APPENDIX K

GAS INSTALLATION CHECKLIST

81

(Informative)

This checklist, as shown below, is provided as guidance for installers to check compliance of a *gas* installation with the AS/NZS 5601 series.

The checklist is not exhaustive, and both Parts 1 and 2 of the AS/NZS 5601 series should be consulted when assessing any gas installation to ensure that the essential safety requirements are met.

GAS INSTALLATION CHECKLIST

Consumer	Date	
Address	Certificate No.	
	Job No.	

Item	С	NA	Notes				
General requirements							
Gas supply verified							
Installation tested and gastight							
Gas pipework							
General requirements							
Design							
Location							
Supports and anchoring							
Corrosion protection							

(continued)

Item	С	NA	Notes
Gas pipework (continued)			
Materials and components			
Isolating valves			
Pressure regulation			
Overpressure protection			
Vent lines			
Test points			
Expansion and contraction			
Pipe protection			
Flexible connections			
Earthing			
Pipeline identification			
Disconnection			
Soundness testing			
Sizing			
Appliance installation			
Appliance(s) declaration			
Mounting and restraint			
Location			
Clearances			
Disconnection			
Combustible surfaces			
Temperature safety			

GAS INSTALLATION CHECKLIST (continued)

GAS INSTALLATION CHECKLIST (continued)

Item	С	NA	Notes
Flues			
Design			
Manufacturer's specifications followed			
Installation and location			
Materials			
Structure and supports			
Clearances			
Temperature safety			
Draught diverter			
Terminal and clearances			
Ventilation			
Appliances input			
Requirements			
Sizing of openings			
Location of openings			
Air not contaminated			
Mechanical ventilation			
LP Gas installations			
Location			
Clearances			
Weather protection			
Ventilation			
Drainage			

(continued)

С NA Notes Item LP Gas installations (continued) Restraint chains Hoses and fittings Labelling and signage Commissioning Purging Controls tested and set Safety devices tested and set Gas rating Combustion testing Consumer instruction Certification Certificate issued

GAS INSTALLATION CHECKLIST (continued)

C = Compliant

NA = Not Applicable

Name	Signature	Reg. No.

APPENDIX L

APPLIANCES IN OUTDOOR AREAS

(Informative)

L1 DIAGRAMMATIC REPRESENTATION OF OUTDOOR AREAS

The following figures are diagrammatical representations of outdoor areas as described in the definition. The areas used in these figures are examples—the same principles apply to any other shaped area.



FIGURE L1 EXAMPLE OF AN ENCLOSURE WITH WALLS ON ALL SIDES, BUT AT LEAST ONE PERMANENT OPENING AT GROUND LEVEL AND NO OVERHEAD COVER





FIGURE L2 OUTDOOR AREA—EXAMPLE 2







FIGURE L4 OUTDOOR AREA—EXAMPLE 4



87

FIGURE L5 OUTDOOR AREA—EXAMPLE 5

L2 DOMESTIC GAS BARBECUES AND RADIANT GAS HEATERS

Domestic gas barbecues and radiant gas heaters designed for outdoor use should be installed outdoors or in areas complying with the above diagrammatical representations of areas that are considered as outdoors.

NOTE: These requirements do not apply to *appliances* with *flue terminals*. For *appliances* with *flue terminals*, refer to Clause 8.4.2.

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OTHER

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INDEX

89

Accessible
Definition1.7.1
Readily accessible1.7.1.1
Appliance
Commissioning
Appliance 0.2.1
Guidelines Appendix I
Requirements 0.2.1
Definitions
Appliance 1.7.2
Flueless appliance, definition 1.7.2.3
Flueless water heater.
prohibition
Freestanding cooking appliance,
definition1.7.2.4
Hob, definition
Room-sealed appliance,
definition1.7.2.5
Second-hand appliance2.9.4.2
Space heater prohibition 2.9.1(c)
Support2.9.3, 2.9.5
Trivet, definition1.7.59
Type A5.1.1
Certification2.9.4.2
Definition1.7.2.1
Type B
Acceptance2.9.4.2
Definition1.7.2.2
Ventilation7.3.1
Water heater
Definition $1./.61$
Prohibition
Appliance installation
Barbecues,
outdoor location Appendix L
Combustible surface,
temperature limitation2.9.3(f), 6.5
Connection pipe sizeAppendix D
Disconnection, means of2.9.7
Domestic gas cooking appliances6.10.1
Clearances6.10.1
Protection of combustible
surface6.10.2
Stabilization
Electrical bonding2.6.5
Electrical requirements2.14, 6.8
Flexible connections, vibration5.1.5
riueless appliances,
restriction
L contions machibited 2.0.1

Instantaneous water heaters6.12	
Locations, prohibited2.9.1	
Instructions, manufacturer's6.4	

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Consumer piping/piping (cont'd)
Bonding, electrical
Condition of 264
Construction
Corrosionsee Corrosion
Definition1.7.47
Design2.7.2
Disconnection, means of2.9.7
Earthing, prohibition of
Extensions 5.2.11.2
Flanges
Flexibility
Gas leaks, locating2.2.6
Installation, entry of
foreign matter2.6.6
Location
Main run
Definition1.7.38
Location
Material, requirements
Pipe sizingsee Pipe sizing
Pressure test points2.7.10
Prohibited locations
Prohibited piping joints, fittings 5.1.4.4
Purging
Repairs
Sealing of open ends
Sealing of outlet
Support
Requirements
Spacing
Testing, acceptable substances2.2.5
Vibration
Corrosion
Appliance installation2.9.3(o)
Control
Cylinders
Cylinder
compartment 2.5.1, 3.4.1, 3.4.3
Piping 2./.1(c)
Diametre nominale (DN).see Nominal size
Electrical
Appliance isolation
methods 2.9.3(i), 2.14, 6.8
Bonding2.6.5
Earthing, prohibition of2.6.5
Fire resistant material
Definition1.7.21
PurposeC1
Requirements
Specification
Thickness requirement, exampleC3

Flame	safeguard	system,
1 0	• •	

1 (* * * *	-		1 7 00
definition		••••••	.1.7.22

Flue

Clearance, combustible surface8.1 Definition1.7.23
Natural draught flue1.7.23(a)
Open flue 1.7.23(b)
Power flue
Disturbances
Environmental effects
Flue cowl, definition1./.24
Flue gases, definition 1.7.25
Flue not cause a nuisance
independently 2.8.4
Locations
Material
Protection of combustible
surface
Protection, flue within a wall
Support 2.8.4
Terminal
Definition 1.7.26
Location2.8.6(d), 2.8.6(e), 8.4.1
Under a covered area
weatherproofing8.3
Gas/LP Gas, definition1.7.30
Gas consumption, definition1.7.27
Gas consumption, definition1.7.27 Gas installation
Gas consumption, definition1.7.27 Gas installation Definition1.7.29 New testing of piping 9.1
Gas consumption, definition1.7.27 Gas installation Definition1.7.29 New, testing of piping9.1 Gas load, definition1.7.31
Gas consumption, definition1.7.27 Gas installation Definition1.7.29 New, testing of piping9.1 Gas load, definition1.7.31 Cas supply
Gas consumption, definition1.7.27 Gas installation Definition1.7.29 New, testing of piping9.1 Gas load, definition1.7.31 Gas supply Gas leaks
Gas consumption, definition1.7.27 Gas installation Definition1.7.29 New, testing of piping
Gas consumption, definition1.7.27 Gas installation Definition1.7.29 New, testing of piping9.1 Gas load, definition1.7.31 Gas supply Gas leaks Methods of location2.2.6 Safety shut-off system,
Gas consumption, definition1.7.27 Gas installation Definition1.7.29 New, testing of piping
Gas consumption, definition
Gas consumption, definition1.7.27Gas installation1.7.29Definition1.7.29New, testing of piping9.1Gas load, definition1.7.31Gas supplyGas leaksMethods of location2.2.6Safety shut-off system, definition1.7.55Verification of gas supply2.2.1Hose assemblies Requirements2.11.5.2.5
Gas consumption, definition
Gas consumption, definition1.7.27 Gas installation Definition1.7.29 New, testing of piping1.7.29 Gas load, definition1.7.31 Gas supply Gas leaks Methods of location2.2.6 Safety shut-off system, definition1.7.55 Verification of gas supply2.2.1 Hose assemblies Requirements2.11, 5.2.5 Definition1.7.35 Installation
Gas consumption, definition
Gas consumption, definition1.7.27 Gas installation Definition1.7.29 New, testing of piping
Gas consumption, definition
Gas consumption, definition
Gas consumption, definition1.7.27Gas installation1.7.29Definition1.7.29New, testing of piping9.1Gas load, definition1.7.31Gas supplyGas leaksMethods of location2.2.6Safety shut-off system, definition1.7.55Verification of gas supply2.2.1Hose assemblies2.11, 5.2.5Definition1.7.35Installation2.11.4Cylinder connections2.11.3, 5.2.5(c)Quick connect devicesInstallation, water and dustLast connections2.13.1Restriction on installation2.13.2
Gas consumption, definition
Gas consumption, definition
Gas consumption, definition1.7.27Gas installationDefinition1.7.29New, testing of piping9.1Gas load, definition1.7.31Gas supplyGas leaksMethods of location2.2.6Safety shut-off system, definition1.7.55Verification of gas supply2.2.1Hose assembliesRequirementsRequirements2.11, 5.2.5Definition1.7.35Installation5.1.5Operating conditions2.11.3, 5.2.5(c)Quick connect devicesInstallationInstallation, water and dust2.13.1Requirements for use2.11.2, 5.2.5(a), 5.2.5(b)Use of2.11.2, 5.2.5(a), 5.2.5(b)Use of2.11.2

Lower explosive limit, definition ... 1.7.20.2 Over-pressure protection

LP Gas

Cylinders, general	.3.1
Requirements2	.3.1
Clearances	.2.2
Compartments,	
LP Gas lockers2.5,	3.4
Connection, maximum length5	.1.5
Definition1.	7.15
Location2.4,	3.2
Multiple-cylinder installation2	.3.5
Restriction on location3	.2.1
Safety valve discharge3.1	.4.4
Cylinder regulators	
Definition 1.7.3	2(c)
Mounting and support	.4.3
Outlet pressure	.4.2
Suitability	.4.1

Materials, fittings and components

Consumer piping, requirements2.7, 5.1
Fire resistant material2.10.2
Flue cowls8.4.1
Flue material
Longscrews 2.10.1(d), 5.1.4.4(d)
Olive-type fittings 2.10.1(b), 2.10.1(c),
5.1.4.2(a), 5.1.4.4(b), 5.1.4.4(c)
Plain nipples 2.10.1(f), 5.1.4.4(f)
POL fitting (Prest-O-Lite),
definition1.7.48
Pressure rating E3.1
Prohibited fittings2.10.1
Quick-connect device
Definitions1.7.51
General2.13.1
Restriction 2.13.2, 5.2.8
Restricted fittings and piping5.1.4.4
Temperature limit device,
spa pool heaters 6.13.3(b)
Thread sealant, restrictions2.6.7
Valve, non-return
Installation2.3.5
Required6.13.5
Symbol Appendix J
Valve, shut-off
Automatic2.12, 5.2.7.2
Manual 2.12, 5.2.7.1
Definition1.7.39
Readily accessible 5.2.2(a)
Safety, definition1.7.55
Symbol Appendix I
Vent valve, symbol Appendix J
Nominal size, definition1.7.42
Outdoor, definition1.7.44

Requirement2.7.9 Suitability of regulators4.1 Symbol. regulatorAppendix J	
Design procedure Pipe sizing graphsD5 Pipe sizing tablesD6 General requirements	
Graphs Appendix D Information required D4 Tables Appendix D Type A appliances 2.7.4	
Pressure Definition1.7.49 Operating pressure, definition1.7.43 Rated working pressure, definition1.7.53	
PurgingCommencing work2.2.2Commissioning9.2.1(a)Completion of work2.2.2Decommissioning2.2.7Installation checklistAppendix KPressure test points2.7.10	
Range hood Clearance	
Readily accessible , definition1.7.1.1	
Referenced documents Normative Appendix A	
Regulators, gas pressure	
Automatic change-over regulator, definition1.7.32(a)Installation requirements2.7.8Cylinder connection5.1.5Cylinder regulatorsee LP GasDefinition1.7.32(c)Definition1.7.32Mounting and support4.3Outlet pressure4.2Piping gas pressure regulator, definition1.7.32(b)	
Piping specification	
Piping specification	

Pressure test points......2.7.10

Upper explosive limit, definition ... 1.7.20.1

Ventilation
Appliance air supply
to be adequate2.9.6
Appliance air requirements
CommissioningI2
Cooker warning label6.10.4
Installation checklistAppendix K
Ventilation openings7.3
Position of openings, caravans7.4
Position of openings, boats7.5
Cylinder compartment,
LP Gas locker2.5.1(c), 3.4.4
Gas detection equipment, boat7.6
Interlock required2.9.6
Piping in caravans 5.2.2(a)
Regulator 4.3(a)
-

Venting Cylinde

Cylinder compartment vent,
obstruction3.4.5.2
Gas2.7.11
Refrigerator6.11.1, 6.11.2, 6.11.4
Vent
Fuel source, distance from6.6
Regulator
Spa pool heater water flow line.6.13.6
Vent line
Definition1.7.60
Installation checklistAppendix K
Performance2.7.11
Where required2.7.11

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