AS/NZS 5601.1:2013
(Incorporating Amendment Nos 1 and 2)

Australian/New Zealand Standard™

Gas installations

Part 1: General installations

STANDARDS Australia

STANDARDS® NEW ZEALAND PAEREWA AOTEAROA

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Gas Appliance Manufacturers Association of Australia
Gas Association of New Zealand
Gas Technical Regulators Committee
Gas Utilisation Institute
LPG Association of New Zealand
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Ministry of Business, Innovation and Employment, New Zealand
Plumbing Industry Commission
The Australian Gas Association

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Australian/New Zealand Standard™

Gas installations

Part 1: General installations

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PREFACE

This Standard was prepared by the Standards Australia/Standards New Zealand Committee AG-006, Gas Installations, to supersede AS/NZS 5601.1:2010.

This Standard incorporates Amendment No. 1 (August 2015) and Amendment No. 2 (May 2016). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

The objective of this Standard is to provide essential requirements and deemed-to-comply solutions, and to promote uniform standards of gas installation.

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. The Standard accommodates some variation of requirements among the regulatory jurisdictions. Appendix N sets out the detail of these variations.

New Zealand instituted legislative changes in 1992 which removed the responsibility for inspection and certification of gas installations from the gas suppliers and instituted a regime of gas certification by a person authorized under the Plumbers, Gasfitters, and Drainlayers Act 2006.

Where the Standard has acquired legal standing, its requirements in Australia are mandatory (variations/exceptions being indicated as described above).

For New Zealand, it is intended that only the performance requirements (Section 2) will be mandatory.

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 the inclusion of them in an informative appendix.

(iii) By the inclusion of them in examples or Caution note.

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 the 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 6 provide more detailed information as a means of compliance with the performance criteria.

The means of compliance in Sections 3 to 6 are not the only means of compliance with the performance criteria in Section 2.

Major changes from AS/NZS 5601.1:2010 include the following:

(A) Exclusion of 1st family gases (e.g., TLP—tempered liquefied petroleum, see Tables 1.1 and 5.1).

(B) Temperature limitations for press fit end connectors (see Table 4.1).

(C) New means of compliance for ventilation of flued appliances, including new normative appendix for combustion products spillage testing (see Clause 6.4.5 and Appendix R).

(D) Adoption by Australia of Table C1, which was previously for New Zealand only.

(E) Revised Appendix F for pipe sizing in relation to increased flow capacities where supply and equipment pressure permits.

(F) Revised Appendix G for the method in calculating breather vent orifice sizes.

(G) New informative Appendix O for gas appliance commissioning.

(H) New informative Appendix P for symbols used in gas control system diagrams.

(I) New informative Appendix Q comprising a gas installation checklist.

(J) New normative Appendix R for spillage testing of combustion products.

Notes to the text contain information and guidance. They are not an integral part of the Standard.

Statements expressed in mandatory terms in Notes to the Tables and/or Figures are deemed to be requirements of this Standard.

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.

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STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard

Gas installations

Part 1: General installations

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard contains the mandatory requirements and means of compliance for the design, installation and commissioning of *gas installation*s that are associated with the use or intended use of fuel *gases* such as *natural gas*, *LP Gas*, or *biogas*.

1.2 APPLICATION

The user of this Standard is expected to be familiar with the properties and characteristics of those fuel *gases* and the principles of combustion, ventilation and flueing applicable to the safe installation and operation of *gas appliances*.

For New Zealand, these requirements cover *gas* installations downstream of the point of supply (as defined in the Gas (Safety and Measurement) Regulations 2010).

For Australia, these requirements cover *gas* installations downstream of the outlet of—

(a) the *consumer billing meter* installation;

(b) the first regulator on a fixed *gas* installation where an *LP Gas tank* or *cylinder*(s) is installed on site; or

(c) the first regulator on site (if no meter is installed) where *LP Gas* is reticulated from offsite storage.

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

Section 2 of this Standard contains the performance requirements for the design, installation, and commissioning of *gas installation*s, including those operating at pressures exceeding 200 kPa. It includes, in Clause 2.6.4, some specific limitations as the performance requirements cannot be reliably met if those prohibitions are breeched.

Sections 3 to 6 of this Standard contain a means of compliance for installations designed to operate with a *gas* supply *pressure* not exceeding 200 kPa.

In Australia, approval for any variation to the requirements of Sections 3 to 6 or the normative appendices might need to be obtained from the appropriate *Technical Regulator*. Appendix N also contains special requirements for Australian jurisdictions.

In New Zealand, the *Technical Regulator* does not provide approvals for variations to the means of compliance in Sections 3 to 6. 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.

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 in New Zealand.

1.3 EXCLUSIONS

This Standard does not apply to—

(a) *portable* or *mobile gas appliances* (such as barbecues or patio heaters) that are connected directly, or by *hose assembly*, to an *LP Gas cylinder*;

(b) automotive *CNG* compressors and refuelling stations;

(c) installations in vehicles for automotive use; or

A2 (d) *caravans* and boats (refer to AS/NZS 5601.2 with the exception of the installation of commercial catering equipment).

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 unless otherwise noted.

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. Precautions shall be taken to avoid any electrical hazards present in the *gas* installation.

1.7 INTERPRETATION

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

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

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*, air ducts, ventilation and other ancillary items.

NOTE: Where it is necessary to distinguish between different *gas* types, the international grouping based on the *Wobbe Index* as shown in Table 1.1 may be used.

TABLE 1.1

WOBBE INDEX

Family	Wobbe Index	Typical gas
1st	22.5 to 30.0	Manufactured *gas*
2nd	39.1 to 55.0	*Natural gas*
3rd	73.5 to 87.5	*LP Gas*

NOTE:.

1 Reference to any of the typical *gases* in this Standard is deemed to be a reference to all *gases* in that family unless otherwise specified.

2 The last remaining areas using 1st family *gases* are in the process of converting to gas types of an alternative family.

1.8 DEFINITIONS

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

1.8.1 Accessible

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

1.8.1.1 *Readily accessible*

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

1.8.2 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.

1.8.2.1 *Type A appliance*

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

1.8.2.2 *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).

NOTE: A *Type A appliance* when used in an industrial/commercial application for which it was not intended is considered to be part of a *Type B appliance*. An example of this is a *certified direct-fired air heater* used as the heating/ventilating device in a spray/bake paint booth.

1.8.2.3 *Balanced flue appliance*

An *appliance* that has air for combustion ducted from, and *combustion products* ducted to, a common terminal.

1.8.2.4 *Direct-fired air heater*

An *appliance* designed for industrial use in which the *combustion products* are released into the airstream being heated.

1.8.2.5 *Elevated cooking appliance*

A cooking *appliance* manufactured with the oven beside the hotplate cooking surface.

1.8.2.6 *Fan-assisted appliance*

An *appliance* incorporating a fan that facilitates the movement of *combustion product* or flue gases through the *appliance*.

1.8.2.7 *Flued appliance*

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

1.8.2.8 *Flueless appliance*

An *appliance* designed to operate without a *flue*.

1.8.2.9 *Freestanding cooking appliance*

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

1.8.2.10 *Mobile appliance*

An *appliance* fitted with wheels that is designed to be easily moved by one person.

1.8.2.11 *Portable appliance*

An *appliance* designed to be carried by the user from place to place, as required.

1.8.2.12 *Room-sealed appliance*

An *appliance* designed such that air for combustion does not enter from, or *combustion products* enter into, the room in which the *appliance* is located.

1.8.3 Appliance gas pressure regulator

See '*Gas pressure regulator*'.

1.8.4 Authorized person

A person authorised under the legislation of the appropriate jurisdiction.

1.8.5 Bathroom

A domestic-type room used for bathing, showering or personal cleansing, as distinct from the larger and better-ventilated ablution centres commonly provided in factories, camping areas and sporting facilities, and the like.

1.8.6 Bedroom

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

1.8.7 Breather vent

An orifice or opening designed to permit atmospheric *pressure* to act on one side of the diaphragm of a regulator or similar device.

1.8.8 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.

1.8.8.1 *Atmospheric burner*

A system where all the air for combustion is introduced by the inspirating effect of the *gas* or the natural draught in the combustion chamber or a combination of the two without mechanical assistance.

1.8.8.2 *Forced draught burner*

A system where all or part of the air for combustion is introduced by providing positive *pressure* in the combustion chamber by mechanical means.

1.8.8.3 *Induced draught burner*

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

1.8.9 Caravan

A structure that is or 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.

1.8.10 Certified/Certification

In Australia, assessed by a *certifying body* and having a certificate number to demonstrate compliance with a Standard or Australian Technical Specification (ATS).

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

1.8.11 Certifying body

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

A2

1.8.11A Chimney liner

A continuous duct made of a material which complies with Table 4.2, (other than bricks and mortar), that is installed inside a chimney and designed to carry *flue* products from the appliance *flue connection* to the *flue terminal*.

1.8.12 Combustible material

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

1.8.13 Combustible surface

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

1.8.14 Combustion products

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

1.8.15 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.

1.8.16 Compressed natural gas (CNG)

Natural gas stored under *pressure* in a *cylinder*.

1.8.17 Condensate

The liquid that separates from a *gas* (including *flue gas*) due to a reduction in temperature.

1.8.18 Condensation

The process of forming *condensate*.

1.8.19 Consumer piping

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

1.8.20 Croxed joint

A joint made by fittings in which the end of the pipe has a raised circular section to seal against the olive.

1.8.21 Cupboard

An enclosed recess constructed primarily for storage purposes.

1.8.22 Cylinder

A container for the storage of *LP Gas*, with a capacity of more than 120 mL but no 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.

1.8.22.1 *Exchange cylinder*

A *cylinder* filled by weight at a *cylinder* filling installation and changed over at the consumer's *premises*.

1.8.22.2 *In-situ fill cylinder*

A *cylinder* that is filled at the consumer's *premises* from a tanker.

1.8.23 Decorative flame effect fire

A *gas appliance* which simulates a solid fuel fire and whose primary function lies in the aesthetic effect of the flames.

1.8.23.1 *Type 1*

Decorative flame effect fires without an *enclosure* and designed to be installed in an existing fireplace with a *chimney*, which vents the *flue gases* outside the building.

1.8.23.2 *Type 2*

Decorative flame effect fires supplied with an *enclosure* and designed to be freestanding, with a *flue* that vents the *flue gases* outside the building.

1.8.24 DN (diametre nominale)

See '*nominal size*'.

1.8.25 Double block and vent safety shut-off system

A *safety shut-off* system that incorporates two *safety shut-off valves* in series, with the volume between the two valves automatically vented. These valves are mutually energized to cause the *vent valve* to close when the *safety shut-off valve*s are open.

1.8.26 Draught diverter

A device, without moving parts, which can be part of the *appliance* or fitted in the *flue* of an *appliance*, at the junction of the *primary* and *secondary flues*, for isolating the combustion system from the effects of *pressure* changes in the *flue*.

1.8.27 Enclosure

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

1.8.28 Excess air

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

1.8.29 Excess flow valve

A normally open valve which closes automatically when a predetermined flow rate in a particular direction is exceeded.

1.8.30 Exhaust fan

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

1.8.31 Exitway

All parts of an escape route protected by fire or smoke separations, or by distance when exposed to open air, and terminating at a final exit.

1.8.32 Explosive limit

1.8.32.1 *Upper explosive limit (UEL)*

The highest percentage of *gas* in air at which combustion can be self-sustaining at standard temperature and pressure, as follows:

(a) *NG/SNG* ....nominal *UEL* 15%.

(b) *LP Gas* ....nominal *UEL* 10%.

1.8.32.2 *Lower explosive limit (LEL)*

The lowest percentage of *gas* in air at which combustion can be self-sustaining at standard temperature and pressure, as follows:

(a) *NG/SNG* .... nominal *LEL* 5%.

(b) *LP Gas* .... nominal *LEL* 2%.

1.8.33 Fail safe (also see lock-out)

The mode of failure whereby a safe condition is maintained upon loss of power or actuating force to any control element, or failure of any control element to operate.

1.8.34 Fire damper

A device for automatically closing off the flow of air through a ventilation opening in the event of fire.

1.8.35 Fire-isolated passageway

A corridor, hallway or the like, of fire-resisting construction, which provides egress to or from a *fire-isolated stairway* or *fire-isolated ramp* or to a road or open space.

1.8.36 Fire-isolated ramp

A ramp within a fire-resisting *enclosure* which provides egress from a *storey*.

1.8.37 Fire-isolated stairway

A stairway within a fire-resisting shaft and includes the floor and roof or top enclosing structure.

1.8.38 Fire resistant material

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

1.8.39 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.

1.8.40 Flue

A passage through which *combustion products* or *flue gases* are discharged, including any *draught diverter*, *slip joint* and associated duct, barometric device, fan or other components in the duct.

1.8.40.1 *Balanced flue*

A *natural draught flue* system in which the *combustion products* are discharged at the same height and atmospheric *pressure* as the combustion air inlet of a *room-sealed appliance*.

1.8.40.2 *Chimney*

A vertical passage usually constructed from masonry or bricks and usually situated above a fireplace where discharge of the flue gases is due to the draught provided by the buoyancy effect of these hot gases.

1.8.40.3 *Common flue*

A *flue* system designed to carry *combustion products* from two or more *appliances*.

A2 **1.8.40.3A** *Flue connection*

A device incorporated in an *appliance* for the connection of a *flue* or *draught diverter*, barometric device, fan or similar part.

1.8.40.4 *Natural draught flue*

A *flue* in which the draught is provided by the buoyancy effect of the hot *gases* in it.

1.8.40.5 *Open flue*

A *flue* system containing a *draught diverter* or canopy.

1.8.40.6 *Power flue*

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

1.8.40.7 *Primary flue*

The portion of the *flue* that extends from the outlet of the *appliance* combustion chamber or heat exchanger to the inlet of the *draught diverter*.

1.8.40.8 *Secondary flue*

The portion of the *flue* that extends from the outlet of the *draught diverter* to the *flue terminal*.

1.8.40.9 *Slip joint*

A join in the *flue* (usually close to the *appliance*) that may be dismantled to facilitate the disconnection of the *appliance* from the *flue*.

1.8.40.10 *Twin wall flue*

A type of *flue* in which the inner *flue* conduit is encased by an outer casing of specific dimensions which acts as an insulator.

1.8.41 Flue cowl

A device placed at the *flue* terminal and designed to prevent the entry of rain or birds and minimize the disturbing effect of wind while not hindering the discharge of *flue gase*s.

1.8.42 Flue gases

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

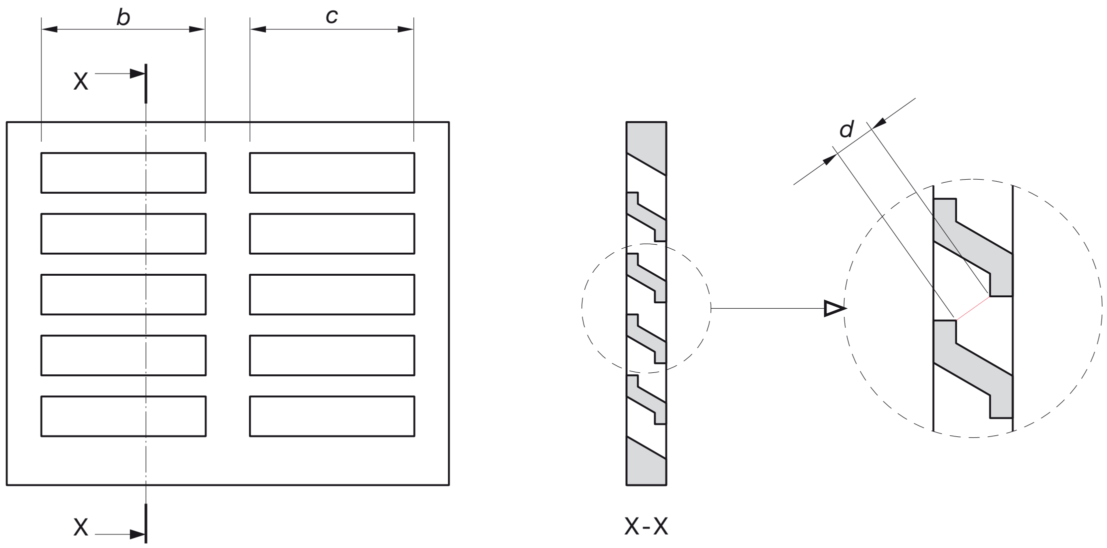
1.8.43 Flue terminal

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

1.8.44 Free area/free ventilation area

Unobstructed cross-sectional area of a grille, louvre or duct, calculated as the sum of the cross-sectional areas of all unobstructed apertures measured through the plane of minimum area and at right angles to the air flow within the apertures.

NOTE: An example of calculating free ventilation area is given in Figure 1.1.



Free ventilation area $A = (b + c) \times N \times d$, where N is the number of rows of slots and d is the narrowest slot/louvre dimension through which air passes unobstructively.

FIGURE 1.1 FREE VENTILATION AREA

1.8.45 Gas

A combustible fuel *gas*.

1.8.45.1 *Natural gas (NG)*

A hydrocarbon *gas*, consisting mainly of methane.

1.8.45.2 *Liquefied petroleum gas (LP Gas)*

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

1.8.45.3 *Simulated natural gas (SNG)*

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

1.8.45.4 *Biogas*

Biogas is a mixture of *gases* that is produced by anaerobic microbial decomposition of organic matter and principally comprises methane and carbon dioxide together with lesser amounts of hydrogen sulphide, water vapour or other *gases*.

1.8.46 Gas consumption

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

1.8.47 Gasfitting (work)

In New Zealand, has the same meaning as in the Plumbers, Gasfitters and Drainlayers Act 2006.

In Australia, as defined by state or territory legislation.

1.8.48 Gas installation

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

1.8.49 Gas load

The total *gas consumption* of all downstream *gas appliances*.

1.8.50 Gas meter

A device used to measure the volume of *gas* passing through it.

1.8.50.1 *Consumer billing meter (also known as a master meter)*

A gas meter that is used to bill the consumer for *gas* used.

1.8.50.2 *Sub-meter (also known as check meter)*

A gas meter used for measuring *gas* downstream of a *consumer billing meter* or *cylinder regulator*.

1.8.51 Gas measurement system (GMS)

A combination of the *gas meter* and any associated valves, filters, regulators, *over-pressure protection* and connections.

1.8.52 Gas pipework

(See *consumer piping*)

1.8.53 Gas pressure regulator

A device that automatically regulates the outlet *pressure* of the *gas* passing through it to a predetermined value.

NOTE: In complex supply systems the *pressure* regulation may be in multiple stages in which case the regulator nearest the source of supply is known as the first-stage regulator, followed by a second-stage regulator, and possibly by third or fourth stages.

1.8.53.1 *Automatic change-over regulator*

A combination valve/*gas pressure regulator*, fitted to an *LP Gas* multiple-*cylinder* installation which will automatically change over from a *cylinder* in use to a reserve *cylinder* at a predetermined *pressure*.

1.8.53.2 *Consumer piping gas pressure regulator*

A *gas pressure regulator* installed in the *consumer piping* to reduce the *gas pressure* to a section of *consumer piping*.

1.8.53.3 *Cylinder regulator*

A *gas* pressure regulator on a *cylinder* installation that is subjected to the *gas* pressure directly from the *cylinder*.

1.8.53.4 *Gas appliance regulator*

A *gas pressure regulator* fitted to a *gas appliance*.

1.8.53.5 *Zero regulator*

A *gas pressure regulator* that controls or maintains the outlet *pressure* to zero or below zero gauge (atmospheric) *pressure*.

NOTE: Usually used in conjunction with an air–*gas* proportioning device.

1.8.54 Gastight

The condition of a *gas installation* or *gas pipework* in which any leakage of *gas* is at a sufficiently low rate that no hazard is likely to ensue, and—

(a) for systems of less than or equal to 30 L, meets the criteria in Appendix E; or

(b) for systems of greater than 30 L, tested to the appropriate requirement and any *pressure* drop or leakage rate does not exceed a limit specified by the *Technical Regulator*.

1.8.55 Griller

An *appliance* for cooking food by radiant heat.

1.8.56 High-rise building

A building having five or more *storeys* above ground level.

1.8.57 Hob

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

1.8.58 Hose assembly

A flexible tube or pipe complete with end couplings.

1.8.59 Hot-tapping

The process of connecting to *consumer piping* whilst the pipe contains *gas*.

1.8.60 Hot water boiler

Any vessel wherein water is intended to be heated to a temperature exceeding 99°C by the application of heat to the vessel without the generation of steam.

1.8.61 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.

1.8.62 Indoor(s)

Within a building, as defined by the appropriate national building code, or within a structure that is enclosed on all sides, as distinct from *quasi-outdoor* areas, balconies and the like. (Refer to definitions of *outdoors* and *quasi-outdoors*).

1.8.63 Insulating joint

A joint or fitting designed to prevent the flow of electric current across the joint or fitting.

1.8.64 Interlock

A device or function that ensures that the operation of items of equipment is dependent upon the fulfilment of predetermined conditions by other items of equipment.

1.8.65 Intrinsically safe

Having a type of protection based on the restriction of electrical energy within apparatus and of interconnecting wiring exposed to the potentially explosive atmosphere to a level below that which can cause ignition by either sparking or heating effects.

1.8.66 Isolation valve

A valve installed in a piping system for the purpose of isolating the pipework downstream of the valve from the supply of *gas*.

1.8.67 Limited flexibility connector

An assembly of semi-rigid pipe, with permanently attached end fittings, that is designed for infrequent movement.

1.8.68 Lock-out

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

1.8.69 Main run

The run of *consumer piping* from the meter or, for *gas* stored in *cylinders*, the first *pressure* regulator to the furthest *appliance* position.

1.8.70 Manual shut-off valve

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

1.8.71 Manufacturer's specification/instruction/recommendation

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.

1.8.72 Maximum allowable operating pressure (MAOP)

The maximum *pressure* that can be sustained with a factor of safety, by the type or class of pipe or *pipe fitting* for its estimated useful life under the anticipated operating conditions.

1.8.73 Maximum over-pressure

The maximum *pressure* at which the installation or any particular portion of the installation, or individual component, including *appliances*, remains safe.

For each individual component the *maximum over-pressure* is—

(a) the *maximum over-pressure* of the component if known; or

(b) 1.5 times the *rated working pressure* of the component, if known.

The *maximum over-pressure* for any portion of an installation is—

(i) the lowest *maximum over-pressure* of the components comprising that portion of the installation; or

(ii) the *pressure* to which that portion of the installation has been tested, if neither of the *pressure*s in Item (a) or (b) are known.

1.8.74 May

Indicates the existence of an option.

1.8.75 Multilayer pipe

Pipe comprising of stress-designed polymeric layers, including one or more stress-designed metallic layers (e.g., PE-X/AL/PE) (also known as 'composite pipe' and 'macro-composite pipe').

1.8.76 Network operator

A person or organization that owns or operates all, or part, of a network.

1.8.77 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 diameter or thread size. It is a convenient round number for reference purposes and is only loosely related to manufacturing dimensions.

1.8.78 Non-return valve

A valve designed to operate automatically to prevent reversal of flow in a pipe.

1.8.79 Operating pressure

The *gas pressure* that any part of the *gas installation* is set to or will be subjected to under normal operating conditions.

1.8.80 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 I provides diagrammatical representations of *outdoor* areas.

1.8.81 Over-pressure protection

A device or system for preventing the *pressure* in *gas pipework* or in *gas appliances* from exceeding a predetermined value.

1.8.82 Permanent joint

A joint that is not intended to, and cannot readily, be disassembled. Examples are brazed, welded, crimped and hydraulically or mechanically compressed joints.

1.8.83 Pipe fitting

A component used to join pipes, or to change direction or diameter of a pipe, or to provide a branch, or to terminate a pipe.

1.8.84 Plant room

A room designed to accommodate one or more *gas appliances*, or other equipment, in which the *gas appliances* can be fully maintained, and which is not normally occupied or frequented for extended periods.

1.8.85 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.

1.8.86 Pool heater

A *gas appliance* designed for heating water in a swimming pool, spa pool or similar body of water.

1.8.87 Premises

A property including a house or building and any grounds belonging to it.

1.8.88 Pressure

Pressure above atmospheric *pressure* (gauge *pressure*).

1.8.89 Pressure test point

A *pipe fitting* that enables the attachment of a hose and *pressure* measuring device to the *gas pipework*.

1.8.90 Proprietary system

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

NOTE: *Proprietary systems* may be incompatible with those of other manufacturers and include multilayer as well as some stainless steel and copper piping systems. *Proprietary systems* may include piping, *flues*, and fittings.

1.8.91 Purge or purging

With respect to *consumer piping*—

(a) replacing the air in *consumer piping* with *gas* or inert *gas*; or

(b) removing the *gas* from *consumer piping* by replacing the *gas* with either air or an inert *gas*.

NOTE: The purpose of *purging* is to prevent the presence in the piping of an explosive mixture of *gas* and air.

1.8.92 Push-on connector

A fitting for attaching a laboratory Bunsen *burner* to *consumer piping* in which a flexible tube end slides over a special nipple and is held by friction. The tube is usually made of synthetic rubber.

1.8.93 Quasi-outdoor(s)

An *outdoor* area sufficiently weatherproofed to allow the installation of an *appliance certified* for *indoors* without affecting its safety, combustion or integrity.

1.8.94 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'.

1.8.95 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 room or recirculate it back into the room.

1.8.96 Rated working pressure

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

1.8.97 Residential garage

A garage at a residential *premises*, but does not include communal car-parking areas or garages being used for commercial purposes.

1.8.98 Riser

A vertical section of the *consumer piping*.

1.8.99 Safe path

That part of an *exitway* that is protected from the effects of fire by fire separations, external walls, or by distance when exposed to open air.

1.8.100 Safety shut-off system

An arrangement of valves and associated controls that shuts off or prevents the supply of *gas* when a limiting condition is met and so avoids an unsafe condition.

1.8.101 Safety shut-off valve

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

1.8.102 Shall

Indicates that a statement is mandatory.

1.8.103 Should

Indicates a recommendation.

A2

1.8.103A Single residential premise

A single residential premise is considered to be:

(a) In Australia, a single dwelling, Class 1a, as defined in the National Construction Code Series, Volumes 1 and 2.

(b) In New Zealand, a detached dwelling, as defined in the New Zealand Building Code.

NOTE: Refer to Appendix L for classification of buildings and structures.

1.8.104 Steam boiler

A vessel wherein steam is intended to be generated at a *pressure* above that of the atmosphere by the application of heat from the *combustion products* to the vessel.

1.8.105 Storey

A space within a building that is situated between one floor level and the floor level next above, or if no floor above, the ceiling or roof above, but not a space that contains only—

(a) a lift shaft, stairway or meter room;

(b) a *bathroom*, shower room, laundry, water closet, or other sanitary compartment;

(c) accommodation intended for not more than 3 vehicles;

(d) a combination of the above; or

(e) a mezzanine.

1.8.106 Swivel joint

A *gastight* coupling between two parts allowing one part to rotate without turning the other.

1.8.107 Tailpipe

A section of pipe, placed at a low point in the *consumer piping*, to collect water and from which it can be removed.

1.8.108 Tank

A container (other than a *cylinder* or aerosol container) designed for the storage of *LP Gas* in either the liquid or gaseous form, and, in Australia, complying with AS 1210.

1.8.109 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).

1.8.110 Temperature limit device

A device that automatically causes the *gas* supply to be interrupted when the temperature at the control point reaches a predetermined limit.

1.8.111 Toughened safety glass

Glass that has been processed by controlled thermal treatments to increase its strength and complies with AS/NZS 2208.

1.8.112 Trivet

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

1.8.113 Valve train

An assembly of valves, *gas pressure regulators*, and other fittings that form an integrated system for flow or *pressure* control and safe operation of a *burner*.

1.8.114 Vapour barrier

Material or coating having a low water-vapour transmission, and used to minimize water-vapour penetration in buildings.

1.8.115 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.

1.8.116 Vent valve

A valve in the *vent line* of a *double block and vent safety shut-off system* that closes when energized and automatically opens when de-energized.

1.8.117 Water heater

A *gas appliance* for the supply of water at a temperature not exceeding 99°C.

1.8.118 Wherever possible/where practicable

A requirement to be met in all circumstances other than those that would create either a significant operational inconvenience or a greater danger than would otherwise arise.

1.8.119 Wobbe Index

The number produced when the heating value of the *gas* (expressed in MJ/m^3) is divided by the square root of the relative density of the *gas*.

NOTE: The groupings of the numbers determine the interchange-ability of the *gas appliances*.

SECTION 2 — CONTENTS

PERFORMANCE-BASED DESIGN AND OTHER ESSENTIAL REQUIREMENTS

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SECTION 2 PERFORMANCE-BASED DESIGN AND OTHER ESSENTIAL REQUIREMENTS

2.1 GENERAL

Where *gas installations* are designed to the performance requirements of this Section, rather than by using the means of compliance under Sections 3 to 6, the level of safety, convenience and efficiency of operation shall be not less than an installation carried out according to Sections 3 to 6. Such designs 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 P for a list of symbols for use in diagrams of *gas* control systems.

2.2 GENERAL WORK AND SAFETY REQUIREMENTS

2.2.1 Verification of gas supply

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

(a) suitable and safe for the *gas appliances* and components to be installed; and

(b) available at an adequate flow rate through the meter and any existing piping to meet the anticipated maximum load.

2.2.2 Work on a gas installation

Except when *hot-tapping* is required, any *gas installation*, or part affected, that contains *gas* shall be isolated and, if necessary, safely *purged* before any *gasfitting work* commences on that *gas installation*. Specialized equipment, skills and safe practices are required.

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

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

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

NOTES:

1 Appendix D provides further guidance on *purging*.

2 The *Technical Regulator* may require to be notified if a hot-tap is required.

2.2.3 Sealing of open ends

All open ends of *consumer piping* and outlets intended for future connection of *gas appliances* or where an *appliance* is disconnected and not immediately reconnected shall be suitably sealed to be *gastight* and prevent ingress of deleterious materials.

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

2.2.4 Testing of consumer piping

New *consumer piping* shall be tested before connection to a *gas* supply in accordance with Appendix E. There shall be no loss of *pressure* during the test period.

Any section of *consumer piping* that has been isolated from the *gas* supply and altered or extended shall be tested in accordance with Appendix E and proved *gastight* before reconnection to the *gas* supply.

2.2.5 Testing of gas installations

New *gas installation*s shall be tested before connection to the *gas* supply in accordance with Appendix E. There shall be no loss of *pressure* during the test period.

Wherever practicable, existing *gas installation*s shall be tested in accordance with Appendix E and confirmed to be *gastight* before any *gasfitting work* is performed on any part thereof.

2.2.6 Safe practices and OHS

Any safety related practice, not in accordance with a means of compliance contained in Sections 3 to 6, shall be established in a safety assessment and documented. Only safe working practices shall be employed—

(a) when working on *gas installation*s;

(b) for locating *gas* leaks;

(c) for the repair of *gas* leaks;

(d) for *hot-tapping*; and

(e) for *purging*.

Precautions shall be taken to avoid any hazard arising from electric currents in, or voltages on, the *gas installation*. Refer to Clause 1.6.

2.2.7 Increasing pressure of gas installations

The suitability of the materials and components for operation at the increased *pressure* shall be verified before the *gas pressure* is increased.

The *gas installation* shall be proved *gastight* at conditions appropriate to the increased *pressure*.

2.2.8 Commissioning and recommissioning

Every *gas installation* shall be commissioned according to *manufacturer's instructions* prior to use to ensure safe start-up and operation of the *gas installation*, and shall include checks of safety and operating controls.

Following maintenance work on any part of a *gas installation*, the affected part of the installation shall be re-commissioned by checking to ensure safe start-up and operation.

Following a shut-down of an installation, or supply to an installation, the installation shall be checked to ensure *gastight*-ness and safe start-up.

NOTES:

1 See Appendix O for guidelines for *Type A appliance* commissioning.

2 See Appendix Q for a checklist for checking compliance of the installation prior to and during commissioning.

2.2.9 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 MATERIALS, FITTINGS AND COMPONENTS

2.3.1 Materials

Materials, fittings and components used in any *gas installation* shall be suitable for use with the—

(a) type of *gas* being conveyed;

(b) the *pressure* to which they may be subjected under both operating and fault conditions; and

(c) the environment in which they are installed.

2.3.2 Proprietary systems

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

NOTE: For industrial and commercial installations, *Technical Regulators* may have specific requirements.

2.3.3 Jointing

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

2.4 CONSUMER PIPING

2.4.1 General

Consumer piping shall be designed and installed to—

(a) convey *gas* at a predetermined *pressure* and flow rate;

(b) be *gastight*; and

(c) avoid damage by corrosion, stress or other means.

Consumer piping shall be installed in a manner that does not adversely affect the structural strength and fire resistance of any building or structure. All *consumer piping* shall be identifiable as part of a pipe system for conveying *gas*.

2.4.2 Design

Consumer piping shall—

(a) be designed and installed to safely supply an adequate flow of the *gas* of the type intended and at the *pressure* required or reasonably foreseen;

(b) be designed to ensure an appropriate *gas* velocity to minimize adverse impacts;

(c) be designed and installed to avoid any obstruction to the *gas* flow;

(d) include provision, *readily accessible*, for isolating the *gas* supply in the event of an emergency;

(e) include provision, *accessible*, for isolating the *gas* supply—

  (i) to facilitate maintenance;

  (ii) to separate buildings;

  (iii) to separate occupancies within a building;

  (iv) to separate floors in multi-*storey* non-residential buildings; and

(f) for proprietary piping systems in residential *premises*, be designed to permit future branching and/or repair. Such provisions shall be located in *accessible* positions where possible.

NOTE: The intent is to permit future extension or connection to a non-compatible piping system to protect the consumer/end user from difficulties that may arise from non-availability of the *proprietary system*. Refer to Table 4.1 for temperature limitations for multilayer consumer pipes.

2.4.3 Prevention of reverse flow

Devices designed to prevent reverse flow shall be installed immediately upstream of the point of interconnection of piping used to convey different *gas*es for mixing within the *consumer piping*.

2.4.4 Location

Consumer piping shall be installed in a manner and in a location that protects it from damage.

Consumer piping shall be designed and located to avoid any hazardous buildup of *gas* should leakage occur.

Consumer piping shall not be placed in any location where it would prejudice egress from a building in an emergency, or interfere with any emergency response.

Consumer piping shall 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 *consumer piping* or any other service.

2.4.5 Support of consumer piping

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

2.4.6 Corrosion control

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

2.4.7 Provision for clearing condensate

Where *condensate* is likely to occur, *consumer piping* shall be installed with a fall to a low point, and a *tailpipe* installed for its removal.

2.4.8 Gas pressure regulators

A suitable *gas pressure regulator* shall be installed *wherever* the *pressure* supplied to any part of a *gas installation* may exceed the *rated working pressure* of that part.

Where *gas pressure regulators* are installed, they shall provide and maintain adequate control of the *operating pressure* to all parts of the *gas installation* that they are intended to control.

Gas pressure regulators shall be positioned in a safe location and shall be *accessible* for maintenance and adjustment.

2.4.9 Over-pressure protection

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

Any part of the *gas installation* that is incapable of withstanding the inlet *pressure* to its *gas pressure regulator* shall be provided with *over-pressure protection*.

2.4.10 Pressure test points

Adequate *pressure test points* shall be provided to ensure all parts of the *gas installation* can be safely tested and commissioned.

2.4.11 Gas venting

Gas venting devices 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.

A1 NOTE: For *pressures* exceeding 200 kPa, refer to AS/NZS 60079.10.1.

2.4.12 Gas pressure raising devices

Gas pressure raising devices shall not adversely affect either the *gas* supply or the *gas installation*.

2.5 FLUES

2.5.1 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 the connected *appliances*. The construction of a *flue* shall in no way impair the design strength or the fire resistance of the building or structure.

2.5.2 Design

Flues shall be appropriately designed, constructed and installed to permit the 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.

2.5.3 Materials

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

2.5.4 Installation

A *flue* shall be supported independently of the *appliance*.

Flues shall be suitably fastened to the host building or structure to ensure stability and to prevent stressing of joints. Any penetration of the building envelope shall be sealed to prevent ingress of water.

2.5.5 Location

The building or structure 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.

2.5.6 Dampers

Any *flue* damper or other device for controlling the draught in a *flue* shall be designed to prevent the *gas appliance* operating in an unsafe manner.

2.5.7 Flue termination

The entry of any material or substance that could impair the performance of the *flue* or *gas appliance* shall be prevented.

NOTE: The above-mentioned material includes the fitment of any mesh screen to the *flue terminal*.

Flue terminals or *flue cowls* shall be located to minimize entry of *combustion products* into any building and to minimize the effects of adverse draught on the performance of the *gas appliance*. *Flue terminals* or *flue cowls* shall be located to prevent harm to persons.

2.5.8 Common flues

Any *gas appliance* connected to a *common flue* shall not adversely affect the operation of any other *appliance* connected to the same *flue*. *Common flues* serving *gas appliances* shall not be used to serve any *appliance* that uses a fuel other than *gas*.

A *common flue* shall be used only where no *appliance* connected to that *flue* is likely to discharge a combustible mixture.

2.5.9 Power flues

Power flue systems shall be designed to prevent the operation of the *gas appliance* if the draught fails.

2.5.10 Use of existing flues or chimneys

Existing *flues* and chimneys shall be used only if they are suitable for the proposed application and permit unrestricted and safe discharge of *combustion products*.

2.6 INSTALLING GAS APPLIANCES

2.6.1 Pre-installation

Gas appliances shall be checked before they are installed to ensure they are suitable to operate on the *gas* being supplied and comply with local *certification* requirements.

2.6.2 General installation requirements

Gas appliances and equipment shall be installed in accordance with the *manufacturer's written instructions*.

The space in which a *gas appliance* is installed shall be ventilated to the extent required to ensure safe and effective operation.

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.

All *manufacturer's instructions* accompanying the *gas appliance* shall be given to the owner or occupier of the *premises* in which the *gas appliance* is installed.

Gas appliances shall be installed so that adjacent *combustible surfaces* are protected from damage resulting from the thermal effects of their operation.

An existing *gas installation* shall be checked for adequate capacity before connecting an additional *gas appliance*.

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* is *fail safe*.

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

Gas appliances shall be suitably supported or secured to prevent stressing of the *consumer piping* unless the *consumer piping* has been specifically designed and constructed to safely support the *gas appliance*.

Every *gas appliance* shall be connected to the fixed *consumer piping* in a manner that minimizes transfer of any stresses arising from the operation of that *gas appliance*.

2.6.3 Gas appliance location

Gas appliances shall be located to—

(a) avoid, or shall be suitably protected against, the effects of corrosive and/or dust laden environments and any likelihood of physical damage;

(b) permit functional adjustment, safe ignition, access for operation and maintenance, and effective operation of any explosion relief device;

(c) avoid any hazard to the building or structure, or to the contents of the building;

(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* when fully laden, e.g., a storage *water heater* when it is full of water.

2.6.4 Limitations on installation of an appliance

An instantaneous *water heater* other than a room-sealed type shall not be installed in a *bedroom*, *bathroom*, toilet or sleeping area.

NOTE: See Appendix N for special requirements set out by *Technical Regulators* in South Australia.

A storage *water heater* with a *gas consumption* exceeding 40 MJ/h shall not be installed in a *bedroom*, *bathroom*, toilet, or sleeping area.

In Australia, a flueless instantaneous *water heater* shall not be installed *indoors*.

A space heater installed in a *bedroom* shall be *flued* and have a *flame safeguard system*.

A *direct-fired air heater* shall not be installed in residential *premises*, or any type of health care or educational establishment.

A space heater or a *decorative flame effect fire* shall not be installed in a *bathroom* or toilet unless it is a room-sealed type.

A space heater other than a room-sealed type shall not be installed in a *bathroom* or toilet.

2.6.5 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.

Negative air *pressures* shall be avoided except for industrial *appliances*, *gas* engines and *gas* turbines specifically designed for negative air *pressure*.

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.

2.6.6 Valve trains

All *valve trains* shall be designed and installed to prevent the presence of a combustible mixture within the *gas appliance* before the ignition sequence is activated.

Every *valve train* shall include means to maintain combustion conditions suitable for the safe and effective operation of the *gas appliance*.

Every fitting used to control the *gas* flow into a *gas appliance* shall be suitable and safe for its application.

All fittings on the *valve train* supplying any *gas appliance* shall permit the safe and effective operation of that *gas appliance*.

Valve trains shall be designed to avoid any particulate matter impairing the operation of any components of the *valve train*.

All sections of a *valve train* shall be capable of safely withstanding any *pressure* that could be reasonably foreseen.

For all *valve trains* there shall be a means of manually isolating the *gas* supply to the *valve train* and a means of disconnection of the *valve train* from the *consumer piping*. This means shall be *accessible* and easily identifiable in normal operation and in an emergency.

2.6.7 Gas appliance connection

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

2.6.8 Commissioning

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

NOTES:

1 See Appendix O for guidelines for *gas appliance* commissioning.

A2 2 See Appendix Q for a checklist for checking compliance of the *gas* installation prior to and during commissioning.

A2 3 See Appendix R for spillage tests for *flued appliances*.

SECTION 3 — CONTENTS

MEANS OF COMPLIANCE—GENERAL REQUIREMENTS AND SAFE WORK PRACTICES

Page

SECTION 3 MEANS OF COMPLIANCE— GENERAL REQUIREMENTS AND SAFE WORK PRACTICES

3.1 GAS SUPPLY

Before commencing an installation, all of the following shall be established:

(a) The type of *gas* available.

(b) That the *gas* supply is adequate to satisfy likely simultaneous demands or peak loading.

(c) That the capacity of the *gas measurement system* (GMS), meter or *cylinder* supply is sufficient to meet the anticipated maximum demand.

(d) The *pressure* of the *gas* available at the inlet to the *consumer piping*.

(e) The maximum *pressure* supplied from the outlet of the GMS, meter or *cylinder* in the event of failure of the supply regulator or control.

(f) Location of GMS or meter.

NOTE: See Appendix M.

NOTES:

1 The *gas* supplier or GMS/meter owner can provide this information.

2 In Australia, the *gas* supplier and/or *Technical Regulator* may require, for complex jobs, notification before work commences and confirmation that completed work is in accordance with this Standard and any other relevant requirements.

3.2 GAS DEMAND

The *gas pressure* and flow requirements for all *gas appliances*, including any existing *gas appliances* shall be established from the *gas appliance* data plates or by reference to the *gas appliance manufacturer's instructions*.

3.3 SAFE WORK PRACTICES

3.3.1 General

Safe working practices shall be employed, including—

(a) when working on *gas installation*s;

(b) for locating *gas* leaks;

(c) for repair of *gas* leaks;

(d) when *hot-tapping*;

(e) to avoid any hazard arising from electrical currents in, or voltages on, the *gas installation*; and

(f) when *purging*.

3.3.2 Isolating gas supply

All existing pipework shall be isolated from its *gas* supply and safely *purged* of *gas* before the work is started, unless such actions would cause significant disruption to existing *gas appliance* users. In situations where unacceptable disruption to operations would arise from isolating the *gas pipework* from the *gas* supply, a suitable flow stopping and *purging* technique performed by appropriately trained and experienced persons shall be used to isolate the pipework locally.

Purging of a *gas installation* shall be planned to—

(a) ensure no pockets of *gas* are left behind in any part of the *gas installation*;

(b) ensure that *gas* is vented from the pipe system to a safe place and level;

(c) prevent *gas* accumulation;

(d) provide good ventilation within the vicinity of the *purge* point;

(e) prevent inadvertent operation of any electronic device; and

(f) prohibit smoking or naked flames.

Purging shall continue until tests indicate the *gas installation* is completely free of *gas* at all *purge* points.

NOTE: Some information for *purging* procedures is given in Appendix D.

3.3.3 Purging after completion of work

After performing any work on *consumer piping*, all air or inert *gas* shall be *purged* from the *consumer piping* before any attempt is made to light a *gas appliance*. All branch lines shall be individually *purged*. *Purging* shall be completed before *gas appliance* testing and commissioning commences.

3.4 SEALING OF OPEN PIPE ENDS

3.4.1 Removal of debris

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

3.4.2 Open ends to be sealed while work is in progress

Where alteration, repair or extension to *consumer piping* necessitates the removal of a *pipe fitting* or a *gas appliance* or the 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.

3.4.3 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*.

3.5 TESTING OF PIPING

3.5.1 Testing a new gas installation

Before any new *gas installation* is put into operation the *consumer piping*, *gas appliances* and *valve trains* shall be tested in accordance with Appendix E.

NOTE: *Consumer piping* that is to be installed in an inaccessible location should be tested prior to the piping being made inaccessible to enable any repairs that may be necessary to be carried out before the piping is made inaccessible.

3.5.2 Testing consumer piping after alteration, repair or extension

Where *consumer piping* has been altered, repaired or extended, the section of the installation isolated to carry out the work shall, before being returned to operation, be tested in accordance with Appendix E.

NOTES:

1 When testing large existing *gas installation*s it may not be practicable to test the whole of the existing installation; in this circumstance the leakage test shall be applied downstream of the last *isolation valve*.

2 *Where practicable*, the existing outlet service should be tested before new *gas* work has commenced.

3.6 ACCEPTABLE SUBSTANCES FOR TESTING

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

3.7 HOT-TAPPING OF BRANCH FITTING TO CONSUMER PIPING

Where it is necessary to *hot-tap* a branch into *consumer piping*, the work shall be planned, coordinated and carried out by persons trained in the procedure. The planning shall include a documented contingency or emergency plan in the event of *gas* escape, fire or explosion whilst the work is in progress.

3.8 INCREASING THE OPERATING PRESSURE OF EXISTING CONSUMER PIPING

Where the *operating pressure* of existing *consumer piping* is to be increased—

(a) the materials and components in the existing installation shall be confirmed as suitable for the increased *operating pressure*; and

(b) the *consumer piping* and *gas appliances* shall be tested in accordance with Appendix E.

NOTES:

1 For reticulated systems, it is the GMS/meter owner's (*gas* supplier) responsibility to adjust the *gas pressure* available at the point of supply.

2 The *gas* supplier should be informed where the *operating pressure* is required to be increased.

3.9 DEALING WITH DANGEROUS GAS INSTALLATIONS

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

NOTES:

1 In New Zealand, the Gas (Safety and Measurement) Regulations 2010 require that when a person carrying out *gasfitting* 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 and the consumer/operator should also be notified.

3.10 METHODS OF LOCATING GAS LEAKS

A non-corrosive soap and water solution or leakage detection fluid applied externally or other suitable *gas* detecting equipment or means shall be the only methods used to locate a *gas* leak. Matches, candles or any other *ignition source* 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. THEREFORE, CAUTION SHOULD 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.

3.11 SAFETY REQUIREMENTS IN THE VICINITY OF GAS LEAKS OR SUSPECTED GAS LEAKS

Where there is a *gas* leak or a suspected *gas* leak or *gas* is present in the atmosphere, taking into consideration *gas* type and leakage rates, action shall be taken to ensure—

(a) all people in the vicinity are evacuated to a safe distance;

(b) the *gas* supply to the *gas installation* is isolated;

(c) all *ignition source*s are identified and are safely isolated or extinguished where possible;

(d) all affected confined spaces are well ventilated to safely disperse any accumulating *gas*;

(e) emergency support services are notified when there is a need; and

(f) the owner and occupier of the property are notified of the action taken and the remedial options available.

NOTE: Suitable warning signs should be used and depending on the severity of the situation it may be necessary to evacuate people from the area. Contact the *gas* supplier if the leak is at or upstream of the consumer's point of supply (usually the billing meter).

3.12 SAFE DISCHARGE OF STATIC ELECTRICITY

When working on *consumer piping* constructed of plastics, any static electricity that may be present in the piping or become present during work shall be discharged safely.

NOTES:

1 A method of discharging the static electricity is to wet the ground and dampen the pipe at the work area with a wet cloth. Then drape the cloth from the pipe to the ground to provide a path to earth. Under these conditions any static electricity should now have been discharged safely.

2 When working on electronic devices protection against the buildup of static electrical charge should be considered.

3.13 ELECTRICAL SAFETY BONDING OR BRIDGING

To avoid the risk of potentially fatal electrical shocks where a metal pipe is to be cut, or a *gas appliance*, component or fitting is to be disconnected from *consumer piping*, a suitable insulated metallic bridging device shall be installed across the intended cut or break to ensure electrical continuity. The bridging device shall not be removed until all work is complete.

3.14 CLEARING A BLOCKAGE IN CONSUMER PIPING

Where a blockage is to be cleared from the *consumer piping*—

(a) the *consumer billing meter*, all other *gas meters* and *gas pressure regulators*, and all *gas appliances* shall be disconnected or isolated before any suction or force is applied;

(b) only *pressure* regulated air or inert *gas* shall be used to clear the blockage; and

(c) on completion of the work the *consumer piping* shall be tested in accordance with Appendix E.

SECTION 4 — CONTENTS

MEANS OF COMPLIANCE—MATERIALS, FITTINGS AND COMPONENTS

SECTION 4 MEANS OF COMPLIANCE— MATERIALS, FITTINGS AND COMPONENTS

4.1 GENERAL

NOTE: A material fitting or component may be required to be submitted to the *Technical Regulator* with supporting evidence for consideration as to its acceptability for use if—

(a) it is not listed in this Section; or

(b) it is listed in this Section by type but is outside the scope of the Standard specified.

4.1.1 Suitability for use

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 will be subjected; and

(c) the environment in which they will be installed.

4.1.2 Reuse of materials and components

Before a pipe, fitting or any other item removed from any existing *gas installation* is reused it shall comply with Clause 4.1.1. Flange gaskets, O-rings and sealing tape shall not be reused.

4.1.3 Mating parts

Screw threads on mating parts shall be to the same Standard or Specification.

4.2 MATERIALS FOR CONSUMER PIPING

In Australia, piping materials and fittings shall meet an appropriate Standard listed in Table 4.1 and shall be subject to the limitations in that Table.

In New Zealand, piping materials and fittings shall meet an appropriate Standard listed in Table 4.1 or an equivalent Standard and shall be subject to the limitations in Table 4.1.

4.3 CONSUMER PIPING RESTRICTIONS

The *consumer piping* elements covered by Table 4.1 are subject to the following restrictions:

(a) A *push-on connector* shall only be used in accordance with Clause 6.2.15.

(b) A brass fitting shall not be buried in the ground unless made of a dezincification-resistant alloy or effectively coated or wrapped to avoid contact with the bedding or backfill.

NOTE: A brass fitting made of dezincification-resistant alloy is identified by the marking 'DR' or 'CR'.

(c) A *manual shut-off valve* constructed of plastics shall not be used above ground.

(d) A lead meter connection shall not be installed in a new installation or when modifying an existing installation.

(e) The following fitting types shall not be used above ground:

(i) Non-metallic fittings.

NOTE: Components of joints that are not in direct contact with gas may be non-metallic provided they comply with AS 4176.8.

(ii) Fittings that depend on metallic surface to non-metallic surface contact to provide a *gastight* seal, unless they are of the permanent crimped or sliding compression sleeve type complying with AS 4176.8.

(iii) Metallic fittings of the olive or compression type that contain non-metallic components.

When used underground the assembled joints shall be designed and installed so as to prevent 'pull-out' during service.

(f) A fitting using an 'O' ring(s) to provide the *gastight* seal shall be designed and installed so as to prevent 'pull-out' during service.

4.4 PROHIBITED TYPES OF JOINTS AND FITTINGS

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

(a) Croxed joints.

(b) Compression fittings with non-metallic olives excluding plastics fittings suitable for *gas* and complying with AS/NZS 4129.

(c) Compression fittings with metallic olives if not approved for use with *gas* in the *manufacturer's instructions*.

(d) Longscrew connectors.

(e) Internally threaded PVC-U fittings unless manufactured with a reinforcing metal band.

(f) Capillary fittings containing soft-solder.

(g) 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.

4.5 PROPRIETARY SYSTEMS

4.5.1 Suitability for intended use

Before any *proprietary system* is installed, its suitability for the intended application shall be verified taking into account other aspects related to the installation (including measurement systems and *gas* quality), normal and emergency operating conditions, temperature, *gas* composition and environmental conditions reasonably likely to be experienced.

4.5.2 Installation of proprietary systems

Proprietary systems shall be installed in accordance with the *manufacturer's relevant instructions*.

NOTES:

1 Following the *manufacturer's instructions* does not relieve the obligation to meet the requirements of Section 2 of this Standard.

2 Manufacturers of *proprietary systems* may specify installer competence in addition to competence normally expected of persons doing *gas* work.

4.5.3 Substitution of components

Except for substitution with components belonging to the same *proprietary system*, no part of a *proprietary system* shall be substituted by any other part unless specified in accordance with the *manufacturer's instructions* of the proprietary system. Transitions from conventional piping to the *proprietary system* shall be made with the appropriate proprietary components, or by extension from a reversion fitting provided by the original installer.

4.5.4 Identification of proprietary piping systems

A label shall be attached adjacent to the *gas meter* or *LP Gas tank* or *cylinder*(s) indicating the make or trade-name of the *proprietary system*.

TABLE 4.1

CONSUMER PIPING MATERIALS

Operating limit, kPa	Pipe		Fittings		Jointing	
	Pipe	**Limiting conditions**	**Fitting**	**Limiting conditions**	**Method**	**Limiting conditions**
7	Black steel complying with AS 1074 Medium grade Screwed ends or plain ends	External corrosion protection required Not permitted in the ground unless coated with high-density polyethylene (PE) complying with AS/NZS 1518 (see Note below) or covered with a proprietary wrapping which is acceptable to the *Technical Regulator* Not permitted in the ground beneath a building	Malleable cast iron fitting	External corrosion protection required	Taper external and parallel internal threads complying with AS ISO 7.1	Maximum permissible size is DN 100 External corrosion protection required
			Copper alloy screwed *pipe fitting* complying with AS 3688			
			Screwed flange, carbon steel or steel alloy to— AS 2129, or ASME B16.5 Class 150, or EN 1759-1 Class 150 (Class 125 for cast iron valves or regulators)	Not to be used for joining pipe lengths unless other joining methods are impracticable Flanges forming a joint shall be of the same size and face type External corrosion protection required		
			Steel butt-welded *pipe fitting* complying with BS 1640-1 or BS 1640-3, or complying with ASME B16.9	External corrosion protection required	Butt weld to AS 4041, Class 3 piping	Where welding is to be carried out, the *Technical Regulator* may require the welder to be authorized External corrosion protection required
			Socket-welded fitting to BS 3799, or complying with ASME B16.11	External corrosion protection required	Fillet weld complying with AS 4041 Class 3 piping	
			Welded flange carbon steel or steel alloy to— AS 2129, or ASME B16.5 Class 150, or EN 1759-1 Class 150 (Class 125 for cast iron valves or regulators)	Not to be used for joining pipe lengths unless other joining methods are impracticable Flanges forming a joint shall be of the same size and face type External corrosion protection required	Slip-on type flanges: Double fillet weld complying with AS 4041, Class 3 piping Other type flanges: Butt weld complying with AS 4041, Class 3 piping	

NOTE: High-density PE coated steel pipe may be used above ground in an indoor location.

(*continued*)

TABLE 4.1 (*continued*)

Operating limit, kPa	Pipe		Fittings		Jointing	
	Pipe	**Limiting conditions**	**Fitting**	**Limiting conditions**	**Method**	**Limiting conditions**
100	Galvanized steel complying with AS 1074 Medium grade Screwed ends or plain ends	Not permitted in the ground beneath a building	Up to 7 kPa, Malleable cast iron fitting complying with ISO 49 Over 7 kPa Wrought steel fitting complying with EN 10241	Fitting to be galvanized	Taper external and parallel internal threads complying with AS ISO 7.1	Up to 7 kPa, maximum permissible size is DN 100 Over 7 kPa, maximum permissible size is DN 80 External corrosion protection of bare threads is required where installed in the ground
			Copper alloy screwed fitting complying with AS 3688	Not to be connected directly to pipe in the ground without the use of an insulation coupling		
			Screwed flange, cast iron, carbon steel or steel alloy complying with— AS 2129, or ASME B16.5 Class 150, or EN 1759-1 Class 150 (Class 125 for cast iron valves or regulators)	Not to be used for joining pipe lengths unless other joining methods are impracticable Flanges forming a joint shall be of the same size and face type External corrosion protection required		

(*continued*)

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TABLE 4.1 (*continued*)

Operating limit, kPa	Pipe		Fittings		Jointing	
	Pipe	Limiting conditions	Fitting	Limiting conditions	Method	Limiting conditions
200	Stainless steel to be Grade 316. Materials, dimensions, design and performance complying with AS 5200.053 and/or ASME B36.19 M	Refer to manufacturer for advice where a high concentration of chlorides (salt) is to be found, particularly in a marine environment. Not permitted beneath a building if in the ground or in a concrete slab unless plastic coated or covered with a proprietary wrapping acceptable to the *Technical Regulator*. Where plastic coated stainless steel tube is used underground or where adverse environmental conditions exist, all joints and fittings shall be protected and made watertight.	Press-fit end connectors complying with AS 3688 or capillary fittings or threaded end connectors complying with AS 3688	Fittings to be compatible with pipe material (Grade 316) and pipe *manufacturer's specifications*. Fittings for press-fit end connectors to have yellow HNBR 'O' rings Press-fit end connectors not to be used for *applications* where the operating temperature exceeds 70°C unless the *manufacturer's specification* warrants higher. Press-fit end connectors not permitted for use as a final connection to an *appliance* where the final connection has to be destroyed to disconnect the *appliance*.	Minimum thickness for mechanical jointing is 1.2 mm Minimum thickness for welding is 2.5 mm	Welding to be Tungsten Inert *Gas* (TIG) or Manual Metal Arc (MMAW). The *Technical Regulator* may require welding in accordance with AS 4041 and the installer to be authorized. Joints in the ground beneath a building to be kept to a minimum.

(*continued*)

TABLE 4.1 (*continued*)

<table>
<tr><th rowspan="2">Operating limit, kPa</th><th colspan="2">Pipe</th><th colspan="2">Fittings</th><th colspan="2">Jointing</th></tr>
<tr><th>Pipe</th><th>Limiting conditions</th><th>Fitting</th><th>Limiting conditions</th><th>Method</th><th>Limiting conditions</th></tr>
<tr><td>100</td><td>Stainless steel pipe, corrugated semi-rigid, complying with BS 7838</td><td>Not permitted for use as final connection to an appliance
Not permitted in the ground beneath a building unless plastic coated.</td><td>Components that terminate with a BSP thread in accordance with the pipe manufacturer's specifications</td><td>Not permitted in the ground beneath a building.
Operating limit of 7 kPa applies where malleable cast iron fittings are used</td><td>Mechanical jointing using components in accordance with the pipe manufacturer's specifications</td><td>Not permitted in the ground beneath a building.
In other locations, joints to be accessible for inspection and renewal. Not to be welded or jointed by any other method</td></tr>
<tr><td rowspan="3">200</td><td rowspan="3">Galvanized and black steel pipe to—
AS 1074 medium grade, or
API 5L Grade B, or ASTM A53/A53M Grade B, or ASTM A106 Grade A or B
Screwed ends</td><td rowspan="3">Not permitted in the ground
External corrosion protection required
Pipe complying with API 5L or ASTM A53/ A53M or ASTM A106 to be joined with screwed connections shall comply with the following (refer to 'jointing' for size limitation):
<table><tr><th>Nom. size DN</th><th>Nom. OD mm</th><th>Min. wall thickness mm</th></tr><tr><td>8</td><td>13.7</td><td>2.2</td></tr><tr><td>10</td><td>17.1</td><td>2.3</td></tr><tr><td>15</td><td>21.3</td><td>2.8</td></tr><tr><td>20</td><td>26.7</td><td>2.9</td></tr><tr><td>25</td><td>33.4</td><td>3.4</td></tr><tr><td>32</td><td>42.2</td><td>3.6</td></tr><tr><td>40</td><td>48.3</td><td>3.7</td></tr><tr><td>50</td><td>60.3</td><td>3.9</td></tr><tr><td>65</td><td>73.0</td><td>5.2</td></tr><tr><td>80</td><td>88.9</td><td>5.5</td></tr><tr><td>100</td><td>114.3</td><td>6.0</td></tr></table></td><td>Wrought steel fitting complying with BS EN 10241 (BSP) or complying with BS 3799 (NPT)</td><td rowspan="2">External corrosion protection required</td><td rowspan="3">Taper external and parallel internal threads complying with AS ISO 7.1 or NPT to ASME B1.20.1</td><td rowspan="3">Up to 7 kPa, maximum permissible size is DN 100
Over 7 kPa, maximum permissible size is DN 80
External corrosion protection required</td></tr>
<tr><td>Copper alloy screwed fitting to AS 3688</td></tr>
<tr><td>Screwed flange, carbon steel or steel alloy to—
AS 2129, or
ASME B16.5 Class 150, or
EN 1759-1 Class 150 (Class 125 for cast iron valves or regulators)</td><td>Not to be used for joining pipe lengths unless other joining methods are impracticable
Flanges forming a joint shall be of the same size and face type</td></tr>
</table>

(*continued*)

TABLE 4.1 (*continued*)

Operating limit, kPa	Pipe		Fittings		Jointing	
	Pipe	**Limiting conditions**	**Fitting**	**Limiting conditions**	**Method**	**Limiting conditions**
200	Galvanized and black steel pipe to— AS 1074 medium grade or API 5L Grade B, or ASTM A53/A53M Grade B, or ASTM A106 Grade A or B, Plain ends	Not permitted in the ground unless coated with high density polyethylene (PE) complying with AS/NZS 1518 (see NOTE below), or covered with a proprietary wrapping acceptable to the *Technical Regulator* Not permitted in the ground beneath a building External corrosion protection required Pipe complying with API 5L or ASTM A53/A53M or ASTM A106 to be joined by welding shall comply with the following: (see below)	Butt-welded fitting complying with BS 1640-1 or BS 1640-3, or complying with ASME B16.9	External corrosion protection required	Butt weld to AS 4041 Class 3 piping	Where welding is to be carried out, the *Technical Regulator* may require the welder to be authorized External corrosion protection required
			Welded flange, carbon steel or steel alloy to— AS 2129, or ASME B16.5 Class 150, or EN 1759-1 Class 150 (Class 125 for cast iron valves or regulators)	Not to be used for joining pipe lengths unless other joining methods are impracticable Flanges forming a joint shall be of the same size and face type External corrosion protection required	Slip-on type flanges: Double fillet weld complying with AS 4041, Class 3 piping Other type flanges: Butt weld complying AS 4041, Class 3 piping	
			Socket-welded fitting complying with BS 3799, or complying with ASME B16.11	External corrosion protection required	Fillet weld complying with AS 4041, Class 3 piping	

Nom. size *DN*	Nom. OD mm	Min. wall thickness mm
15	21.3	3.7
20	26.7	3.9
25	33.4	4.5
32	42.2	4.9
40	48.3	3.7
50	60.3	3.9
65	73.0	5.2
80	88.9	5.5
100	114.3	4.8
150	168.3	4.8
200	219.1	4.8
250	273.1	4.8
300	323.8	6.4

NOTE: High-density PE coated steel pipe may be used above ground in an indoor location.

(*continued*)

TABLE 4.1 *(continued)*

Operating limit, kPa	Pipe		Fittings		Jointing	
	Pipe	**Limiting conditions**	**Fitting**	**Limiting conditions**	**Method**	**Limiting conditions**
200	Copper tube complying with AS 1432 *Type A or Type B* with or without plastic coating applied by the manufacturer For sizes over DN 200, tube shall be complying with AS 1572 with copper alloy designation C12200 complying with AS 2738 and a minimum wall thickness of 2.64 mm	Not permitted beneath a building if in the ground or in a concrete slab unless plastic coated or covered with a proprietary wrapping acceptable to the *Technical Regulator* Where plastic coated copper tube is used underground or where adverse environmental conditions exist, all joints and fittings shall be protected and made watertight	Copper alloy flared compression fitting complying with AS 3688 or complying with AS D26	Not permitted in the ground beneath a building. Mixing of AS 3688 and AS D26 fitting components not permitted	Flared compression	Not permitted in the ground beneath a building
			Copper alloy brazing capillary fitting complying with AS 3688		Open flame brazing complying with EN 14324	Brazing alloy to comply with AS/NZS 1167.1, alloy classification B2 Canary colour - (minimum silver content 1.8%) or a comparable rod Joints in the ground beneath a building to be kept to a minimum
			Junctions may be formed in 'hard drawn' tube only	To be formed with appropriate mechanical branch forming tools		
			Socket formed in tube (spigot and socket joining lengths of tube)	To be formed with appropriate tube expanding tool		
			Brazing flange, copper alloy complying with AS 2129	Not permitted in the ground beneath a building Not to be used for joining pipe lengths unless other joining methods are impracticable Flanges forming a joint shall be of the same size and face type		
			Screwed flange, carbon steel, steel alloy or copper alloy to— AS 2129, or ASME B16.5 Class 150, or EN 1759-1 Class 150 (Class 125 for cast iron valves or regulators)	Not permitted underground Not to be used for joining pipe lengths unless other joining methods are impracticable Flanges forming a joint shall be of the same size and face type	Taper external and taper or parallel internal threads complying with AS ISO 7.1 or NPT complying with ASME B1.20.1	Fitting to be brazed to the pipe, not screwed Up to 7 kPa, maximum permissible size is DN 100. Over 7 kPa, maximum permissible size is DN 80
			Composite loose ring socket flange complying with AS 1432, AS 2129 or ASME B16.5 Class 150 and AS 3688 where appropriate			

(continued)

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TABLE 4.1 (*continued*)

Operating limit, kPa	Pipe		Fittings		Jointing	
	Pipe	**Limiting conditions**	**Fitting**	**Limiting conditions**	**Method**	**Limiting conditions**
200 (cont'd)	Copper tube … (cont'd)	(Not permitted beneath a building if in the ground or in a concrete slab unless plastic coated or covered with a proprietary wrapping acceptable to the *Technical Regulator* Where plastic coated copper tube is used underground or where adverse environmental conditions exist, all joints and fittings shall be protected and made watertight.)	Copper and copper alloy press-fit end connector complying with AS 3688 and the test requirements of BS 8537 or ANSI LC-4	Fittings to have yellow HNBR 'O' rings Not to be used for applications where the operating temperature exceeds 70°C unless the *manufacturer's specification* warrants higher. Not permitted in the ground beneath a building. Press-fit end connectors not permitted for use as a final connection to an *appliance* where the final connection has to be destroyed to disconnect the *appliance*.	Crimped joint to be formed using method and tools in accordance with the *manufacturer's specifications*	The *Technical Regulator* may require the installer to be authorized. Observe *manufacturer's instructions* for adjacent hot-work.
200	Polyethylene complying with AS/NZS 4130	Not permitted beneath a building Not permitted above ground	Compression fitting or electrofusion fitting which is acceptable to the *Technical Regulator* Mechanical compression fitting in accordance with AS/NZS 4129	The *Technical Regulator* may require internal stiffeners with compression *fittings* Mechanical compression fittings complying with AS/NZS 4129 may require internal stiffeners	Electrofusion, butt-fusion, or mechanical joints carried out complying with AS/NZS 4645.3	The *Technical Regulator* may require the installer to be authorized PTFE (teflon) tape is the only thread sealant to be used on plastics fittings
70	PVC-HI complying with AS ISO 6993.1	Not permitted beneath a building Not permitted above ground	Solvent-cement fitting complying with AS/NZS 1477, PN 12 or PN 18 or complying with AS ISO 6993.3	Internally threaded *fittings* are not permitted	Solvent-cement jointing or mechanical joints carried out complying with AS/NZS 4645.3	PTFE (teflon) tape is the only thread sealant to be used on plastics *fittings* Priming fluid and solvent cement be in accordance with the pipe *manufacturer's specifications*
	PVC-U made to AS 1464.1 Class 100, Type 1, 2 or 3, or Class 450 Type 3		Solvent-cement fitting complying with AS/NZS 1477, Class 12 or Class 18		Solvent-cement jointing or mechanical joints carried out complying with AS/NZS 4645.3	

(*continued*)

TABLE 4.1 (*continued*)

Operating limit kPa	Pipe		Fittings		Jointing	
	Pipe	**Limiting conditions**	**Fitting**	**Limiting conditions**	**Method**	**Limiting conditions**
200	Polyamide (Nylon 11 and 12) complying with AS 2944.1, Class 300 or Class 400	Not permitted beneath a building Not permitted above ground	Polyamide fitting complying with AS 2944.2	The *Technical Regulator* may require internal stiffeners with compression *fittings*	Adhesive jointing, or mechanical joints carried out complying with AS/NZS 4645.3	The *Technical Regulator* may require the installer to be authorized Adhesive shall be in accordance with the pipe *manufacturer's specifications* PTFE (teflon) tape is the only thread sealant to be used on plastics fittings
70	(a) Polyethylene/aluminium/ polyethylene (PE/AL/PE) and cross-linked polyethylene/aluminium/ cross-linked polyethylene (PE-X/AL/PE-X) *multilayer pipe* complying with AS 4176.8 and relevant Australian Technical Specifications (ATS) (b) Cross-linked polyethylene/aluminium/ polyethylene (PE-X/AL/PE) *multilayer pipe* complying with AS 4176.8	Not permitted for use as final connection to an *appliance* Ensure compliance with any instructions or warnings in accordance with the *manufacturer's instructions* To be protected against UV degradation PE/AL/PE and PE-X/AL/PE not to be used for applications where the operating temperature exceeds 60°C. PE-X/AL/PE-X not to be used for applications where the operating temperature exceeds 80°C To be protected against UV degradation	Complying with AS 4176.8 and relevant Australian Technical Specifications (ATS)	Same temperature limitations as for pipe Not permitted in the ground beneath a building	Joints to be formed using method(s) and tool(s) in accordance with the *manufacturer's specifications*	The *Technical Regulator* may require the installer to be authorized *Consumer piping* installed in the ground beneath a building shall be *multilayer pipe* without joints.

(*continued*)

TABLE 4.1 (*continued*)

Operating limit kPa	Pipe		Fittings		Jointing	
	Pipe	**Limiting conditions**	**Fitting**	**Limiting conditions**	**Method**	**Limiting conditions**
A2 70	Cross-linked polyethylene (PE-X) pipes for pressure applications in accordance with AS/NZS 2492, PEX-Yellow, PE-X 80 no darker than RAL 1018 and PE-X 100 and PE-X 125 no lighter than RAL 1033	Not permitted beneath a building. Not permitted above ground. Not permitted for use as a final connection to *appliances*	Compression fitting which is suitable to the *Technical Regulator*	The *Technical Regulator* may require internal stiffeners with compression fittings. Mechanical compression fitting in accordance with AS/NZS 2537.5	Joints to be formed using methods and tools in accordance with the *manufacturer's specifications*	The *Technical Regulator* may require the installer to be authorized

4.6 MATERIAL BETWEEN LP GAS CYLINDER VALVE AND INLET TO FIRST REGULATOR

Materials for piping between the *LP Gas cylinder* valve and the inlet to the first regulator shall be in accordance with AS/NZS 1596.

NOTE: Guidance is given in Paragraph J9, Appendix J.

4.7 OTHER MATERIALS

4.7.1 Fire resistant material

Fire resistant material shall comply with Appendix C.

4.7.2 Gasket material

The material for a gasket shall be suitable for the *operating pressure* and temperature of the system and shall be compatible with the type of *gas* to be supplied.

NOTES:

1 Aluminium 'O' rings and spirally wound metal gaskets are acceptable.

2 Details of bolting standards can be found in AS/NZS 4645.2.

3 The manufacturers' nominated gasket crunch forces often result in relatively high loads when gaskets are used in *gas* applications. It may be necessary to apply specialized lubricants, torque spanners and specially machined washers to prevent flange and fastener damage.

4 When using plastics components in a flange gasket system, special attention should be given to uniformity of bolt torque.

4.7.3 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 to AS 4623 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.

4.7.4 Vent line material

Vent lines shall be constructed of the following material as appropriate:

(a) Metal pipe and *pipe fittings* or *multilayer pipe* and *pipe fittings* which comply with Table 4.1 when within a building.

(b) Metal pipe and *pipe fittings*, *multilayer pipe* and *pipe fittings* or PVC-U pipe and *pipe fittings* suitable for exposed conditions, when outside a building.

4.7.5 Flue material

Materials for *flues* shall comply with Table 4.2.

TABLE 4.2
FLUE MATERIALS

<table>
<tr><th>Material</th><th>Protective finish</th><th colspan="2">Application and limitations (see Note)</th></tr>
<tr><td colspan="4">Low temperature applications (not exceeding 300°C)</td></tr>
<tr><td>Aluminium alloy 1100, 3003
0.7 mm thickness
AS/NZS 1734</td><td>None</td><td colspan="2">Only where accessible for inspection and renewal
Internal flues not to exceed 12 m in length, external flues not to exceed 7 m</td></tr>
<tr><td>Aluminium alloy 1100, 3003 (flexible liner and flexible flue connector) as follows:
(a) Chimney liner flex-2 ply—0.26 mm thickness.
(b) Single wall flexible connector—0.31 mm thickness.</td><td>None</td><td colspan="2">(a) is suitable for use as a chimney liner
(b) is suitable where changes of direction are required (e.g., as an alternative to flue elbows)
Neither (a) nor (b) to be used where mechanical damage could occur</td></tr>
<tr><td>Bricks (clay building)
Cement or lime mortar joints</td><td>None</td><td colspan="2">Only slight condensation allowable, minimum wall thickness of flue 50 mm</td></tr>
<tr><td>Bricks</td><td>Inside face lined with acid-resisting tiles embedded in acid-resisting jointing material</td><td colspan="2">Flues lined with non-absorbent tiles shall have provision made for condensate drainage</td></tr>
<tr><td>Bricks</td><td>Faced with water and acid-proof cement mix</td><td colspan="2">Only slight condensation allowable</td></tr>
<tr><td>Copper not less than 0.5 mm thickness</td><td>None</td><td colspan="2">Only slight condensation allowable</td></tr>
<tr><td>Fibre cement, light grade (asbestos free)</td><td>Autoclaved</td><td colspan="2">Only slight condensation allowable</td></tr>
<tr><td>Flue bricks</td><td>None or glazed internally</td><td colspan="2">If condensation is heavy, internally glazed flue bricks shall be used
Joints to be acid-resisting
Bricks glazed internally shall have provision made for condensate drainage.
Non-glazed, only slight condensation is allowable
Provision of an air gap between the flue brick and the finished wall may be necessary to minimize heat transfer</td></tr>
<tr><td rowspan="6">Mild steel
0.6 mm thickness
0.8 mm thickness
1.0 mm thickness</td><td rowspan="6">Aluminized 122 g/m², or A275 zinc to AS 1397, or aluminium zinc complying with AS 1397</td><td colspan="2">Only where accessible for inspection and renewal</td></tr>
<tr><td colspan="2">Internal flues not to exceed 12 m in length, external flues not to exceed 7 m</td></tr>
<tr><td>Wall thickness, mm</td><td>Maximum flue diameter, mm</td></tr>
<tr><td>0.6</td><td>100</td></tr>
<tr><td>0.8</td><td>200</td></tr>
<tr><td>1.0</td><td>300</td></tr>
<tr><td>Concrete bricks or blocks (precast)</td><td>None</td><td colspan="2">Only slight condensation allowable, minimum wall thickness of flue 50 mm</td></tr>
</table>

(continued)

TABLE 4.2 (*continued*)

Material	Protective finish	Application and limitations (see Note)	
Twin wall flue, complying with AS 4567	As per AS 4567	To prevent heat transfer to adjacent structures and to minimize *condensation* *Certified appliances* with a *draught diverter* will meet this maximum *flue gas* temperature requirement	
PVC-U to AS/NZS 1260	None	Low temperature *flues* not exceeding 60°C	
High temperature applications (above 300°C)			
Fibre cement, heavy grade (asbestos free)	Autoclaved	None	
Fire bricks, set in fireclay	None	Especially very high temperature *flues*	
Mild steel 1.6 mm thickness	None	Only where *accessible* for renewal	
Stainless steel 0.5 mm 0.7 mm	300 and 400 Series Grade	**Wall thickness, mm**	**Maximum *flue* diameter, mm**
		0.5	100
		0.7	200

NOTE: In addition to the listed limitations, consideration should be given to the deleterious effect of some *flue* products from some *appliances*, e.g., pottery kilns, incinerators, atmosphere generators or the like.

4.8 COMPONENTS

4.8.1 Miscellaneous components

Fabricated pipe branches shall comply with AS 4041 or AS/NZS 4645 series.

Components shown in Table 4.3 shall comply with the appropriate Standard and in Australia be *certified*.

TABLE 4.3
MISCELLANEOUS COMPONENTS

Component	Standard
Automatic shut-off valves	AS 4629
Manual shut-off valves	AS 4617, Type 1 or Type 3
Quick-connect devices	AS 4627
Vent valves	AS 4629
Flue cowls	AS 4566
Limited flexibility connectors	AS 4631

4.8.2 Manual shut-off valves

Manual shut-off valves shall be selected after giving consideration to materials, *pressure* rating, *pressure* drop, service involved, emergency use, and reliability of operation, and shall be—

(a) of the quarter-turn type;

(b) open when the handle is in line with the pipe and closed when the handle is across the pipe; and the seat of the handle and the spindle top are such that the handle cannot be fitted in any other way;

(c) installed so that the valve cannot open under the action of gravity or vibration; and

(d) capable of being connected to the inlet piping such that, when the outlet piping is disconnected, the valve will remain securely attached to the inlet piping.

Manual shut-off valves constructed of plastics shall not be used above ground.

4.8.3 Hose assemblies

Hoses shall be used only as a complete assembly and shall be suitable for the application.

4.8.4 Swivel joints and couplings

A *swivel joint* or coupling shall be suitable for the application.

SECTION 5 — CONTENTS

MEANS OF COMPLIANCE—INSTALLING CONSUMER PIPING

SECTION 5 MEANS OF COMPLIANCE— INSTALLING CONSUMER PIPING

5.1 GENERAL

5.1.1 Condition of pipe and pipe fittings

Pipe and *pipe 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.

5.1.2 Prohibition of earthing through consumer piping

Consumer piping shall not be used as a component of an earthing system of any electrical installation or works. Metallic pipework shall be segregated from electrical and other services and from the earth system or, where that is not possible, electrically bonded to control touch potentials to safe levels.

NOTES:

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

2 Segregation may be achieved by a 25 mm separation or greater in air or by insulation having an insulation resistance not less than 1 MΩ when tested at 500 V d.c.

3 Separation from earthing electrodes is given in AS/NZS 3000.

4 Guidance for high voltage earthing is given in AS 2067.

5.1.3 Protection from other materials

Consumer piping shall be suitably protected from deterioration likely to arise from any process material or the rest of the piping system when dissimilar metallic materials are used. Suitable protection can be achieved by the application of corrosion resistant coatings, *insulating joints* or by sleeving.

5.1.4 Storage and handling of pipe

Metallic pipes shall be stored in such a manner that the potential for corrosion is minimized. Plastics and *multilayer pipes* shall be protected from direct sunlight or any other deteriorating effects. Storage, unloading, hauling, handling and installing of pipe shall be carried out with care to avoid damage to the pipe or to any protective coating. Refer to AS/NZS 4645.3 for further guidance.

5.1.5 Condition of pipe during installation

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

5.1.6 Restriction on repair of defective pipe or pipe fitting

Pipes and *pipe fittings* shall not be repaired except for repair of a defective welded or brazed joint. Where a defective pipe or *pipe fitting* is found it shall be replaced.

5.1.7 Jointing

Jointing of pipe shall comply with Table 4.1 and the following as appropriate:

(a) *Flanged joints—welded/screwed* The method of bolting shall be suitable for the *operating pressure* of the system and comply with all requirements.

(b) Welded joints shall be completed using an appropriate welding procedure.

(c) Capillary joints in copper pipe shall be prepared using purpose designed tools or purpose made proprietary *pipe fittings*.

NOTE: Excess flux should be removed after jointing.

(d) Compression *pipe fittings* and flare *pipe fittings* shall be used only where they are *accessible* for the nut to be tightened to make a *gastight* joint.

(e) Screwed *pipe fittings* and unions shall be used only in *accessible* and ventilated locations.

(f) Jointing of plastics and *multilayer pipes* and *pipe fittings* shall be according to the *manufacturer's relevant instructions*.

(g) Jointing of dissimilar copper pipe sizes shall only be by use of appropriate *pipe fittings* or mechanical tools. Crimping of the larger pipe or expansion of the smaller pipe is not permitted.

5.1.8 Restriction on use of thread sealant

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

NOTES:

1 A compression joint includes a flare, a union, and a POL connection to a *cylinder* valve.

2 The only thread sealant permitted for use on a plastics *pipe fitting* is PTFE (teflon) tape.

5.1.9 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.

5.1.10 Re-making a flanged joint

Where a flanged joint is to be re-made, the gasket shall be renewed.

5.1.11 Pipe installation not to reduce building strength or fire resistance

The design strength or fire resistance of a building (for example, *fire dampers*, sprinkler systems, alarm systems) shall not be reduced by the installation of *consumer piping*.

NOTE: The building codes of Australia and New Zealand may impose additional requirements, especially in commercial or multiple residence dwellings, where consumer *gas* piping is to be run in defined access/egress ways.

5.1.12 Identification of pipework

5.1.12.1 *Identification*

Except in single occupancy residential *premises*, above-ground *consumer piping* shall be identified when any one of the following applies:

(a) The *operating pressure* of the *consumer piping* exceeds 7 kPa.

(b) The location of the pipe is such that it is not readily identifiable as *consumer piping*.

The identification shall comply with AS 1345 in all other respects.

NOTES:

1 Refer to Clause 4.5.4 for identification of *proprietary piping systems*.

2 Durable adhesive pipe markers may be used for identifying *consumer piping*.

5.1.12.2 *Marking*

The identification markings shall comply with Figure 5.1.

The identification markings shall be placed—

(a) at spacings of not more than 8 m;

(b) adjacent to branches, junctions, valves, wall and floor penetrations; and

(c) on all *tailpipes*.

Other *gas* types within the scope of this Standard shall be identified and marked in a manner acceptable to the *Technical Regulator*.

Where *consumer piping* is sleeved (e.g., in a conduit), the sleeving shall be identified in accordance with Figure 5.1. The identification markings shall be placed in accordance with Items (a), (b) and (c) above.

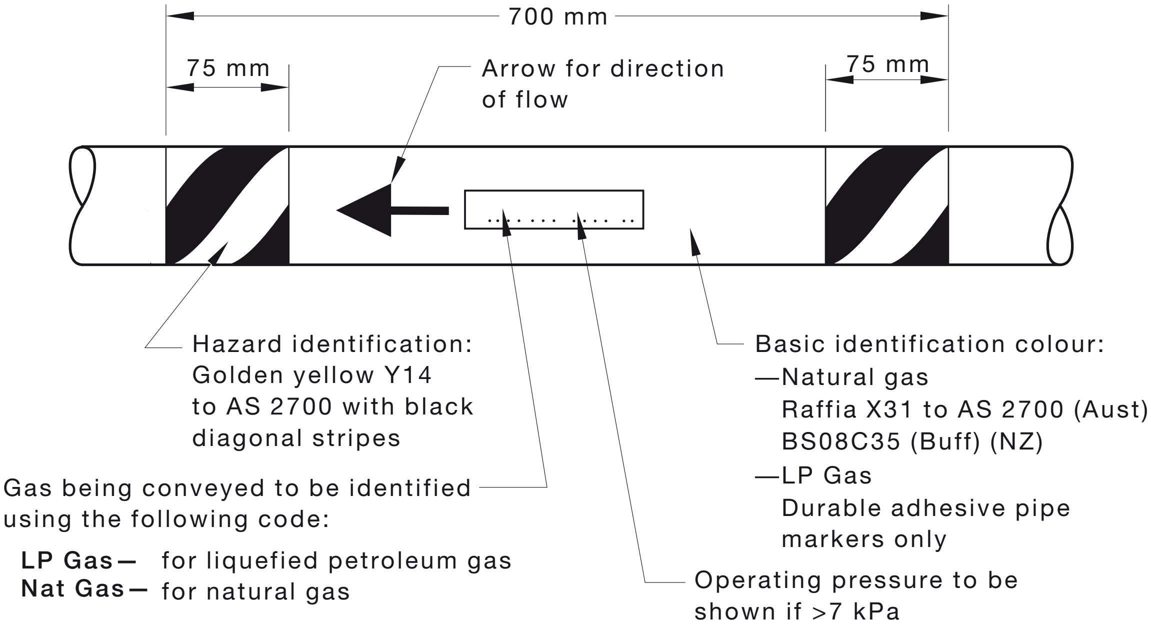


FIGURE 5.1 IDENTIFICATION OF PIPEWORK

5.2 DESIGN OF CONSUMER PIPING

NOTE: Where *consumer piping* is intended to operate at a *pressure* exceeding 7 kPa, or for *LP Gas* 140 kPa, the *Technical Regulator* may require plans and specifications to be submitted prior to the commencement of work on the installation.

5.2.1 Pressure rating of piping and components

All piping and components in a *consumer piping* system up to and including the next downstream *gas pressure regulator* shall be able to withstand a *pressure* not less than the lowest of—

(a) 100% of the inlet *pressure* of the next upstream regulator;

(b) where *over-pressure protection* is fitted, the *maximum over-pressure* likely to occur when the next upstream regulator fails; and

(c) where no upstream regulator is fitted on the service to the installation, the *maximum allowable operating pressure* of the section of the network supplying the installation.

NOTES:

1 This requirement applies to the entire installation if there is no *consumer piping gas pressure regulator*.

2 In most cases the *maximum over-pressure* in Item (b) above for 2nd family *gas* (*natural gas*) supplies to installations is 7 kPa and for 3rd family *gases* (*LP Gas*) 14 kPa.

3 If the *maximum over-pressure* exceeds 7 kPa for *natural gas* supplies or 14 kPa for *LP Gas* supplies the *maximum over-pressure* is required to be clearly marked on or adjacent to the *gas* service *pressure* regulator by the *gas* supplier/GMS owner. It will be necessary to determine from the *network operator* the maximum *pressure* that could occur under *gas pressure regulator* fault conditions at the outlet of the *consumer billing meter* or the outlet of the *cylinder* or *tank* regulator.

5.2.2 Appliance pressure rating

If an *appliance* is not capable of remaining safe when exposed to the lowest *pressure* determined in Clause 5.2.1, additional components shall be installed to provide protection against the over-pressurization.

5.2.3 Requirements where pressurized air, oxygen or a stand by gas is to be used in conjunction with the fuel gas

Where pressurized air, oxygen or a standby *gas* is to be used in conjunction with the fuel *gas*, a suitable protective device, to avoid contamination of the fuel *gas*, shall be installed in the *consumer piping* as close as possible to and upstream of the point of interconnection of any *gas* and air, oxygen or standby *gas* line.

A flashback arrestor shall be installed as close as practicable to the *burner* nozzle when oxygen is being used as part of the working flame process.

NOTES:

1 If air, oxygen or another *gas* is mixed with the fuel *gas*, an explosive mixture may result. Therefore, where work involving air, oxygen or standby *gas* in conjunction with *consumer piping* is to be carried out, the *Technical Regulator* may require to be specifically advised prior to the commencement of any work.

2 A *gas* and combustion air mixing device incorporating a normally closed double diaphragm *zero regulator* used in conjunction with a proportional mixing device requires no further protection unless connected directly to an air or oxygen supply which operates at a *pressure* exceeding 7 kPa.

3 Suitable protective devices include—

(a) a *non-return valve*;

(b) a three-way valve that completely closes one side before opening the other;

(c) a reverse flow detection device that controls a positive shut-off valve;

(d) a normally-closed air-actuated positive shut-off *pressure* regulator (e.g., *zero regulator* used in conjunction with a proportional mixing device); or

(e) a *flame safeguard system* incorporating Class 1 *automatic shut-off valves*.

5.2.4 Consumer piping size

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

NOTE: Appendix F provides methods for determining pipe sizing.

5.2.5 Pipe size for consumer piping supplying a domestic type gas appliance

The diameter of piping, intended to supply a *Type A* or domestic-type *gas appliance* shall be such that the minimum *pressure* in Table 5.1 is available at the *appliance* inlet.

In individually metered single occupancy *premises*, the minimum *pressure* shall be available at each *appliance* with all *appliances* connected to the *consumer piping* operating at maximum *gas consumption*.

TABLE 5.1

MINIMUM PRESSURE AT APPLIANCE INLET

Family of gases	Minimum pressure at appliance inlet, kPa
2nd (*NG, SNG*)	1.13
3rd (*LP Gas*)	2.75

NOTE: The *appliance* inlet is the inlet to the first *appliance* control device other than the *appliance manual shut-off* valve if fitted.

5.2.6 Flexibility of piping

Consumer piping shall be designed to have sufficient flexibility to prevent—

(a) excessive stress in the piping material and attached equipment caused by thermal expansion and contraction;

(b) excessive bending or loading at joints; and

(c) undesirable forces or movements at points of connection to equipment or at anchorage or guide points.

NOTES:

1 Formal calculations may be required where reasonable doubt exists regarding adequate flexibility of the system. Reference should be made to AS 4041 for guidance.

2 The requirements of this Clause may be satisfied by use of one or more of the following:

(a) Bends, loops or offsets formed in the piping.

(b) Flexible joints or couplings of the type designed to absorb thermal expansion and contraction.

(c) Expansion joints.

3 See also Clauses 5.2.7 and 5.7.5.

5.2.7 Pipe alignment at expansion joint

Pipe alignment guides shall be used with an expansion joint. The guides shall be fitted in accordance with the *manufacturer's relevant recommendations*.

A2

5.2.8 'Text deleted'

5.2.9 Occupancy isolation

In the case of multiple occupancies within the same building—

(a) the *consumer piping* to each occupancy shall include a quarter turn *manual shut-off valve*;

(b) the valve shall be *accessible* and, *where practicable*, external to the occupancy; and

(c) a durable, permanent sign shall be located in a prominent position adjacent to the valve, identifying it as a *gas* valve, and if remote from the occupancy identifying the occupancy.

5.2.10 Building isolation

Except in the case of single occupancy residential *premises*, where more than one building is to be supplied with *gas* from one *consumer billing meter* or *gas* storage vessel—

A2

(a) the *consumer piping* shall include a *manual shut-off valve* at the each point of entry of piping to each building;

(b) the valve shall be *accessible* and external to the building; and

(c) a durable permanent sign shall be located in a prominent position adjacent to the valve. The sign shall include the wording 'GAS VALVE'.

NOTE: The *consumer piping* should be designed to ensure that when a valve is turned off, the *gas* supply to only one building is affected.

5.2.11 Isolation for specific installations

In installations where a number of *appliances* without *flame safeguard systems* are used, such as a school laboratory, a means of isolation shall be fitted in a *readily accessible* location. An adjacent sign shall be installed indicating its purpose.

NOTES:

1 Means of isolation includes a *manual shut-off valve* or a *safety shut-off system* which, if required, can be key operated to reset.

2 Suggested wording for the notice is 'GAS ISOLATION: Turn off when *gas* is not in use or in the case of emergency. Before turning on, ensure all the *appliances* (e.g., Bunsen *burners*) are turned off'.

5.2.12 Provision of emergency valve (Steam boilers and hot water boilers)

When a *steam boiler* or *hot water boiler* is installed, a means of remote emergency shut off shall be provided. The means of remote emergency shut-off shall be one or more of the following:

(a) Type 1 manual quarter turn *isolation valve* that meets the requirements of AS 4617.

(b) Emergency stop button hard wired into either—

(i) a remote class 1 safety shut off valve which meets the requirements of AS 4629 and which isolates *gas* flow when de-energized;

OR

(ii) a safety shut off valve arrangement compliant with the requirements of AS 3814 if fitted to the *appliance*.

The stop button or manual valve shall be—

(A) located in a safe, *readily accessible* position remote from the boiler; and

(B) clearly identified by means of an appropriate sign.

A2

5.2.13 Reversion fittings for proprietary multilayer piping

In installations, in Class 1 buildings in Australia, or detached or multi-unit dwellings in New Zealand, where a proprietary multilayer piping system having a *main run* exceeding 10 m in length and connected to more than one *appliance* is being installed, reversion to standard thread complying to AS ISO 7.1, BSPT, or a standard annealed copper tube, shall be provided at both of the following *accessible* locations:

(a) In the *main run* immediately prior to the first branch take off point.

(b) In the *main run* immediately prior to the last branch take off point.

An example is shown in Figure 5.2(a).

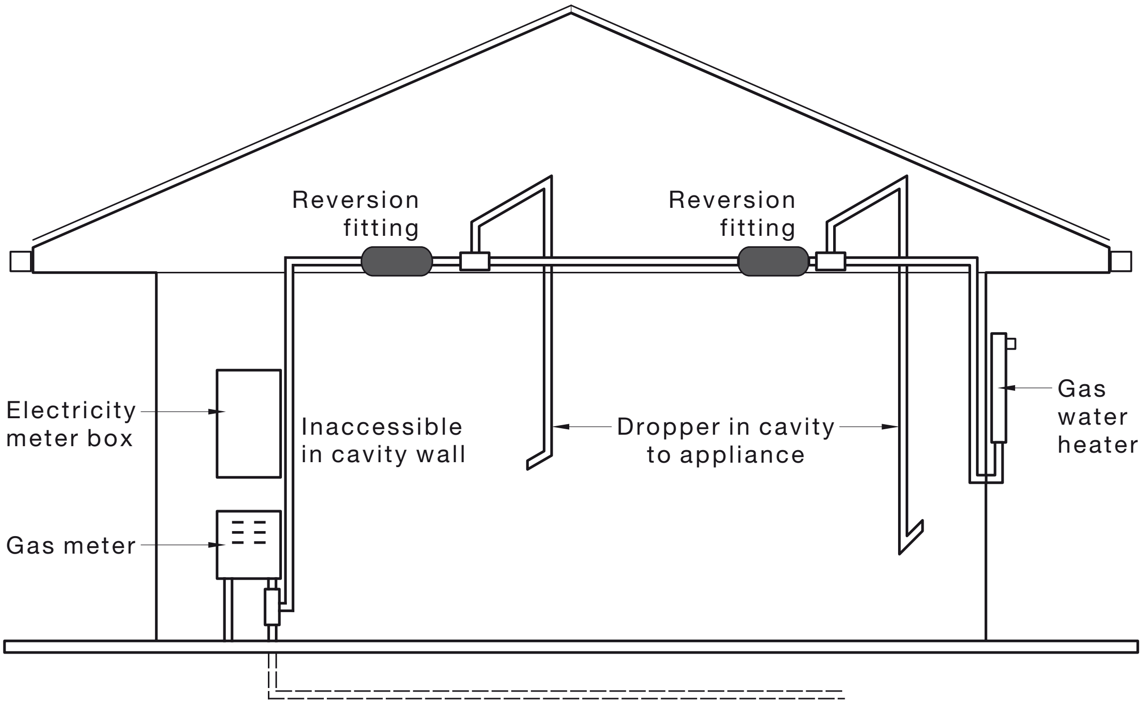
Figure 5.2(b) and Figure 5.2(c) show acceptable reversion options for complying with this Clause.

NOTES:

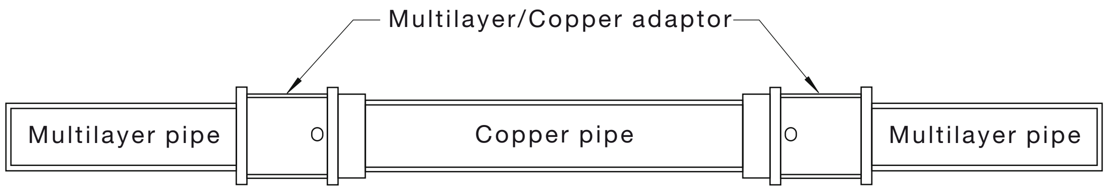
1 The reversion fitting may be incorporated in the upstream side of the branch take off fitting.

2 The intent is to permit future extension or connection to a non-compatible piping system to protect the consumer/end user from difficulties that may arise from non-availability of the *proprietary system*.

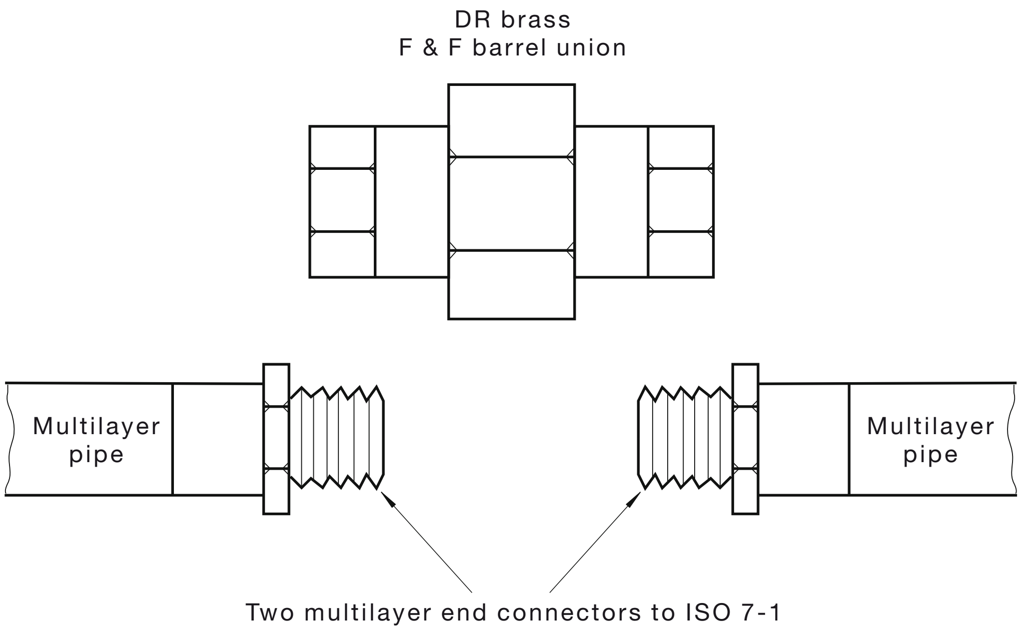
3 See Appendix L for definition of Class 1 building.



(a) Example of reversion fittings installed in a multilayer piping system (composite pipe)



(b) Reversion to copper tube



(c) Reversion to standard thread

FIGURE 5.2 MULTILAYER PIPING SYSTEM—REVERSION FITTINGS

5.3 LOCATION OF CONSUMER PIPING

5.3.1 Prohibited locations

Consumer piping shall not be installed in any of the following locations:

(a) Attached to a fence.

(b) In a lift well.

(c) In a clothes chute or rubbish chute.

(d) In a fire hydrant cabinet or fire hose reel cabinet.

(e) In a *fire-isolated stairway*, *passageway or ramp*, *exit-way* or *safe path*.

(f) In a fire control room.

NOTES:

1 Local building regulatory authorities may have additional restrictions for the location of *consumer piping*.

2 A brick wall in sound condition used as a fence is generally deemed suitable.

3 Refer also to Paragraph K5 in Appendix K.

5.3.2 Piping in an air duct, plenum ceiling, air handling plenum or ventilating duct

Where *consumer piping* is to be in an air duct, air plenum ceiling, air handling plenum or ventilating duct, all of the following shall apply:

(a) The *operating pressure* shall not exceed 7 kPa.

(b) Joints shall be kept to a minimum.

(c) All joints shall be *permanent joints*.

5.3.3 Piping not to be subject to physical damage

Consumer piping shall not be located where physical damage to the pipe is likely to occur, unless adequate protection is provided.

5.3.4 Separation from above-ground low and extra low voltage electrical equipment

There shall be at least 25 mm separation between any *consumer piping* and any above-ground—

(a) metal electrical conduit;

(b) electrical wire or cable not in a conduit; or

(c) electrical earthing electrode.

Where *consumer piping* is not separated by a suitable electrically insulating material, it shall be 150 mm away from electricity meters and associated control or fuse boxes.

NOTE: Guidance for high voltage supplies and earthing cables is given in AS 2067.

5.3.5 Piping not to support an electrical conductor

Consumer piping shall not be used to support an electrical conductor.

5.3.6 Piping not to be exposed to liquid discharge

Consumer piping shall not be exposed to liquid discharge (e.g., from a *water heater* relief valve or *appliance condensate* drain).

5.3.7 Above-ground piping not to touch the ground

Consumer piping shall not be laid on the ground.

Consumer piping above the ground shall be at least 50 mm clear of the finished ground level.

5.3.8 Piping in a concealed location other than underground or embedded in concrete

Where *consumer piping* is to be in a concealed location, other than underground or embedded in concrete, the requirements detailed in Table 5.2 shall apply.

TABLE 5.2

PIPING IN CONCEALED LOCATION

Operating pressure	Accessibility (Note 1)	Ventilation required? (Note 2)	Pipe materials and jointing
Up to and including 7 kPa	*Accessible*	Yes	Pipes and jointing as per Table 4.1
	Inaccessible	Yes	Pipes as per Table 4.1 Joints to be kept to a minimum
	Accessible or Inaccessible	No	Pipe as per Table 4.1 Joints to be *permanent joints* and kept to a minimum
Exceeding 7 kPa	*Accessible*	Yes	Pipes as per Table 4.1 Joints to be *permanent joints* and kept to a minimum
	Inaccessible	Not to be installed	

NOTES:

1 In this Table *accessible* means access can be gained by, for example, a ceiling access opening or sub-floor door except that in a multi-*storey* building it means able to be viewed at each floor.

2 For ventilation requirements see Clause 5.3.12.

5.3.9 Piping passing through a building's exterior wall

Consumer piping passing through an exterior wall of a building shall—

(a) be protected against corrosion;

(b) be sealed at the wall to prevent entry of *gas* into the building in the case of leakage of *gas* outside the building;

(c) not be subjected to any load from the building; and

(d) where piping penetrates a *vapour barrier*, the integrity of the *vapour barrier* shall be maintained.

5.3.10 Piping passing through floors and internal walls

Where pipework directly passes through cavity floors or cavity walls from one building space to another, it shall be sleeved and sealed to prevent any leaking *gas* migrating between building spaces and to avoid imposition of loads on the piping system.

NOTE: Where the pipe is to be sleeved—

(a) sleeves should be as small as practicable and not bond to the pipe;

(b) *where practicable*, both ends of sleeves should be sealed to the pipe with a flexible compound; and

(c) both ends of sleeves that adjoin the structure should be sealed with a suitable building material.

5.3.11 Piping in the ground beneath a building

Consumer piping installed in the ground beneath a building shall be—

(a) copper pipe and joints in accordance with Table 4.1. Any joints kept to a minimum;

(b) *multilayer pipe* without joints; or

(c) plastic coated semi-rigid stainless steel without joints.

A2 NOTES:

1 In Australia, the term ‘building’ includes carparks classified under BCA (Building Code of Australia) Class 7a and non-habitable buildings or structures classified under BCA Class 10a.

In New Zealand, the term ‘building’ includes carparks as defined in the New Zealand Building Code (see Appendix L).

2 Appendix N lists the specific additional requirement for South Australia regarding the installation of piping in the ground underneath a building.

5.3.12 Ventilation of concealed piping

Where *consumer piping* is to be installed in a void, duct or sleeve and the conditions in Clause 5.3.8 indicate ventilation is required; all of the following shall apply:

(a) Ventilation openings shall be provided at each end of the area.

(b) The openings shall be in a safe location.

(c) Each opening shall have a free ventilation area that complies with Table 5.3.

TABLE 5.3

VENTILATION FOR CONCEALED PIPING

Cross-sectional area of void, duct or sleeve m^2	Minimum free ventilation area of each opening
Not exceeding 0.05	Full cross-sectional area
Exceeding 0.05 but not exceeding 7.5	0.05 m^2
Exceeding 7.5	0.006 × cross-sectional area of void, duct or sleeve in m^2

5.3.13 Piping embedded in concrete

Where *consumer piping* is to be embedded in a concrete wall or floor, the following, as appropriate, shall apply:

(a) The piping shall be—

(i) copper tube, plastics coated or covered with an appropriate proprietary wrapping.

(ii) *multilayer pipe* installed without joints; or

(iii) plastics coated semi-rigid stainless steel without joints.

(b) The *operating pressure* shall not exceed 7 kPa.

(c) The amount of cover shall be adequate for the particular application.

(d) Copper pipe joints and fittings shall be kept to a minimum and be brazed and then covered in a proprietary wrapping.

(e) Piping shall be placed so that cutting, bending or displacement of any reinforcement from its proper location is not necessary.

(f) Piping in a floor shall be placed between the top and bottom reinforcement.

(g) The size of piping shall not reduce the design strength of the concrete slab.

(h) Piping shall not extend through expansion joints in the concrete.

NOTE: The installed piping should be tested for leakage before being embedded in the concrete.

5.3.14 Piping in wooden joists

Holes and notches shall be avoided *wherever possible*. Where *consumer piping* is laid across floor joists and cannot simply be attached to the bottom edge of the joist it shall be located in notches or circular holes of the minimum practicable size, and the following shall apply:

(a) Unless specified in the *manufacturer's instructions* for the joist, holes shall be —

  (i) within the middle third of the depth of the joist;

  (ii) of a diameter not exceeding 20% of the joist depth or 32 mm, whichever is the lesser; and

  (iii) not more than three times the depth of the joist from a joist support.

(b) Notches shall be—

  (i) in the bottom edge of the joist;

  (ii) of a depth not exceeding 20% of the joist depth or 32 mm, whichever is the lesser; and

  (iii) located no further than 450 mm from a joist support.

Holes or notches shall not be made in cantilevered joists or joists in ceiling or roof spaces except with the approval of a design engineer.

NOTE: For New Zealand, see NZS 3604 if further detailed information is needed.

5.3.15 Piping in wooden plates and studs

Holes in the faces and notches in the edge of a plate or stud shall be not more in diameter or depth respectively than—

(a) for 75 mm wide plates: 19 mm; or

(b) for 100 mm wide plates: 25 mm.

NOTE: For New Zealand, see NZS 3604 if further detailed information is needed.

5.3.16 Piping in steel framed buildings

Where copper or multilayer piping passes through a steel frame, it shall be protected to prevent abrasion of the pipe and any pipe coating or contact between dissimilar metals.

5.3.17 Protection of multilayer piping

Multilayer piping installed above ground shall be protected against—

(a) degradation from exposure to ultraviolet light; and

(b) physical damage where this is likely to occur.

If the protection conceals the pipe, the requirements of Clause 5.1.12 shall be satisfied by the markings being applied to the protection.

NOTE: Typical means of protection includes sleeving or wrapping with a suitable protective material. Refer to supplier for advice and evidence of resistance to ultraviolet light.

5.4 INSTALLATION OF CONSUMER PIPING UNDERGROUND

5.4.1 General

Underground plastics *consumer piping* is generally permitted except under buildings.

NOTES:

1 Undercroft carparks and verandahs are considered as buildings.

2 A trace wire should be installed with any underground plastics piping to aid in its detection.

5.4.2 Bedding and support of pipe in the ground

Consumer piping in the ground shall be bedded on a firm compacted surface along its entire length.

NOTE: To satisfy this requirement, it may be necessary to trim the trench to 'let in' the fittings, collars or flanges to ensure the piping is evenly supported.

5.4.3 Depth of cover

Consumer piping in the ground shall have sufficient depth or be covered in such a way to protect the pipe from physical damage.

The depth of cover shall comply with Table 5.4, except where suitable means of protection are used. In no case shall depth of cover be less than 300 mm.

Pipework in the ground shall be located where it is not liable to mechanical damage or shall be physically protected. Suitable means of cover or provision of extra protection include encasement, bridging or design to withstand higher loads.

TABLE 5.4

DEPTH OF COVER FOR CONSUMER PIPING

Location	Minimum depth of cover, mm
Roadways (including trafficable areas on private property)	450
Private property (non-trafficable areas)	300
Rock	300

5.4.4 Quality of bedding and backfill

Bedding material and backfill shall—

(a) be of a type and grade which will not have an adverse effect on the pipe or pipe coating; and

(b) within 75 mm of the pipe, be free of stones or other materials which could damage the pipe or pipe coating.

NOTE: In some ground conditions it may be necessary to use sand for bedding and backfilling to comply with the requirements of this Clause.

5.4.5 Consolidation of bedding and backfill material

Bedding and backfill material shall be consolidated in a manner so as—

(a) not to damage the *consumer piping*; and

(b) to minimize subsequent trench subsidence.

5.4.6 Marker tape

Marker tape complying with the requirements of AS/NZS 2648.1 shall be laid above plastic
A2 and multilayer *consumer piping* when installed in an open-cut trench.

NOTE: The marker tape should be between 150 mm and 300 mm below finished ground level. Detectable marker tape may be preferred on large installations e.g., schools, factory complexes, etc., or non-detectable marker tape and a continuous insulated single core tracer wire along the pipe, terminating above ground at each *riser*.

5.4.7 Termination of plastic pipe and metallic continuation

In Australia, plastics *consumer piping* shall terminate horizontally at least 300 mm below ground level and be connected to a metallic *riser* which complies with the requirements of Table 4.1 for underground pipe.

In New Zealand, plastic *consumer piping* shall either—

(a) terminate at least 300 mm below ground level and be fitted with a metallic *riser* which complies with the requirements of Table 4.1 for underground pipe; or

(b) have the *riser* and all sections above-ground sheathed and protected to prevent ultraviolet degradation and physical damage.

NOTE: In both countries, galvanized steel should not be used with plastic *pipe fittings* as stress cracking and degradation of the *pipe fitting* can occur.

5.4.8 Securing a riser

The *riser* from buried plastics *consumer piping* shall be secured such that stress in the underground pipe is minimized.

NOTE: Attaching a short length of the plastic pipe material to the *riser* will assist others in identifying the buried material at a later date.

5.4.9 Separation from underground electrical cable

The separation between any underground *consumer piping* and any electrical supply cable shall be at least—

(a) 100 mm in any direction, where the electrical supply cable is indicated along its length with marker tape and is provided with mechanical protection; or

(b) 300 mm in any direction, where the electrical supply cable is neither indicated nor protected in accordance with (a).

NOTES:

1 Mechanical protection is provided by any of the following: concrete slabs, continuous concrete pour, bricks designed for protecting electrical supply cables.

2 Guidance for high voltage supplies is given in AS 2067.

5.4.10 Separation from underground electrical earthing electrode

The separation between any underground *consumer piping* and an electrical earthing electrode, for an electrical supply not exceeding 1000 V, shall be at least 500 mm.

NOTE: Guidance for high voltage supplies is given in AS 2067.

5.4.11 Separation from underground communication cable

The separation between any underground *consumer piping* and a communication cable shall be at least 100 mm.

5.4.12 Separation from underground services

The separation between any underground *consumer piping* and any service, including other *consumer piping*, other than an electrical or communication service shall be at least—

(a) 100 mm, for *consumer piping* not exceeding 65 mm *nominal size*; or

(b) 300 mm, for *consumer piping* exceeding 65 mm *nominal size*.

5.4.13 Crossing other underground services

Any underground *consumer piping* crossing any other service shall—

(a) cross at an angle of not less than 45°; and

(b) have a vertical separation of not less than 100 mm.

5.5 CORROSION CONTROL

5.5.1 Corrosion protection of bare steel

Uncoated or bare steel *consumer piping* shall be protected against corrosion as soon as possible after installation and before commissioning. Where a pipe or *pipe fitting* is to be installed in a corrosive environment including buried underground, the pipe or *pipe fitting* shall be protected with a suitable wrapping or coating.

5.5.2 Corrosion protection of above-ground pipework

Where corrosion protection is required for above-ground pipework, protection shall be provided by an appropriate painting system or by a proprietary coating system.

5.5.3 Joining of electrochemically incompatible materials

Where there is potential for corrosion to occur and electrochemically incompatible materials shall be joined, a suitable *insulating joint* shall be used for the connection.

5.5.4 Requirement where coated steel pipe emerges from the ground

Where steel pipe coated with high-density polyethylene or coated with an acceptable proprietary wrapping enters or emerges from the ground, the coating or wrapping shall be extended at least 300 mm out of the ground. If the coating or wrapping is not suitable for exposure to ultraviolet light (UV) it shall be further coated with a suitable material.

5.5.5 Requirement where consumer piping is to include cathodic protection

Where *consumer piping* is to include cathodic protection, a suitable *insulating joint* shall be fitted—

(a) where the *consumer piping* enters or emerges from the ground; and

(b) with a clearance of at least 300 mm from the finished ground level.

The effectiveness of the cathodic protection system shall be proved by a suitable method as soon as possible after it is applied.

NOTES:

1 It is recommended that the effectiveness of the cathodic protection system be monitored at least bi-annually or more often as indicated by the site conditions.

2 Prior to the installation of any cathodic protection system, the local or state electrolysis authority should be contacted. New cathodic protection systems should not interfere with existing systems or buried structures and system licenses may need to be obtained.

5.5.6 Proving effectiveness of pipe protection

Where *consumer piping* is to be in the ground and protection is required by Clause 5.5.5 or Table 4.1, the effectiveness of such protection shall be proved by recognized methods.

5.6 WATER AND DUST CLEARING PROVISION IN CONSUMER PIPING

5.6.1 Provision of tailpipe

Where *condensate* is likely to occur inside a pipe, a *tailpipe* shall be installed. The *consumer piping* shall be graded to fall to the *tailpipe* at not less than 4 mm per metre run.

NOTE: It is preferable for the *consumer piping* to drain to a *tailpipe* near the meter outlet.

5.6.2 Design and location of a tailpipe

Tailpipes shall be designed to—

(a) terminate with a plug or cap which is easily removed;

(b) be *accessible* for cleaning and emptying;

(c) form a trap in which an accumulation of *condensate* will completely fill the *tailpipe*, and then shut off the flow of *gas* before *condensate* can run back into the meter;

(d) be in a location where the *condensate* is unlikely to freeze;

(e) be of adequate capacity for the pipe draining to it; and

(f) be of diameter equal to or larger than the pipe to which it is attached.

NOTE: Where the diameter of the *tailpipe* is greater than 25 mm, the cap or plug fitted to the end of the *tailpipe* may be reduced to 25 mm.

5.6.3 Marking of tailpipes

Where there are a number of *tailpipes* installed in different systems in the same *premises* (a block of flats or units) each *tailpipe* shall be clearly and durably marked to indicate the *consumer piping* to which it is connected.

5.6.4 Tailpipes that terminate below ground level

A *tailpipe* that terminates below ground level shall terminate in a well-constructed and drained pit made of a robust material. The pit shall be of sufficient size to enable the plug or cap to be easily removed. A lid marked 'GAS' shall be fitted over the pit.

5.6.5 Provision for dust clearing

A *riser* in excess of 8 m in *consumer piping* supplied from an underground pipe or reticulation system shall have *accessible* provision for dust clearing.

NOTE: The provision may be either a plugged tee or cross fitting located at the bottom of the *riser*. Similar clearing provision may be necessary at each change of direction in any horizontal run where considerable dust is present in the *consumer piping*.

5.7 CONSUMER PIPING FOR A HIGH-RISE BUILDING

5.7.1 General

The design of *consumer piping* for *high-rise buildings* is a specialized area and shall be only carried out by appropriately qualified and experienced persons.

NOTES:

1 Guidance is contained in Appendix K.

2 The *Technical Regulator* may require to be specifically advised prior to the commencement of the installation of *consumer piping* in a *high-rise building*.

3 The *Technical Regulator* may require the design be verified by an independent competent third party and design records be kept for a minimum of 10 years.

4 This requirement also applies to *consumer piping* passing through unventilated spaces in buildings.

5 Reference should be made to the applicable building regulations, which give requirements for the construction of fire-rated pipe ducts, and the construction of *plant rooms* and *enclosure*s for *appliances* in *high-rise buildings*.

6 Special consideration should be given to *pressure* reducing systems (at higher floors) and seismic valves where appropriate.

5.7.2 Prohibition on flexible hoses

Flexible hoses with rubber lining shall not be used in unventilated areas.

5.7.3 Plan of consumer piping to be displayed on site

A plan of the *consumer piping* shall be prominently displayed in the fire control room or in another appropriate location. The plan shall be current and comply with the following:

(a) Detail the location of all emergency *manual shut-off valves*.

(b) Be vermin proof and weatherproof.

5.7.4 Manual shut-off valve in riser and lateral

A clearly identified *manual shut-off valve* shall be installed in an *accessible* position—

(a) at the *gas* entry point to each *riser* where there is more than one *riser*;

(b) in each lateral branch pipe as close as practicable to the main *riser*; and

(c) for each tenancy, unless the valve in Item (b) above serves that purpose.

5.7.5 Support and flexibility of riser

A *riser* shall comply with the following:

(a) Have a pipe supporting system that is designed to make allowance for expansion and contraction.

(b) Where the *riser* is inside a building, it shall be sleeved where it passes through each floor and ceiling slab, with any joint within the sleeve being welded or brazed.

NOTE: See also Clauses 5.2.6, 5.3.10 and 5.8.

5.7.6 Minimizing strain at a lateral

Strain at the junction of a lateral and a *riser*, due to the relative movement between a *riser* and the building, shall be minimized.

5.8 SUPPORT OF CONSUMER PIPING

NOTE: For pipe with a nominal bore exceeding 200 mm consult AS 4041.

5.8.1 Consumer piping support system requirements

The *consumer piping* support system shall—

(a) be capable of supporting the piping system;

(b) firmly restrain the piping in the intended position and control movement of the piping system, taking into account any seismic requirements where appropriate; and

(c) have any component of the supporting system, which is to be in contact with the pipe, made of material that is compatible with the *consumer piping* material or electrically isolated from such piping system or equipment.

NOTES:

1 To satisfy these requirements consideration needs to be given to—

(a) the construction and dimensions of the supporting device and its components;

(b) the method and strength of attachment to the supporting structure as well as the stability of the supporting structure;

(c) the possibility of damage to exposed *consumer piping* spanning joists or bearers; and

(d) movement due to thermal expansion and contraction.

2 For seismic design in New Zealand, refer to NZS 4219.

5.8.2 Spacing of supporting devices

The spacing of supporting devices shall not exceed those given in Table 5.5, or shall be in accordance with the piping *manufacturer's relevant recommendations*.

TABLE 5.5

SPACING OF SUPPORTING DEVICES

Nominal size of pipe DN	Vertical or horizontal run spacing, m			
	Steel pipe	Copper or stainless steel pipe	Semi-rigid stainless steel pipe	Multilayer pipe
8	2	1	—	—
10	2	1.5	—	—
12	—	—	0.5	0.75
15	2	1.5	0.5	1
18	—	1.5	—	—
20	2.5	1.5	0.5	1.25
25	2.5	2	0.5	1.5
32	3	2.5	0.5	2
40	3	2.5	—	2
50–65	3	3	—	2
80–200	4	4	—	—

5.8.3 Diameter of rod hangers

The diameter of rod hangers shall comply with Table 5.6.

TABLE 5.6

DIAMETER OF ROD HANGERS

Nominal size DN, mm	Minimum rod diameter for single rod hangers, mm
Up to 50	10
65 to 90	12
100 to 125	16
150 to 200	20

NOTE: Where two rod hangers are to be used at a support point, the minimum diameter indicated by the Table may be reduced by one standard size for all rods greater than 10 mm.

5.9 USE OF HOSE ASSEMBLIES

NOTE: Refer to specific *appliance* sections for additional requirements. For example, the use of hose assemblies on cooking *appliances*.

5.9.1 Hose assembly requirements

A2 *Hose assemblies* shall not be joined together and shall be—

(a) of a continuous length, as short as practicable, and subject to the specific *appliance* requirements, not exceed 3 m;

(b) of adequate diameter for the maximum *gas consumption* of the *appliance*; and

(c) in Australia, *certified* to AS/NZS 1869.

5.9.2 Prohibited location of hose assembly connection point

A connection point for a *hose assembly* shall not be located in a—

(a) *bedroom*;

(b) *bathroom*;

(c) sauna;

(d) toilet;

(e) hallway; or

(f) *residential garage*.

5.9.3 Location of connection point for hose assembly

A connection point for a *hose assembly* shall be located—

(a) to avoid traffic across the hose; and

(b) at least 1 m away from a doorway in a building.

NOTE: Where flueless space heaters are permitted by the relevant jurisdiction, there may be a requirement that fixed ventilation openings be provided. Consideration should be given to providing such openings when installing the connection point. See Appendix N for details.

5.9.4 Hose assembly—Prohibited installation methods

A *hose assembly* shall not pass—

(a) from one room to another through a doorway with a closable door;

(b) through a wall, portable partition, ceiling or floor;

(c) through a fixed partition, unless the opening in the partition is large enough to accommodate the hose and its attachments without causing damage; or

(d) through the panel or casing of the *appliance* unless the *appliance* is specifically manufactured to avoid damage to the *hose assembly*.

5.9.5 Hose assembly—Operating conditions

Under normal operating conditions, a *hose assembly* shall not be installed where it will be—

(a) exposed to a temperature exceeding the maximum temperature specified in the hose *manufacturer's instructions*;

(b) subject to strain, abrasion, kinking or permanent deformation; or

(c) subject to damage by vermin.

5.9.6 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 *consumer piping* by a threaded or other metal connection or connected as specified in Clause 5.9.7.

5.9.7 Hose assembly connecting a portable or mobile appliance

Where a *hose assembly* is to be used to connect a *portable* or *mobile appliance*, the *hose assembly* shall—

(a) be connected permanently to the *appliance* and have a *manual shut-off valve* and union fitted at the inlet end of the *hose assembly*; or

(b) be connected permanently to the *appliance* and have a *quick-connect device*, located at the inlet end of the *hose assembly* which automatically shuts off the *gas* supply when disconnected; or

(c) where a *quick-connect device*, which automatically shuts off the *gas* supply when disconnected, is located at the *appliance* end of the *hose assembly*, have a *manual shut-off valve* at the inlet end of the *hose assembly*.

NOTES:

1 The method in Item (b) is used where an *appliance* is to be disconnected from the *gas* supply by the user, i.e., a portable heater, a barbecue or where the *appliance* is to be regularly disconnected for cleaning purposes.

2 The method in Item (c) may be used where larger *appliances* are to be disconnected from the *gas* supply by the user, i.e., for cleaning purposes around commercial catering *appliances*.

3 An *appliance* restraint may be required, refer to Clause 6.2.14.

5.10 QUICK-CONNECT DEVICES

NOTE: See Appendix N for special requirements set out by the *Technical Regulators* in Western Australia and Victoria.

5.10.1 Quick-connect device installed outside above ground

A *quick-connect device* socket installed outside shall be at least 300 mm above the ground or floor and shall have a means of securing a safety chain or wire within 50 mm of the *quick-connect device* socket to prevent strain on the hose.

5.10.2 Quick-connect device socket installation method where subjected to water or dust

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

NOTE: When installed outside, directing the outlet downward would satisfy this requirement.

5.10.3 Quick-connect devices installed outdoors below ground

A *quick-connect device* socket installed *outdoors* below ground level shall—

(a) be suitable for the conditions of use; and

(b) be installed in a purpose-built *enclosure* that has the following provisions:

  (i) Be constructed of non-*combustible material.*

  (ii) Has an appropriately constructed lid.

  (iii) Has adequate means of drainage.

  (iv) Has a means of securing a safety chain or wire within 50 mm of the *quick-connect device* socket to prevent strain on the hose.

5.11 INSTALLING GAS EQUIPMENT

5.11.1 Consumer piping gas pressure regulators

5.11.1.1 *Requirements for a consumer piping gas pressure regulator*

Regulators shall—

(a) be constructed of material, and use lubricants, suitable for the particular application;

(b) be protected by the installation of *over-pressure protection* where the regulator is incapable of withstanding the *maximum over-pressure* of the next upstream regulator under fault conditions;

(c) have a capacity suitable for the design *gas load* and allowable *pressure* drop for the particular application; and

(d) meet the requirements of Clause 5.2.1.

5.11.1.2 *Consumer piping gas pressure regulator installation requirements*

*Consumer piping gas pressure regulator*s shall be—

(a) above-ground unless the *Technical Regulator* permits otherwise;

(b) in a well-ventilated place;

(c) protected from the entry and accumulation of water (e.g., sprinkler water, rainwater etc.) and other foreign matter;

(d) *accessible* for maintenance and adjustment;

(e) not subjected to excessive temperature;

(f) positioned to minimize the possibility of ignition of any discharge from a *breather vent*;

NOTE: For the discharge of a *breather vent* within an *enclosure* or room, see Clause 5.11.5.7.

(g) positioned to minimize exposure to physical damage; and

(h) mounted in a horizontal position if weight loaded.

NOTES:

1 Particular attention should be given to the risk of impact from falling ice and snow, where appropriate.

2 In non-residential installations, it is advisable to install a manual *isolation valve* upstream of a *consumer piping* regulator to allow servicing of the regulator without causing undue supply disruption to other parts of the installation.

5.11.1.3 *Prohibited locations for a consumer piping regulator*

Consumer piping gas pressure *regulators* shall not be installed in—

(a) a lift shaft or lift motor room;

(b) a room specifically intended for electrical switchgear;

(c) a fire-separated stairway or passageway;

(d) a fire hydrant cabinet or hose reel cabinet;

(e) sprinkler or hydrant pump room;

(f) in a cavity wall; or

(g) a position that would obstruct egress from a building.

5.11.1.4 *Where a consumer piping gas pressure regulator is required*

A *consumer piping gas pressure regulator* shall be fitted—

(a) where any *gas appliance* in the *premises* is not fitted with a *gas appliance regulator*, unless the *gas* supply or *consumer piping pressure* will not exceed 1.5 kPa for *natural gas*, or 3.5 kPa for *LP Gas*;

(b) where the intended *operating pressure* of the *consumer piping* exceeds the *rated working pressure* of the *gas appliance regulator*(s); or

(c) where the *gas pressure* to a section of *consumer piping* would otherwise exceed the *rated working pressure* of the piping, *pipe fittings* or components in that section.

5.11.1.5 *Where a gas appliance regulator is not required*

Where a *gas appliance regulator* is not required, upstream protection shall be provided and set to the *maximum over-pressure* of the *gas appliance*.

5.11.1.6 *Consumer piping regulator outlet operating pressure notice*

Where the outlet *operating pressure* setting of a *consumer piping gas pressure regulator* for *natural gas*, exceeds 1.5 kPa or for *LP Gas* exceeds 3.5 kPa, there shall be a permanent and durable notice in a prominent position near the regulator showing the outlet *pressure* setting.

NOTE: Suitable wording for this notice would be—

'THIS REGULATOR OUTLET PRESSURE SETTING IS ____ kPa.'

5.11.2 Over-pressure protection

5.11.2.1 *Over-pressure protection and its performance*

Over-pressure protection shall be provided where the *operating pressure* at the inlet to a *gas pressure regulator* exceeds—

(a) the *maximum over-pressure* of piping and components supplied by the regulator up to and including the next downstream regulator; and

(b) one of the following:

  (i) 7 kPa for *NG* and *SNG*.

  (ii) 14 kPa for *LP Gas*.

The *over-pressure protection* device shall ensure that piping and components supplied by the regulator up to and including the next downstream regulator will not be subjected to a *pressure* greater than the *maximum over-pressure* for that piping and those components.

NOTE: Where the inlet *pressure* to an *appliance gas pressure regulator* will exceed 7 kPa a *consumer piping* regulator may be required.

5.11.2.2 *Requirements where over-pressure protection system shuts off the gas supply*

Where an *over-pressure protection* system is of a type that shuts off the *gas* supply—

(a) the *over-pressure protection* system shall be of a manual reset type to restore supply; and

(b) a *gas* filter that will prevent the passage of foreign particles larger than 1 mm shall be located upstream of and no more than 5 m from the device that shuts off the *gas* supply.

5.11.3 Protection of gas supply system from low pressure where a gas pressure-raising device or a gas engine is installed

Where a *gas pressure*-raising device or a *gas* engine is to be installed, a suitable low-*pressure* device shall be installed in the *consumer piping* as near as practicable to the inlet of the *pressure*-raising device or engine. The device shall cut off the power to the *gas pressure*-raising device or engine when the inlet *pressure* falls below 20% of the *operating pressure* at the sensing point or 0.8 kPa, whichever is the higher.

NOTES:

1 This is the minimum allowable figure. The actual setting should be discussed with the *network operator* or *Technical Regulator*. The setting should be as high as possible to provide maximum protection of upstream equipment without causing nuisance shut-downs.

2 Such devices include, but are not limited to, a mechanical diaphragm-operated or electrically-operated diaphragm low-*pressure* shut-off valve.

3 See also Clause 5.12.3 for additional requirements for pressure raising devices.

5.11.4 Pressure test points

*Pressure test point*s shall be *accessible* and provided at, or adjacent to, the—

(a) outlet of *gas pressure regulators* installed in the *gas pipework*;

(b) inlet and outlet of *pressure* raising devices installed in the *gas pipework*;

(c) outlet of the venting device of a *double block and vent safety shut-off system*;

(d) inlet of a *gas appliance*, if no appropriate test point is incorporated in the *gas appliance*; and

(e) where a permanent *pressure* gauge is fitted, a provision to fit an alternate test point shall be provided.

Where *pressures* exceed 7 kPa, *pressure test points* shall be of the self-sealing type.

NOTE: For *pressures* exceeding 7 kPa, the testing equipment should include a mechanical connection to the test point.

5.11.5 Venting

NOTE: In this Clause, the term 'vent terminal' means a vent opening on a regulator or similar device having a diaphragm, or the terminal of a *vent line*.

5.11.5.1 *Performance of vent line*

A *vent line*, under all operating conditions, shall not adversely affect the operation of the device to which it is connected.

5.11.5.2 *Vent line terminating outside a building*

When any of the following are installed inside a building, they shall be fitted with a *vent line* that terminates outside a building:

(a) A *safety shut-off system* which requires venting to atmosphere.

(b) A *gas pressure* relief device.

NOTE: This does not apply to a relief device fitted to an *LP Gas cylinder*.

(c) A *consumer piping gas pressure regulator* incorporating a *gas pressure* relief device.

(d) A *breather vent* except where Clause 5.11.5.7 or 5.11.5.8 applies.

5.11.5.3 *Limitation on interconnection of vent lines*

Vent lines shall not be interconnected except where they are *breather vent lines* from the same *gas appliance*; or *vent lines* from vented *safety shut-off system*s fitted to the same *gas appliance*.

5.11.5.4 *Size of a common vent line*

Subject to Clause 5.11.5.1, a common *vent line* shall have a cross-sectional area not less than the sum of the cross-sectional areas of the two largest *vent lines* being interconnected.

5.11.5.5 *Size of vent line for a consumer piping gas pressure regulator breather vent or relief device*

Subject to Clause 5.11.5.1, the minimum size of any *vent line* for a *consumer piping gas pressure regulator breather vent* or a relief device shall be as follows:

(a) For a *vent line* not exceeding 10 m in length, the size shall be the vent connection size.

(b) For a *vent line* exceeding 10 m but not exceeding 30 m in length, the size shall be one standard pipe size larger than the vent connection size.

NOTES:

1 Restrictions due to changes in direction should be considered in determining *vent line* size.

2 A *vent line* exceeding 30 m in length needs to be designed taking into account the effects of regulator or relief device inlet *pressure*, *vent line* flow resistance and the duty of the regulator or relief device.

5.11.5.6 *Size of vent line for a vented safety shut-off system*

The size of a *vent line* for a vented *safety shut-off system* shall comply with Table 5.7.

NOTE: Restrictions due to changes in direction should be considered in determining *vent line* size.

TABLE 5.7

VENT PIPE SIZE FOR VENTED SAFETY SHUT-OFF SYSTEMS

Vent valve minimum nominal size DN	Maximum length, m									
	Vent line nominal size DN									
	15	20	25	32	40	50	65	80	100	150
6	60	160	400							
8	30	80	200							
10	15	40	100							
15	8	20	50							
20		10	25	64						
25			13	32	80					
32				16	40	100				
40					20	50	130			
50			NOT APPLICABLE			25	65	160		
65							32	80	200	
80								40	100	300

5.11.5.7 *Discharge from breather vents*

5.11.5.7.1 *Non-domestic applications*

One of the following criteria shall be used to determine if a *breather vent* may be vented within a room:

(a) *Breather vents* may be vented within a room or *enclosure* if the effective volume of the room or *enclosure* exceeds the value V given by the following equation:

$$V = K d^2 \sqrt{P}$$

where

V = effective volume of room or *enclosure* that houses the regulator, in cubic metres (not to exceed 1 000 m^3)

= floor area × (ceiling height – height of device above floor), for second family *gases*

= Floor area × height of device above floor, for third family *gases*

K = 8.83, for the 2nd family *gases*

= 14.0, for the 3rd family *gases*

d = *breather vent* hole diameter, in millimetres

P = inlet *pressure* to the vented device, in kilopascal-gauge (not to exceed 200 kPa)

Where the effective room or *enclosure* size is known the maximum diameter of the *breather vent* may be found from the following equation:

$$d = \sqrt{V/(K\sqrt{P})}$$

(b) A *breather vent* may discharge into a room or *enclosure* when the diameter of the *breather vent* orifice does not exceed the maximum value determined by Appendix G.

NOTES:

1 The equations in Criterion (a) are based on an air flow rate of one air change per hour and complete mixing of any vented *gas* within the effective volume.

The dispersion of vented *gas* is dependent on many factors and will never be completely uniform; for instance, concentrations in the vicinity of the point of release can be expected to be higher than in the surrounding space.

2 The equations in Criterion (a) are based on the assumption of a *breather vent* discharge coefficient of 0.60. While this is typical of a *breather vent* with sharp edges in some cases the discharge coefficient may be higher and this will result in higher *gas* flows requiring larger room or *enclosure* volumes for safe operation.

3 Based on the above assumptions, the calculations limit the *gas* concentration to 20% of the lower flammability limit (LFL).

4 If the effective volume (and *pressure*) is known and the vent diameter is required, the equation (explicit in diameter) at the end of Criterion (a) may be used.

5 The limitation on the *breather vent* orifice diameter is related to a possible worst-case safety condition of a ruptured diaphragm (or similar membrane) separating the *gas* within the device from free air outside the device. The aim of this provision is to ensure that the accumulation of *gas* in a room or *enclosure*, as a result of diaphragm rupture, will remain below the *lower* flammability limit (LFL) of the air/*gas* mixture.

6 Some devices, such as regulators, employ an orifice below the diaphragm, to control *gas* flow, and a vent opening above the diaphragm, to permit the regulator to operate correctly. In the event of a diaphragm rupture in these cases, '*breather vent* orifice' means the smaller orifice through which *gas* escapes into a room or *enclosure*. Care should therefore be taken to establish whether the internal orifice or the vent of the device is the smaller.

5.11.5.7.2 *Domestic applications*

In addition to Clause 5.11.5.7.1, in Class 1 and 2 buildings (Australia) or housing (New Zealand), the *breather vent* diameter in domestic installations shall not exceed 0.7 mm.

5.11.5.8 *Restriction of breather vent*

To avoid fitting a *vent line* to a device having a *breather vent*, the device may have a vent restricting orifice fitted to it, provided—

(a) the orifice does not exceed the maximum value determined by Clause 5.11.5.7;

(b) such a restriction is specified in accordance with the *manufacture's instructions* for the device; and

(c) the orifice does not, under all operating conditions, adversely affect the operation of the device.

5.11.5.9 *Vent terminal location*

NOTE: The requirements of this Clause do not apply to a *breather vent* terminal. See Clause 5.11.1.2(f).

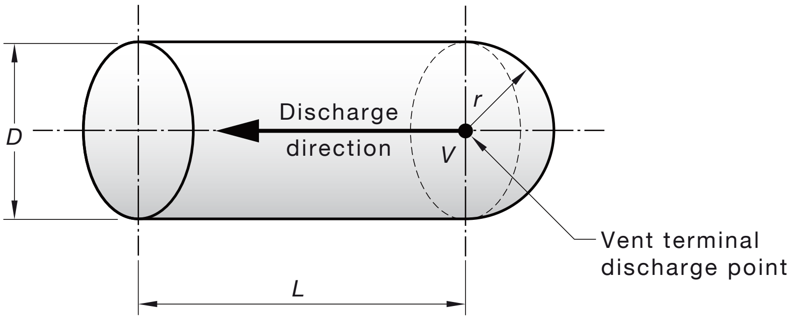
A vent terminal shall be located where *gas* discharge will dissipate without entering buildings or creating any hazard. The point of discharge shall—

A1 (a) be at least 3 m from a mechanical air inlet into a building unless calculations based on Figure 5.3(a) give a greater distance; and

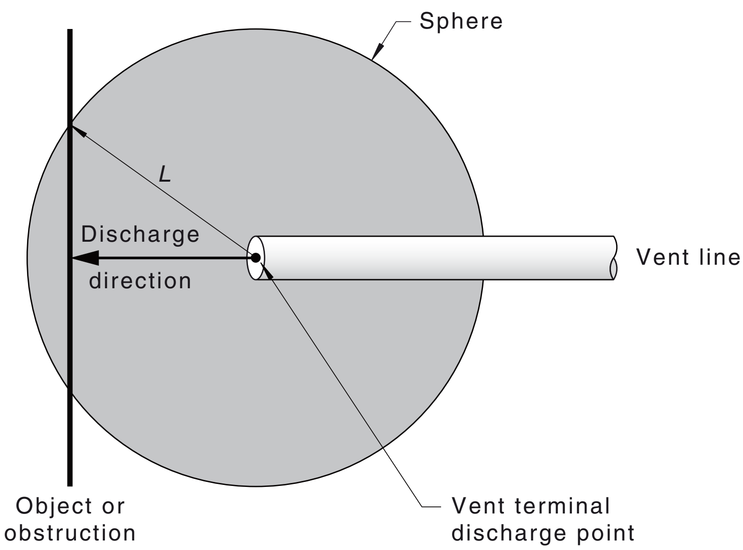
A1 (b) be located so there is no *ignition source* or opening into a building within the exclusion zone shown in Figure 5.3(a); and

A1 (c) in cases where there is any object (e.g. wall, ground, etc.) in the direction of discharge and within the exclusion zone of Figure 5.3(a), be located such that there is a clearance of at least distance *L* of Figure 5.3(b) to any ignition source or opening in all directions.

A1



(a) Vent terminal exclusion zone with no object in the discharge direction



(b) Vent terminal exclusion zone with an object in the discharge direction

Vent terminal diameter (not shown)	Exclusion zone, m		
	L	***D***	***r***
Not exceeding 50 mm	1.5	1	0.5
Exceeding 50 mm	1.5*T*	*T*	0.5*T*

NOTES:

1 $T = \dfrac{\text{Vent terminal diameter (mm)}}{50}$, in metres.

2 The exclusion zone shown in Figure 5.3(a) depicts a space consisting of a cylinder in the discharge direction and a hemisphere in the opposite direction of discharge from the vent terminal discharge point.

3 The exclusion zone only applies up to 200 kPa.

FIGURE 5.3 VENT TERMINAL EXCLUSION ZONE

5.11.5.10 *Vent terminal construction*

Vent terminal construction shall prevent the entry and accumulation of water (e.g., sprinkler water, rainwater etc.), birds, insects or other materials that could cause blockage.

5.11.5.11 *Vent line to be readily removable*

The *vent line* shall include a means of disconnection such as a union or flange near the device to be vented, unless the *vent line* can otherwise be readily removed.

5.11.6 Sub-meters

NOTE: This Clause gives requirements for the installation of *sub-meter*s only. The requirements for *consumer billing meter*s (*master meter*) are determined by the *network operator* but guidance is provided in Appendix M.

5.11.6.1 *Requirements for sub-meters*

*Sub-meter*s shall—

(a) be constructed of materials, and use lubricants, suitable for all *gases*; and

(b) have a capacity suitable for the design *gas load* and allowable *pressure* drop for the particular application.

5.11.6.2 *Prohibited locations of a sub-meter*

*Sub-meter*s shall not be located—

(a) in a lift shaft or lift motor room;

(b) in a room specifically intended for electrical switchgear (unless all equipment is *intrinsically safe*);

(c) in a *fire-isolated stairway* or *passageway*;

(d) in a fire hydrant or hose reel cabinet;

(e) in a sprinkler or hydrant pump room;

(f) in a position that would obstruct egress from a building;

(g) in a *bedroom*;

(h) in an area where extreme temperatures or sudden extreme changes in temperature may occur;

(i) on a floor which is frequently wetted;

(j) on a floor which contains materials which may corrode the meter;

(k) on the ground;

(l) in the foundation area under a building; or

(m) in a cavity wall, except where Clause 5.11.6.4 applies.

5.11.6.3 *Sub-meter location and identification*

*Sub-meter*s shall be installed in *accessible* locations where they are protected from damage and which permit ease of replacement, maintenance and reading, and shall be clearly identified with the *gas installation* they supply.

NOTE: Possible causes of damage include impact, corrosion, thermal extremes, excessive vibration, steam and dampness.

5.11.6.4 *Sub-meter in a recess or meter box in a cavity wall*

A recess or meter box in a cavity wall for housing a *sub-meter* shall comply with the following:

(a) Be constructed of non-*combustible material*.

(b) Be completely sealed from any adjoining recess or cavity.

(c) Be of adequate size to permit ease of replacement and maintenance of the *sub-meter*.

(d) Be ventilated directly to outside atmosphere and the required ventilation shall comply with the Clause 5.13.2.

5.11.6.5 *Ventilation requirements where in an enclosure*

Where a *sub-meter* is installed in an *enclosure*, the *enclosure* shall be ventilated in accordance with the requirements of Clause 5.13.2 or Clause 5.13.4 as appropriate.

5.11.6.6 *Provision of manual shut-off valve*

A *manual shut-off valve* shall be provided in the *consumer piping* upstream of the *sub-meter*. The valve shall be *accessible* for operation and be as close as practicable to the *sub-meter*.

5.11.6.7 *Connection of the sub-meter*

*Sub-meter*s shall be attached to the *consumer piping* by suitable connections and shall be supported independently of, and connected to, the *consumer piping* in such a way that strain on the *sub-meter* or connecting piping is minimized.

5.12 GAS PRESSURE-RAISING DEVICES

NOTE: The *network operator* may require to be specifically advised prior to the installation of a *gas pressure*-raising device.

5.12.1 Protection against pulsation

A suitable pulsation damper or surge *tank* shall be installed where the *gas pressure* raising device might cause *pressure* pulsation that could harm or adversely affect any part of the *gas installation* or *gas* distribution network.

5.12.2 Connection requirements

A *gas pressure*-raising device shall be attached to the piping by flexible connections to prevent vibrations impacting on *consumer piping*.

5.12.3 Required controls

A *gas pressure*-raising device shall have the following controls on the inlet side in the sequence given:

(a) A *manual shut-off valve*.

(b) A manual reset type low *pressure* switch in accordance with Clause 5.11.3.

(c) A *non-return valve*.

5.12.4 Requirements of downstream pipe and equipment

Piping and equipment downstream of a *gas pressure*-raising device shall have—

(a) a *rated working pressure* of not less than the maximum *operating pressure* of the *gas pressure*-raising device;

(b) a test *pressure* not less than the highest *pressure* likely to occur due to equipment failure; or

(c) *over-pressure protection* fitted.

5.13 VENTILATION OF GAS EQUIPMENT

5.13.1 General

Gas equipment in this Clause means a meter, regulator or *gas pressure*-raising device.

Where natural ventilation is used, all or part of the required ventilation may be supplied by air 'leaked' into an *enclosure* through gaps in the structure. To determine the amount of adventitious ventilation available, allow 700 mm^2 per m^3 of volume of the space being ventilated.

Where a meter, regulator or *gas pressure*-raising device is to be installed in an *enclosure*, the *enclosure* shall be ventilated by one of the methods detailed in Clause 5.13.2, 5.13.3 or 5.13.4.

5.13.2 Natural ventilation to outside

5.13.2.1 *General*

Two permanent openings shall be provided directly to outside, each with a minimum free ventilation area provided as calculated using the appropriate formula in Clause 5.13.2.2 or Clause 5.13.2.3 and deducting the allowance in Clause 5.13.1 for adventitious ventilation.

5.13.2.2 *Enclosures containing meters or regulators*

The minimum free ventilation area, $A = R \times F$, where—

A = the minimum free ventilation area (square millimetres)

R = equipment rated capacity (cubic metres per hour)

F = 1000 for *pressures* not exceeding 7 kPa; or

= 2000 for *pressures* exceeding 7 kPa but not exceeding 200 kPa; or

= 3000 for *pressures* exceeding 200 kPa but not exceeding 1050 kPa.

NOTE: Where a meter and a regulator are to be installed in an *enclosure* as part of one system, the equipment rated capacity is taken as the badge capacity of the meter in m^3/h at 125 Pa *pressure* differential. That is, not the sum of the regulator and meter rated capacities. The *pressure* used to determine F is the highest *operating pressure* in the *enclosure*.

5.13.2.3 *Enclosures containing pressure-raising devices*

The minimum free ventilation area, $A = R \times 3000$

where

A = the minimum free ventilation area (square millimetres)

R = equipment rated capacity (cubic metres per hour)

5.13.3 Natural ventilation via adjacent room

Where the ventilation is to an adjacent room, the adjacent room shall be non-habitable and the *free area* of each opening shall be twice the requirements of Clause 5.13.2. These requirements shall apply to all subsequent rooms until a room is ventilated to outside. That room shall be ventilated in accordance with Clause 5.13.2.

5.13.4 Mechanical ventilation

Where the ventilation for the *enclosure* is to be provided by mechanical means, this shall be directly to outside and the system shall comply with Table 5.8. Fan motors shall be remote from the exhaust duct (indirect drive) or be rated to operate in a Zone 1 hazardous area (see AS/NZS 60079.10.1).

Where a combination of natural and mechanical ventilation is to be used to ventilate an *enclosure*—

(a) exhaust air shall be provided by mechanical means; and

(b) no *open flued gas appliance* shall be installed in the *enclosure*.

TABLE 5.8

VENTILATION OF GAS EQUIPMENT—MECHANICAL VENTILATION

<table>
<tr><th>Gas equipment in enclosure</th><th>Minimum airflow to outside L/s (see Note 1)</th><th>Safety requirement for ventilation failure (see Note 4)</th></tr>
<tr><td>Meter and/or regulator</td><td>Equipment rated capacity (Note 2) (m^3/h) × 0.1</td><td rowspan="2">An interlock which causes the gas supply to the equipment to shut down and lockout; OR
A remote alarm which can only be reset at the enclosure</td></tr>
<tr><td>Gas pressure-raising device</td><td>Equipment rated capacity (m^3/h) × 0.3</td></tr>
<tr><td>Gas equipment and an appliance</td><td>The greater of minimum airflow rate required for the appliance or equipment (Note 3)</td><td>An interlock which causes the gas supply to the appliances in the enclosure to shut down and lockout AND one of the following:
—An interlock which causes the gas supply to the equipment to shut down and lockout; OR
—A remote alarm which can only be reset at the enclosure</td></tr>
</table>

NOTES:

1 To enable this airflow to be achieved adequate airflow into the *enclosure* is required.

2 Where a meter and regulator are installed in an *enclosure* as part of one system, the equipment rated capacity is taken as the badge capacity of the meter in m^3/h at 125 Pa differential. That is, not the sum of the regulator and meter rated capacities.

3 For the minimum airflow requirements for an *appliance*, see Clause 6.4.8.

4 Clause 6.4.9 gives details for sensing devices that are required for these situations.

5.13.5 Location of openings

The ventilation openings shall be located such that adequate ventilation is achieved in all parts of the enclosed area. For natural ventilation the openings shall be located to ensure the distance between the top of the upper opening and the ceiling of the *enclosure*, and the distance between the bottom opening and the floor of the *enclosure* does not exceed 5% of the height of the *enclosure*.

5.13.6 Ventilation of an enclosure containing a meter or regulator and a gas pressure-raising device

Where a meter or regulator and a *gas pressure*-raising device are to be installed in the same *enclosure*, the ventilation requirements shall be calculated by the method described in this Clause 5.13 that provides the greater amount of ventilation to the *enclosure*.

5.13.7 Ventilation of an enclosure containing gas equipment and a gas appliance

Where *gas* equipment and a *gas appliance* are to be installed in the same *enclosure*, the ventilation requirements shall be calculated by one of the methods in this Clause 5.13 or in Clause 6.4 whichever provides the greater amount of ventilation to the *enclosure*.

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MEANS OF COMPLIANCE—INSTALLING GAS APPLIANCES

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SECTION 6 MEANS OF COMPLIANCE— INSTALLING GAS APPLIANCES

6.1 REQUIREMENTS FOR GAS APPLIANCES

6.1.1 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 express compliance requirements for *gas appliances*.

6.1.2 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 *appliance* is installed, the *appliance* shall satisfy the safety requirements of the *Technical Regulator*.

6.1.3 Appliance conversion

In Australia, an *appliance* may be converted to suit another *gas* type provided—

(a) the *appliance* is suitable for that *gas*; and

(b) the conversion is in accordance with with the *manufacturer's instructions*.

NOTES:

1 Where an *appliance* is to be converted to a *gas* type, which is not shown on the *appliance* data plate, the *Technical Regulator* may require to be specifically advised prior to the commencement of the work.

2 When converting an *appliance* from another fuel to *gas*, the conversion should be in accordance with a conversion procedure acceptable to the *Technical Regulator*.

In New Zealand, if an *appliance* is converted (other than by simple exchange of injectors) its compliance with the Gas (Safety and Measurement) Regulations 2010 shall be verified.

6.2 GENERAL INSTALLATION REQUIREMENTS

6.2.1 Determination of adequate gas supply

The maximum consumption of the *gas appliances* being installed shall be determined, and this load, along with any existing loads, shall be checked to ensure that it can be met—

(a) for reticulated *gas* supplies, by the *gas meter* or measurement system, and reticulation system; or

(b) for on-site storage systems, by the storage system and any *gas pressure regulators*, vaporizers, or *pressure* boosters, etc.

Before connecting an additional *gas appliance* to an existing *consumer piping* system, the existing piping shall be checked for adequate capacity. If found to be unsuitable, the existing *consumer piping* shall be made suitable or separate piping shall be installed.

6.2.2 Manufacturer's installation instructions

Appliances shall be installed in accordance with the requirements of this Standard and the *manufacturer's instructions*.

Where there is any conflict between the *manufacturer's installation instructions* and the requirements of this Standard, the matter shall be referred:

(a) In Australia, to the *Technical Regulator*.

(b) In New Zealand, to the *gas appliance* manufacturer or the New Zealand representative for a ruling.

NOTE: This does not relieve any responsibility for compliance with Section 2 of this Standard.

6.2.3 Restriction on flueless gas appliances

A2 A flueless *gas appliance* shall not be installed in a—

(a) bedroom other than a domestic gas cooking appliance installed in a combined sleeping/living area in accordance with Clause 6.10.1.14;

(b) bathroom;

(c) toilet;

(d) sauna; or

(e) spa room.

6.2.4 Restriction on appliance location

A *gas appliance* shall not be installed—

(a) internally, unless it is designed for *indoor* installation; or

(b) externally, unless it is designed for *outdoor* installation.

NOTES:

1 A *gas appliance* designed for *indoor* installation may be installed 'externally' in an *enclosure* or a *quasi-outdoor* situation if, following the *manufacturer's instructions*, the relevant requirements of this Standard are satisfied.

2 A *gas appliance* designed for *outdoor* installation may be installed in applications which do not meet the definition of *outdoor*(s) but are well ventilated. Examples are well ventilated commercial or communal car parks, including underground car parks, if acceptable to the *Technical Regulator*.

6.2.5 Temperature limitation on nearby combustible surface

A *gas appliance* shall be installed such that the surface temperature of any nearby *combustible surface* will not exceed 65°C above ambient.

NOTES:

1 *Certified* domestic and small commercial *gas appliances* installed to the *manufacturer's relevant instructions* should satisfy the intent of this requirement provided they take into account local building practice.

2 If there is insufficient space or natural air flow to meet this requirement, creating an air gap between a heat shield and/or insulating material and the combustible substrate may be effective.

3 Care should be taken where a *combustible surface* is covered by a non-*combustible material*. For example, covering a *combustible surface* with stainless steel may not prevent heat transfer and in some circumstances a hazardous situation could arise.

6.2.6 Gas appliances using pressurized air or oxygen or having a standby gas connected

Where a *gas appliance* uses pressurized air or oxygen in the combustion process or has a standby *gas* connected, the requirements of Clause 5.2.3 shall apply.

6.2.7 Automatic control to fail safe

Any installation intended for remote, automatic or unattended operation shall include a control system installed in accordance with the *manufacturer's relevant instructions* and the control system shall be *fail safe*.

NOTE: A *certified appliance* that is intended for remote, automatic or unattended operation is deemed to comply with this requirement.

6.2.8 Electrical requirements

6.2.8.1 *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.

6.2.8.2 *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 a *accessible* position; or

(c) a switch operating in all live (active and neutral) conductors.

6.2.9 Restoration of electricity supply

Where interruption of the electricity supply can cause *burner* shut-down, then restoration of the electricity supply shall not be capable of causing a hazard.

6.2.10 Gas appliance support

Every *gas appliance* shall be supported on, or secured to a durable structure that is appropriate for the use and location of the *gas appliance*. The supports shall maintain the *gas appliance* in a plumb or level position and the means of securing the *gas appliance* to its support shall be of suitable materials and strength for the purpose. *Gas appliances* shall not be supported by *gas pipework* unless the pipework has been designed for that purpose. The *gas appliance* shall be supported and placed so that the weight of the *gas appliance* will not cause deformation of any part of the building structure and *wherever possible* shall be located directly over or close to a load-bearing member.

6.2.11 Earthquake restraint

For New Zealand, restraints for *gas appliances* shall be designed in accordance with NZS 4219.

6.2.12 Flexible connections for the prevention of vibration

A *gas appliance* that may impart significant vibration to the *consumer piping* shall be connected to the *consumer piping* using a flexible connection or expansion loop suitable for the application.

6.2.13 Connection of gas appliance designed to move on castors, rollers or wheels

A *gas appliance* designed to move on castors, rollers or wheels shall be connected to the *consumer piping* using a *hose assembly*.

6.2.14 Gas appliance restraint where a hose assembly is used

Where a *gas appliance* (other than a portable space heater), having a mass greater than 20 kg and fitted with castors, rollers or wheels, or designed to be slid out for servicing, is connected by a *hose assembly*, the extent of movement of the *gas appliance* shall be restrained by means other than the *hose assembly*.

The *hose assembly* shall be connected in accordance with Clause 5.9.7.

NOTES:

1 The restraint should be no more than 80% of the length of the *hose assembly*.

2 The restraining means should be strong enough to restrain the *appliance* according to the means used to move it.

6.2.15 Push-on connectors limited to connecting laboratory Bunsen burners

*Push-on connector*s shall be used only for connecting laboratory Bunsen *burners*, and only where—

(a) the *gas pressure* will not exceed 3 kPa;

(b) the Bunsen *burner* or the outlet of the hose has no valve fitted; and

(c) a *manual shut-off valve* is fitted upstream of and adjacent to the inlet end of the hose.

6.3 GAS APPLIANCE LOCATION

6.3.1 Adverse effect of air movement systems

Gas appliances shall not be installed where the operation of any ventilation system, air distribution system, fan, or air blower could, under any circumstances—

(a) deprive the *gas appliance* of the air required for combustion and *draught diverter* dilution; or

(b) otherwise adversely affect the operation of the *gas appliance*.

NOTE: Extraction fans (e.g., kitchen rangehoods and *exhaust fans* in toilets and *bathroom*s) lower the *pressure* in a building which can cause the spillage of *combustion products* from *flued appliances*. This applies particularly to modern buildings which are much more air tight than older buildings and allow much less ventilation through adventitious openings. In buildings with *flued appliances* and extraction fans, the *appliances* should be able to operate without *combustion product* spillage whether or not such fans are running. To achieve this it may be necessary to install permanent ventilation in addition to that already required by Clauses 6.4.4 or 6.4.5.

To determine if additional ventilation is required, refer to Paragraph R2, Appendix R.

6.3.2 Protection from physical damage

Adequate protection shall be provided if a *gas appliance* is located where physical damage to the *gas appliance* is likely to occur.

6.3.3 Accessibility

Gas appliances shall be installed only in *accessible* locations and 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.

6.3.4 Hazards to buildings or persons

Gas appliances shall be installed so as to not cause a hazard to persons, buildings, walls, nearby surfaces, curtains, furniture or opened doors, and not obstruct the free movement of persons.

6.3.5 Proximity of flammable goods or chemicals

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*.

NOTES:

1 Such substances include some cleaning solvents, including those used in dry-cleaning processes.

2 For New Zealand, reference should be made to the Hazardous Substances (Classes 1 to 5 Controls) Regulations 2001 for controls on *appliances* in hazardous areas.

3 Refer to AS/NZS 60079.10.1 for classification of hazardous areas.

6.3.6 Presence of water

Where the base of a *gas appliance* is likely to be subjected to water from any source, the *gas appliance* support(s) shall be designed, and the surroundings drained, so that water will not remain in contact with the *gas appliance* base.

6.3.7 Installation above a source of cooking vapour, steam or grease

Where a *gas appliance*, other than a *room-sealed appliance*, is to be installed above a source of cooking vapour, steam or grease, there shall be a clearance of at least 600 mm between the *gas appliance* and the source of cooking vapour, steam or grease. However, a *gas appliance* shall not be located vertically above a fryer, open flame cooking table, char grill or open flame barbecue.

6.3.8 Installation in a cupboard

Where a *gas appliance* is to be installed in a *cupboard*, a warning notice shall be fixed in a prominent position, on or adjacent to the *gas appliance*, stating—

Flammable or corrosive materials should not be stored in this cupboard.

6.3.9 Installation in a bedroom

Special provisions apply for the installation of a *gas appliance* in a *bedroom*; refer to the specific *gas appliance* detail for requirements.

6.3.10 Installation in a garage

Where a *gas appliance*, other than a *room-sealed appliance*, is to be located in a garage—

(a) the *gas appliance* shall be installed with—

  (i) the *burners*, including pilots, and combustion air intake to the *gas appliance* at least 450 mm above the floor; or

  (ii) within a rigid permanently fixed non-combustible vapour-proof wall at least 450 mm high surrounding the *gas appliance* and having sufficient clearance to allow an adequate supply of combustion air and access for servicing.

(b) a warning notice shall be affixed in a prominent position adjacent to the *gas appliance* or *gas appliances* stating—

Naked Flames—Danger—
Flammable vapour not permitted within 3 metres of this gas appliance

6.3.11 Appliance in a roof space

Where an *appliance* is to be located in a roof space the following, as appropriate, shall apply:

(a) The roof section in which the *appliance* is to be installed shall be capable of supporting the additional load.

(b) The *appliance* shall be supported and placed so that the weight of the *appliance* will not cause deformation of any part of the building structure.

(c) The location of the *appliance* shall allow access for lighting and servicing. Permanent fixed means of access is required where the *appliance* location is beyond the extent of normal steps or ladder.

(d) A walkway shall be provided from the access point to the *appliance* and shall extend around the *appliance* to the point where access may be required for lighting or servicing. The walkway shall be—

(i) at least 600 mm wide from the access point to the *appliance*;

(ii) where required around the *appliance*, at least 750 mm;

(iii) permanently fixed to the building; and

(iv) capable of supporting the weight of a person.

(e) Where the *appliance* is installed on a combustible platform and the *appliance burner* is less than 300 mm above the *appliance* base, then one of the following criteria shall be met:

(i) The combustible platform shall be covered with a *fire resistant material* to at least the perimeter of the *appliance* base, and where any louvre or fixed opening into the *burner* compartment exists, this shall be extended to at least 300 mm beyond the front of the *appliance* base. An air gap of not less than 25 mm shall exist between the *appliance* base and the *fire resistant material*.

(ii) The combustible platform shall be covered with corrosion resistant sheet metal having a minimum thickness of 0.6 mm extending to the perimeter of the *appliance* base, but extending at least 300 mm beyond the *appliance* base in front of any louvre or fixed opening into the *burner* compartment. An air gap of not less than 100 mm shall exist between the *appliance* base and the sheet metal.

(f) Permanent artificial lighting shall be provided at the *appliance*, with the switch located adjacent to the access opening.

(g) Clearances as stated in the *manufacturer's installation instructions* shall be observed, to provide adequate clearances for servicing and removal of *burners*, fans, and any other components. Ducting shall not reduce such clearances or intrude on the walkway.

NOTES:

1 Some manufacturers have additional requirements for drains or the like on some types of *appliances*, the instructions for those *appliances* need to be consulted for these requirements.

2 Local building and OHS requirements take precedence over the means of compliance described in this Clause which may be inappropriate in some situations and types of construction.

3 Where ancillary equipment is part of the *gas appliance* installation, the platform, walkway and lighting requirements apply to the ancillary equipment.

6.3.12 Location of appliances in residential premises

Appliances in residential *premises* shall be located such that an additional means of access as indicated in Clause 6.3.13 is not required.

NOTE: Consideration should be given to future access for servicing, replacement and to local occupational health and safety requirements.

6.3.13 Appliance on roof, wall or elevated structure in locations other than single residential premises

Where an *appliance* is to be located on a roof, wall or elevated structure the following, as appropriate, shall apply:

(a) The roof section or structure where the *appliance* is to be installed is to be capable of supporting the additional load.

(b) The *appliance* shall be installed more than 1.5 m from the edge of the roof or structure unless the edge of the roof or structure has a parapet wall or an alternative means of fall protection is provided, or a means of safe access acceptable to the *Technical Regulator*, can be arranged by the property owner or his representative.

NOTE: Other means of access include elevating work platforms, scissor and boom lifts.

(c) Where an *appliance* is mounted on a wall, the height of the base of the *appliance* from the ground or floor level shall not exceed 2.5 m unless permanent means of access, or another means of access, which is acceptable to the *Technical Regulator*, can be arranged by the property owner or his representative.

NOTES:

1 Consideration should be given to future access for servicing and replacement and to local occupational health and safety requirements.

2 Local OHS requirements take precedence over the means of compliance described in this Clause which may be excessive or inadequate in some situations and types of construction.

6.3.14 Appliance under a floor

Where an *appliance* is to be installed under the floor of a building the following, as appropriate, shall apply:

(a) There shall be a minimum clearance of 200 mm between the lowest part of the floor structure and any part of the *appliance*.

(b) To allow adequate access to the *appliance*—

(i) the *appliance* shall be located within 2 m of the access opening; or

(ii) there shall be a minimum clearance of 1.2 m between the lowest part of the floor structure and ground level, maintained from the access opening to the *appliance*.

(c) The *appliance* shall stand on a level concrete base of at least 50 mm thickness or be suspended above the ground level.

(d) Fixed artificial lighting shall be provided at the *appliance*, with the switch located adjacent to the access opening.

6.3.15 Domestic gas barbeques and radiant gas heaters

NOTE: Refer to Appendix I for guidance on the installation of domestic *gas* barbecues and radiant *gas* heaters for *outdoor* use.

6.4 AIR SUPPLY TO GAS APPLIANCES

NOTE: Specific appliance ventilation requirements are given as follows:

(a) For multiple cookers in schools and the like, see Clause 6.10.1.3.

(b) For decorative flame effect fires (not flame effect gas space heaters), see Clause 6.10.9.5.

(c) For laundry dryers, see Clauses 6.10.14.4 and 6.10.14.5.

(d) For refrigerators, see Clause 6.10.18.3.

(e) For quick connect devices in Western Australia, see Paragraph N3.1.1, Appendix N.

(f) For quick connect devices in Victoria, see Paragraph N3.1.2, Appendix N.

(g) For flueless space heaters in South Australia, see Paragraph N3.2.1, Appendix N.

(h) For flueless space heaters in Western Australia, see Paragraph N3.2.2, Appendix N.

Where the requirements above conflict with those in this Clause (6.4), the requirements above apply.

6.4.1 Adequacy of air supply

Gas appliances shall be installed in locations with adequate ventilation for complete combustion of *gas*, proper operation of the *flue* and to maintain the temperature of the immediate surroundings at safe limits, under normal operating conditions.

6.4.2 Quality of air supply

Gas appliance air supply shall not be contaminated with *combustion products*, or contain materials such as chemicals, dust and fibres, or flammable vapours which could affect combustion or the safe operation of the *gas appliance*.

See Figure 6.2 for clearances from appliance combustion air intake openings to flue terminals, gas meters, electricity meters or fuse boxes.

6.4.3 Installation where atmosphere is contaminated

Where an *appliance* is to be installed in an area where excessive dust or lint or any flammable vapours are present, combustion air shall be ducted from outside.

6.4.4 Air requirements for gas appliances

6.4.4.1 *Application*

6.4.4.1.1 *For Australia*

This Clause (6.4.4) applies to new *gas appliance* installations in buildings that were approved for construction prior to the adoption of this Standard by the relevant *Technical Regulator*.

For new *gas* installations in buildings that are approved for construction after adoption of this Standard by the relevant *Technical Regulator*, refer to Clause 6.4.5 for new ventilation requirements.

NOTES:

1 Check with your local *Technical Regulator* for an adoption date for this Standard.

A2 2 Commissioning (Clause 6.11) requires that installations be tested to ensure the adequacy of ventilation and that other mechanical air supply or exhaust equipment does not have an adverse effect on *appliance* safety and performance.

6.4.4.1.2 *For New Zealand*

This Clause (6.4.4) applies to all installations irrespective of the type and time of the installation or the age of the building.

A2 NOTE: Commissioning (Clause 6.11) requires that installations be tested to ensure the adequacy of ventilation and that other mechanical air supply or exhaust equipment does not have an adverse effect on *appliance* safety and performance.

6.4.4.2 *General requirements*

Where an *appliance*(s), other than a room-sealed type, is to be installed in a room or A2 *enclosure* other than a plant room or residential garage, that room or *enclosure* shall be ventilated to ensure proper operation of the *gas appliance*(s) and the flueing system, and to maintain safe ambient conditions. Where the total input of the *appliance*(s) exceeds 3 MJ/h for each cubic metre (approximately 800 W/m^3) of the room or *enclosure* volume, the space shall be ventilated in accordance with Clauses 6.4.4.3, 6.4.4.4 and 6.4.4.5 in cases where natural ventilation is to be used, or Clause 6.4.8 in cases where mechanical ventilation is to be used, unless otherwise stated in Clauses 6.4.6 (special requirements for flueless space heaters) and 6.10. For the purpose of assessing the adequacy of ventilation, the space that cannot be isolated by doors is the 'volume of a room'.

A2 Where an appliance(s), other than a room-sealed type, is to be installed in a plant room or residential garage, ventilation is required irrespective of the gas consumption of the appliances or the volume of the room.

NOTES:

1 As a *room-sealed appliance* draws required air from outside, ventilation of the *enclosure* is not normally required. However, the *enclosure* will require ventilation if an excessive rise in ambient temperature occurs.

2 Where the total input of the *gas appliances* does not exceed 3 MJ/h per cubic metre of room/*enclosure* volume, the required air may be provided by adventitious openings, i.e., gaps around doors, windows, etc. However, adventitious ventilation may be inadequate in some modern well-sealed buildings.

3 To establish whether the required air is to be provided by adventitious openings or additional ventilation openings, the total input of the *gas appliance*(s), excluding room sealed type(s), in the room/*enclosure* in MJ/h is divided by the room/*enclosure* volume in m^3. See Appendix N for ventilation requirements for flueless space heaters that may apply.

4 For the purpose of assessing the adequacy of ventilation of open plan homes where e.g., the lounge, kitchen, dining room and hall are interconnected without doors, the space in these various zones is combined to constitute the volume. If a door has been removed then the volume should be calculated as if the door was in place.

5 For air requirements for multiple cookers in schools and the like, refer to Clause 6.10.1.3.

6.4.4.3 *Natural ventilation*

Two permanent openings shall be provided each with a minimum free ventilation area as calculated using the following equation:

$$A = F \times T$$

where

A = the minimum free ventilation area, in millimetres squared

F = the factor given in Table 6.1

T = the total *gas consumption* of all *gas appliances*, excluding room sealed *appliances*, in megajoules per hour

The minimum dimension of any free ventilation opening shall be 6 mm to minimize linting.

6.4.4.4 *Natural ventilation via adjacent room*

The requirements of Clause 6.4.4.3 apply to all ventilation openings.

For natural ventilation via an adjacent room which vents direct to outside, the ventilation openings between the room, in which the appliance is installed, and the adjacent room shall be required. If the total input of the *appliances* does not exceed 3 MJ/h for each cubic metre of the total volume of the *enclosure* and rooms, the ventilation opening in the adjacent room direct to outside is not required.

In cases where natural ventilation is via multiple adjacent rooms, the ventilation opening in the room in which the appliance is installed and the first adjacent room shall be required. Ventilation openings between the first and subsequent adjacent rooms are required until a subsequent room is ventilated directly to outside or the total input of the *appliances* does not exceed 3 MJ/h for each cubic metre of the total volume of the *enclosure* and rooms.

A2 For a plant room, the adjacent room shall be a non-habitable room and the adjacent room shall be ventilated directly to outside irrespective of the gas consumption of the appliances or the volume of the room. Ventilation via an adjacent room is not permitted for a residential garage.

6.4.4.5 *Location of ventilation openings*

For *appliances* with a *flue*, the lower opening shall be located at or below the level of the *burner*, and the upper opening shall be above the level of the *draught diverter*. The position of openings in relation to each other shall be such as to provide a flow of air across the area.

For *flueless appliances*, the openings shall be located to ensure both of the following do not exceed 5% of the height of the room or *enclosure*:

(a) Distance between the top of the upper opening and the ceiling of the room or *enclosure*.

(b) Distance between the bottom of the lower opening and the floor of the room or *enclosure*.

For all *appliances*, the two openings may be combined provided that the top and bottom of the opening reach the limits set by this Clause.

TABLE 6.1

VENTILATION

Gas appliance location	Source of ventilation	Factor *F*
Gas appliance in a room or *enclosure*, other than a *plant room*	Directly to outside*	300
	Via an adjacent room	600
Gas appliance in a *plant room*	Directly to outside*	150
	Via an adjacent room	300
A2 *Gas appliance* in a *residential garage*	Directly to outside*	300

* 'Directly to outside' means any one of the following options, provided the ventilation path maintains equal or greater *free area* and is unobstructed by building material or insulation:

(a) Directly through an outside wall (preferred option).

(b) Through an outside wall but offset.

(c) Into a cavity ventilated to outside.

(d) Into an underfloor space ventilated to outside.

(e) Into a roof space ventilated to outside.

6.4.5 Air requirements for gas appliances—New gas appliance installations in buildings approved for construction after publication of this Standard—Australia only

6.4.5.1 *Application*

This Clause (6.4.5) applies to new *gas appliance* installations in buildings that are approved for construction after adoption of this Standard by the relevant *Technical Regulator*.

NOTE: In Australia, the energy rating of buildings has resulted in a reduction in adventitious ventilation and this can impact on the operation of *flued gas appliances*. This Clause (6.4.5) contains reference to permanent ventilation provisions that may be required to ensure safe operation of such *appliances*.

For New Zealand, this Clause (6.4.5) does not apply. Refer to Clause 6.4.4 for ventilation requirements in New Zealand.

6.4.5.2 *General ventilation requirements*

Where *appliances* are installed in spaces such as a room, *enclosure*, residential garage or *plant room*, that space shall be ventilated to ensure proper operation of the *gas appliance*(s) and any flueing systems, and to maintain safe ambient conditions. Such ventilation may be achieved by natural or mechanical means.

In the case of natural ventilation, the requirements for all *appliances* other than flueless space heaters are specified in Table 6.2 with the methodology and examples given in Clause 6.4.5.3. The requirements for flueless space heaters are specified in Clause 6.4.6. Table 6.2, Clause 6.4.5.3 and Clause 6.4.6 apply unless otherwise specified in Clause 6.10. In the case of mechanical ventilation, the requirements are specified in Clause 6.4.8, unless otherwise specified in Clause 6.10.

As room sealed *appliances* draw the air required for combustion from outside, ventilation of the space is not required to ensure their proper operation but may be required to avoid excessive rises in ambient temperatures in the space.

NOTES:

1 If the *appliance*(s) have the potential to interact with mechanical extraction ventilation (for example, kitchen rangehoods and *exhaust fans* in toilets and *bathrooms*), compliance with Clause 6.3.1 is also required.

2 Commissioning procedures (see Clause 6.11.4) require that installations be tested to ensure the adequacy of ventilation and that other mechanical air supply or exhaust equipment does not have an adverse effect on appliance safety and performance.

3 In the case of room sealed Type B *appliances*, the amount of ventilation required needs to be assessed (see Clause 2.6.5).

6.4.5.3 *Calculation of natural ventilation areas*

6.4.5.3.1 *Spaces containing only flued appliances*

For determining the ventilation requirements for spaces containing only *flued appliances*, the following methodology shall apply:

(a) Calculate the space volume (V), in m^3.

(b) Divide the total *gas consumption* (T) for *flued appliance(s)* by the space volume (V) to give the value G. If G is greater than 0.4 MJ/h/m^3 as shown in Table 6.2 for *flued appliances*, then additional ventilation openings are required.

(c) Calculate the *free area* of any required additional ventilation openings (as determined in Step (b) above) by multiplying the *gas* input to the *flued appliance* by the appropriate ventilation area A, B or C for *flued appliances* in Table 6.2.

(d) Determine the number of ventilation openings and their location in accordance with the applicable space listed in Table 6.2 for *flued appliances*.

Example 1:

A 40 MJ/h flued space heater is installed in a room 10 m long, 5 m wide and 2.4 m high. At least one wall faces directly to outside and the space is to be ventilated by natural means.

1 Calculate the room volume, $V = 10 \times 5 \times 2.4 = 120$ m^3.

2 Divide the total *gas consumption*, T (40 MJ/h), for the flued space heater by the room volume, V (120 m^3), to give the value $G = 40/120 = 0.333$ MJ/h/m^3.

Because G is less than 0.4 MJ/h/m^3 as shown in Table 6.2 for *flued appliances*, additional ventilation openings are not required.

Example 2:

A 30 MJ/h flued space heater is installed in a room 5 m long, 5 m wide and 2.4 m high. At least one wall faces directly to outside and the space is to be ventilated by natural means.

1 Calculate the room volume, $V = 5 \times 5 \times 2.4 = 60\ m^3$.

2 Divide the total *gas consumption*, T (30 MJ/h), for the flued space heater by the room volume, V (60 m^3), to give the value $G = 30/60 = 0.5\ MJ/h/m^3$. Because G is greater than 0.4 $MJ/h/m^3$ as shown in Table 6.2 for *flued appliances*, additional ventilation openings are required.

3 Calculate the *free area* of additional ventilation openings:

- From Table 6.2 for a *flued appliance* in a room vented directly to outside, the ventilation opening is to have a *free area* (A) of 450 mm^2 per MJ/h of *appliance gas* input.
- *Free area* of ventilation opening, $A = 30 \times 450 = 13\ 500\ mm^2$

4 Determine the number of ventilation openings and their location:

- From Table 6.2 for a flued appliance in a room vented directly to outside, one ventilation opening in the wall facing direct to outside is required.

Example 3

An identical 30 MJ/h flued space heater to the one in Example 2 is again installed in a room 5 m long, 5 m wide and 2.4 m high. This time, however, the space is to be vented by natural means via an adjacent room. The adjacent room has at least one wall facing directly to the outside and measures 3 m long, 3 m wide and 2.4 m high.

From the results of Steps 1 and 2 in Example 2 above, it is concluded that additional ventilation openings are required.

If a vent is placed between the two adjacent rooms, consideration shall be given to the space volume of the adjacent room and combine this with the space volume for the room in which the flued space heater is installed,

1 Calculate the volume for the room in which the flued space heater is installed, $V = 5 \times 5 \times 2.4 = 60\ m^3$.

2 Calculate the volume of the adjacent room = $3 \times 3 \times 2.4 = 21.6\ m^3$.

3 The combined volume of the two rooms = $60 + 21.6 = 81.6\ m^3$.

4 Divide the total *gas consumption*, T (30 MJ/h), for the flued space heater by the combined room volume (81.6 m^3) to give the value $G = 30/81.6 = 0.36$ MJ/h/m^3. Because G is less than 0.4 MJ/h/m^3 as shown in Table 6.2 for *flued appliances*, the combined volume of the two rooms is large enough to ensure that additional ventilation to outside is not required and, hence, vent *B2* from Table 6.2 is not required.

5 Calculate the *free area* of the additional ventilation opening (*B1*) between the two rooms:

- From Table 6.2, for a *flued appliance* in a room vented via an adjacent room, ventilation openings *B1* and *B2* are to have a *free area* (A) of 650 mm^2 per MJ/h of *appliance gas* input.
- *Free area* of ventilation opening *B1* = $30 \times 650 = 19\ 500\ mm^2$

6 Determine the number of ventilation openings and their location:

- From Step 1, it was determined that additional ventilation of the room where the *appliance* is located is required. Additional ventilation of the adjacent room is not required.
- From Table 6.2, for the case of a *flued appliance* in a room vented via an adjacent room direct to outside, only one vent between the two rooms, and *free area* of ventilation opening *B1* = 19 500 mm^2, is required.

6.4.5.3.2 *Spaces containing only flueless appliances other than flueless space heaters*

For determining the ventilation requirements for spaces containing only *flueless appliances* other than flueless space heaters, the following methodology shall apply:

(a) Calculate the space volume (V), in m^3.

(b) Divide the total *gas consumption* (T) for *flueless appliance*s other than flueless space heaters by the space volume (V) to give the value H. If H is greater than 3 $MJ/h/m^3$ as shown in Table 6.2 for *flueless appliance*s, then additional ventilation openings are required.

(c) Calculate the *free area* of any required additional ventilation openings (as determined in Step (b) above) by multiplying the *gas* input to the *flueless appliance* by the appropriate ventilation area D, E or F for *flueless appliances* other than flueless space heaters in Table 6.2.

(d) Determine the number of ventilation openings and their location in accordance with the applicable space listed in Table 6.2 for *flueless appliances* other than flueless space heaters.

Example 1:

A 60 MJ/h freestanding cooking range is installed in a kitchen 5 m long, 5 m wide and 2.4 m high. At least one wall faces directly to outside and the space is to be ventilated by natural means.

1 Calculate the kitchen volume, $V = 5 \times 5 \times 2.4 = 60$ m^3.

2 Divide the total *gas consumption*, T (60 MJ/h), for the freestanding cooking range by the kitchen volume, V (60 m^3), to give the value $H = 60/60 = 1$ $MJ/h/m^3$.

Because H is less than 3 $MJ/h/m^3$ as shown in Table 6.2 for *flueless appliance*s other than flueless space heaters, additional ventilation openings are not required.

Example 2:

A 120 MJ/h freestanding cooking range is installed in a kitchen 4 m long, 4 m wide and 2.4 m high. At least one wall faces directly to outside and the space is to be ventilated by natural means.

1 Calculate the kitchen volume, $V = 4 \times 4 \times 2.4 = 38.4$ m^3.

2 Divide the total *gas consumption*, T (120 MJ/h), for the freestanding cooking range by the kitchen volume, V (38.4 m^3), to give the value $H = 120/38.4 = 3.125$ $MJ/h/m^3$. Because H is greater than 3 $MJ/h/m^3$ as shown in Table 6.2 for *flueless appliances* other than flueless space heaters, additional ventilation openings are required.

3 Calculate the *free area* of additional ventilation openings:

- From Table 6.2 for a *flueless appliance* in a room vented directly to outside, the ventilation opening is to have a *free area* (A) of 300 mm^2 per MJ/h of *appliance gas* input.
- *Free area* of ventilation opening, $A = 120 \times 300 = 36\,000$ mm^2.

4 Determine the number of ventilation openings and their location:

- From Table 6.2 for a *flueless appliance* in a room vented directly to outside, two ventilation openings in the wall facing direct to outside are required.

6.4.5.3.3 *Spaces containing both flued appliances and flueless appliances other than unflued space heaters*

For determining the ventilation requirements for spaces containing multiple types of appliances, the following methodology shall apply:

(a) Calculate the space volume (V), in m^3.

(b) Calculate the total *gas consumption* (T), in MJ/h, of all *flued* and *flueless appliances* other than flueless space heaters.

(c) Divide the total *gas consumption* of all *appliances* (T) by the the space volume (V) to give the value G.

(d) Check whether the value G calculated in Step (c) is greater than 0.4 MJ/h/m^3—

(i) If not, no additional ventilation is required and there is no need to proceed to Step (e) or beyond.

(ii) If yes, additional ventilation is required. Proceed to Step (e).

(e) Divide the *gas consumption* of only the *flueless appliance(s)* by the the space volume (V) to give the value H.

(f) Check whether the value H calculated in Step (e) is greater than 3 MJ/h/m^3—

(i) If not, proceed to Step (g).

(ii) If yes, proceed to Step (h).

(g) Additional ventilation is determined, assuming only the *flued appliance(s)* that are installed, as follows:

(i) Calculate the *free area* of any required additional ventilation openings by multiplying the *gas consumption* for only the *flued appliances* by the appropriate ventilation area A, B, or C for *flued appliances* in Table 6.2.

(ii) Determine the number of ventilation openings and their location in accordance with the applicable space listed for *flued appliances* in Table 6.2.

(h) Additional ventilation is determined from the total *gas consumption* of all *flued* and *flueless appliances* other than flueless space heaters (T) with vent sizes and locations determined as per the requirements for *flueless appliances*, as follows:.

(i) Calculate the *free area* of any required additional ventilation openings by multiplying the total *gas consumption* (T) by the appropriate ventilation area D, E, or F for *flueless appliances* in Table 6.2.

(ii) Determine the number of ventilation openings and their location in accordance with the applicable space listed for *flueless appliances* in Table 6.2.

Example 1:

A 30 MJ/h flued space heater is installed along with a 60 MJ/h freestanding cooking range in a kitchen measuring 7.5 m × 5 m × 2.4 m. At least one wall faces directly to outside and the space is to be ventilated by natural means.

1 Calculate the space (kitchen) volume, $V = 7.5 \times 5 \times 2.4 = 90\ m^3$.

2 Add the *gas consumption* of the flued space heater and the freestanding cooking range together, $T = 30 + 60 = 90$ MJ/h.

3 Divide the total *gas consumption*, T (90 MJ/h), by the space volume, V (90 m^3), to give the value $G = 90/90 = 1\ MJ/h/m^3$.

4 Because G is greater than 0.4 $MJ/h/m^3$, additional ventilation openings are required.

5 Divide the *gas consumption* of the freestanding cooking range (60 MJ/h) by the kitchen volume, V (90 m^3), to give the value $H = 60/90 = 0.666\ MJ/h/m^3$. Because the value H is not greater than 3 $MJ/h/m^3$, Clause 6.4.5.3.3(g) above applies.

6 From Table 6.2 for a *flued appliance* in a room vented directly to outside, the ventilation opening is to have a *free area* (A) of 450 mm^2 per MJ/h of *flued appliance gas* input only. Applying Clause 6.4.5.3.3(g) as follows:

- *Free area* of ventilation opening, $A = 30 \times 450 = 13\ 500\ mm^2$.
- From Table 6.2 for a *flued appliance* in a room vented directly to outside, one ventilation opening in the wall facing direct to outside is sufficient.

Example 2:

Parameters are the same as in Example 1. However, the kitchen is much smaller measuring 5 m × 4 m × 2.4 m and the *gas consumption* for the free standing cooker is much greater at 150 MJ/h.

1 Calculate the space (kitchen) volume, $V = 5 \times 4 \times 2.4 = 48\ m^3$.

2 Add the *gas consumption* of the flued space heater and the freestanding cooking range together, $T = 30$ MJ/h + 150 MJ/h = 180 MJ/h.

3 Divide the total *gas consumption*, T (180 MJ/h), by the space volume, V (48 m^3), to give the value $G = 180/48 = 3.75\ MJ/h/m^3$.

4 Because G is greater than 0.4 $MJ/h/m^3$, additional ventilation openings are required..

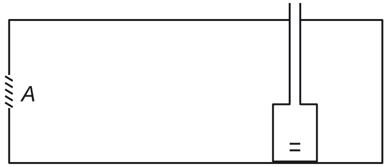
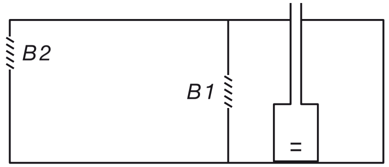
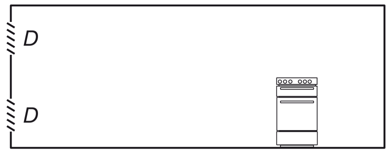
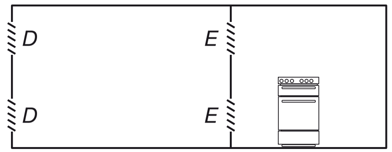
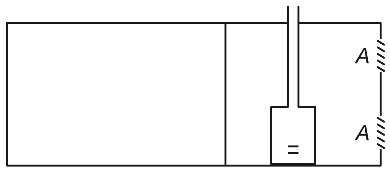
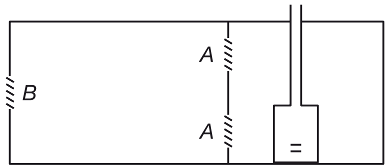
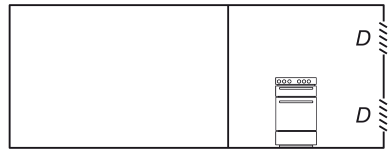
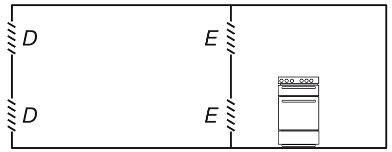
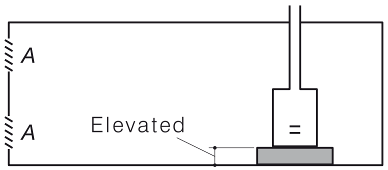
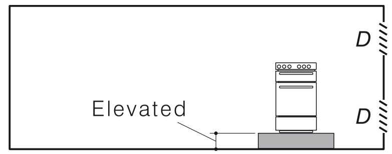
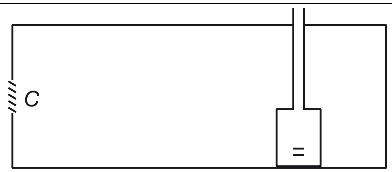
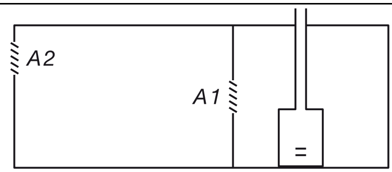
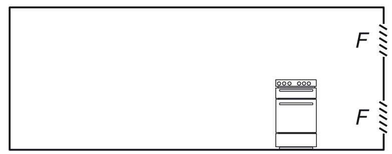
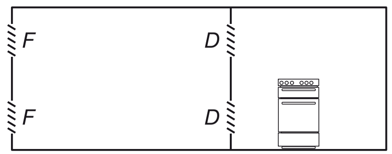
5 Divide the *gas consumption* of the freestanding cooking range (150 MJ/h) by the kitchen volume, V (48 m^3), to give the value $H = 150/48 = 3.125\ MJ/h/m^3$. Because the value H is greater than 3 $MJ/h/m^3$, Clause 6.4.5.3.3(h) above applies.

6 From Table 6.2 for a *flueless appliance* in a room vented directly to outside, the ventilation openings are to have a *free area* (D) of 300 mm^2 per MJ/h of the combined *gas* input of *flued* and *flueless appliance*. Applying Clause 6.4.5.3.3(h) as follows:

- *Free area* of each ventilation opening, $D = 180 \times 300 = 54\ 000\ mm^2$.
- From Table 6.2 for a *flueless appliance* in a room vented directly to outside, two ventilation openings in the wall facing direct to outside are required.

TABLE 6.2
NATURAL VENTILATION FOR GAS APPLIANCES

A2

Appliance	Flued appliances		Flueless appliances other than flueless space heaters	
	Direct to outside	**Via an adjacent room**	**Direct to outside**	**Via an adjacent room**
In a room	 Where input G >0.4 MJ/h/m^3, $A = T \times 450$ (mm^2)	 Where input G >0.4 MJ/h/m^3, $B1 = B2 = T \times 650$ (mm^2)	 Where input H >3.0 MJ/h/m^3, $D = T \times 300$ (mm^2)	 Where input H >3.0 MJ/h/m^3, $D = T \times 300$ (mm^2), $E = T \times 600$ (mm^2)
In an *enclosure*	 Where input G >0.4 MJ/h/m^3 two vents at high and low levels, $A = T \times 450$ (mm^2)	 Where input G >0.4MJ/h/m^3, two vents to adjacent space, high and low levels, one vent in adjacent space to outside, $A = T \times 450$ (mm^2), $B = T \times 650$ (mm^2)	 Where input H >3.0 MJ/h/m^3, $D = T \times 300$ (mm^2)	 Where input H >3.0 MJ/h/m^3, $D = T \times 300$ (mm^2), $E = T \times 600$ (mm^2)
In a *residential* garage	 Two vents, $T \times 450$ (mm^2) *Appliance* to be elevated in accordance with Clause 6.3.10. No Allowance for adventitious ventilation (see Clause 6.4.7)	Not permitted	 Two vents, $D = T \times 300$ (mm^2) *Appliance* to be elevated in accordance with Clause 6.3.10. No Allowance for adventitious ventilation (see Clause 6.4.7)	Not permitted
In a *plant room*	 $C = T \times 325$ (mm^2) No allowance for adventitious ventilation	 $A1 = A2 = T \times 450$ (mm^2) No allowance for adventitious ventilation	 $F = T \times 150$ (mm^2) No allowance for adventitious ventilation	 $D = T \times 300$ (mm^2), $F = T \times 150$ (mm^2) No allowance for adventitious ventilation

NOTE: See next page for Notes to this Table.

T = Total *gas consumption* of all applicable *appliances*, in MJ/h.

Notes to Table 6.2 are as follows:

1 The minimum dimension of any additional ventilation openings *A*, *B*, *C*, *D*, *E*, and *F* shall be 6 mm to minimize linting.

2 Where only a single ventilation opening is required in a space, it can be located anywhere along the height of the wall. It can also be located in the roof, ceiling or floor provided it is connected directly to outside (see Note 6 below). The *free area* required for the single ventilation opening may be achieved by the use of multiple ventilation openings, provided the locations of multiple openings meet other
A2 requirements (see Note 3).

3 Where multiple ventilation openings are mandatory (garages and *enclosures*) or used for other reasons, the following applies:

(a) For *flued appliances*, the lower level opening shall be located below the level of the *burner* and the upper level opening above the level of the *draft diverter* or similar device. The position of ventilation openings in relation to each other shall be such as to provide a flow of air across the area. Ventilation openings can be located in the roof, ceiling or floor, provided they are connected directly to outside (see Note 6).

(b) For *flueless appliances* other than flueless space heaters, the openings shall be located to ensure both of the following do not exceed 5% of the height of the room or *enclosure*:

(i) Distance between the top of the upper opening and the ceiling of the room or *enclosure*.

(ii) Distance between the bottom of the lower opening and the floor of the room or *enclosure*.

(c) For all *appliances*, the two openings may be combined, provided the top and bottom of the opening reach the limits set in (a) and (b) above.

4 For *flued appliances* in any location, air to the *burner*(s) and the *draught diverter* shall be from the same air space.

5 For all *appliances* in garages, ventilation openings shall be directly to outside. No allowance shall be made for natural ventilation via adventitious openings (see Clauses 6.4.7). For additional general requirements for *appliances* in garages, refer to Clause 6.3.10.

6 'Directly to outside' means any one of the following options, provided the ventilation path maintains equal to, or greater than, *free area* and is unobstructed by building material or insulation:

(a) Directly through an outside wall (preferred option).

(b) Through an outside wall but offset.

(c) Into a cavity ventilated to outside.

(d) Into an underfloor space ventilated to outside.

(e) Into a roof space ventilated to outside.

7 Ventilation openings shall be located so that building occupants are not provoked into sealing them against discomfort from cold draughts or noise. Discomfort from cold draughts can be avoided by supplying air directly to *appliances*, locating ventilation openings close to *appliances* (for example, by locating them in the floor), by drawing air from intermediate spaces such as hallways or by ensuring good mixing of incoming cold air by placing external ventilation openings close to ceilings.

8 For rooms or enclosures, where the input of the *gas appliances* does not exceed the input limits shown (e.g., 0.4 $MJ/h/m^3$ for *flued appliances* or 3 $MJ/h/m^3$ for *flueless appliances* other than flueless space heaters), the required ventilation may be assumed to be provided by natural ventilation through adventitious openings, for example, through gaps around doors, windows, except for garages (see Note 5).

9 To establish whether the required air can be provided by natural ventilation through adventitious openings or whether additional ventilation openings are required, and to determine the *free area* of any such additional ventilation openings, refer to Clause 6.4.5.3.

10 For natural ventilation—

(a) for natural ventilation via an adjacent room which vents direct to outside, the ventilation openings between the room in which the *appliance* is installed and the adjacent room are always required. The ventilation opening in the adjacent room direct to outside is not required if the total input of the *gas appliances* does not exceed the input limit for the combined volume of the two rooms (see Example 3 in Clause 6.4.5.3.1).

(b) in cases where natural ventilation is via multiple adjacent rooms, the ventilation opening in the room in which the *appliance* is installed and the first adjacent room are always required. Ventilation openings between the first and subsequent adjacent rooms are required until a subsequent room is ventilated directly to outside or the total input of the *gas* appliances does not exceed the input limit for the combined volume of the room in which the *appliance* is installed and all adjacent rooms.

11 For the purpose of assessing the adequacy of ventilation, the space that cannot be isolated by doors is the 'volume' of that space. For the purpose of assessing the adequacy of ventilation of open plan homes where, e.g., the lounge, kitchen, dining room and hall are interconnected without doors, the space in these various zones is combined to constitute the volume. If a door has been removed then the volume shall be calculated as if the door was in place.

12 The requirements in this Table apply unless otherwise stated in Clause 6.10.

13 For air requirements for multiple cookers in schools and the like, refer to Clause 6.10.1.3.

6.4.6 Special requirements for flueless space heaters

For flueless space heaters in habitable spaces, the total input rating of the *gas appliances* shall not exceed—

(a) 0.4 MJ/h for each cubic metre of room volume (approximately 100 W/m^3) if the *gas appliance* is thermostatically controlled; or

(b) 0.2 MJ/h for each cubic metre of room volume (approximately 50 W/m^3) if the *gas appliance* is not thermostatically controlled.

In internal spaces such as passageways and lobbies, the total input rating of the flueless space heaters shall not exceed 0.4 MJ/h for each cubic metre of heated volume (100 W/m^3), irrespective of whether the *gas appliance* has thermostatic control.

NOTES:

1 Specific local requirements regarding the installation of flueless space heaters are listed in Appendix N for Victoria, Western Australia and South Australia.

2 Specific requirements for installation of flueless space heaters are given in Clause 6.10.6.3.

3 For other types of *flueless gas appliances*, the ventilation requirements of Clause 6.4.4 or 6.4.5 apply unless specific ventilation requirements are given in Clause 6.10.

6.4.7 Appliance in a residential garage

Ventilation shall comply with Clauses 6.4.4 or 6.4.5 with the additional requirement that the ventilation shall be directly to outside. No allowance shall be made for adventitious ventilation.

NOTE: Refer to Clause 6.3.10 regarding *appliance* location in a garage.

6.4.8 Mechanical ventilation

Where the air supply to *gas appliances* is to be provided by mechanical means, it shall be drawn directly from the outside in accordance with Table 6.3.

Where *appliances* are in a space served by mechanical ventilation, the installation shall be designed and tested to ensure compliance with Clause 6.3.1.

TABLE 6.3

AIR REQUIREMENTS—APPLIANCES—MECHANICAL VENTILATION

Type of appliance burner	Low level mechanical air supply		High level exhaust			Position of openings in relation to each other
	Minimum air flow required L/s	Location of opening	Mechanical L/s	Natural: Minimum size of opening mm^2	Location of opening	
Atmospheric	*Appliance* input (MJ/h) × 0.5	As in Clause 6.4.4.5	Between 1/4 and 1/3 of the rate of inlet air required	*Appliance* input (MJ/h) × 150 as in Clause 6.4.4.3	As in Clause 6.4.4.5	As in Clause 6.4.4.5
Forced or induced draught	*Appliance* input (MJ/h) × 0.3					

NOTES:

1 A smoke match placed in the vicinity of the *draught diverter* of the *appliance* is one method to check that there is sufficient air supply to avoid a *pressure* less than atmospheric at the *appliance*, as required by Clause 6.3.1.

2 *Appliance* input shall include the total input of all *appliances* in the area including those using other fuels.

6.4.9 Interlock for air supply to gas appliance

Where the required air supply to a *gas appliance* relies on a mechanical system, there shall be an *interlock* to cause the *gas* supply to the *appliance*(s) to be shut off upon failure of the mechanical air supply system. The *interlock* sensor shall *fail safe* and it shall be proved in the no-flow state prior to start up and shall be one or both of the following, as applicable:

(a) Be of the type that will sense actual air movement.

(b) Where an air damper is used, ensure supply of *gas* to the *appliance* only whilst the damper is open to permit proper operation of the *appliance*.

NOTE: Except for industrial applications, *gas appliances* with a permanent pilot need only be *interlocked* to cause the main *burner* to shut off.

6.4.10 Air heating gas appliance in a confined space

Where an air heating *gas appliance* is installed in a confined space the heated and returned air shall be ducted and separated from air for combustion and *draught diverter* dilution.

6.4.11 Combustion and dilution air for a gas appliance with an open flue

Where a *gas appliance* has an *atmospheric burner*, air to the *burner*(s) and the *draught diverter* shall be from the same air space.

6.5 GAS SHUT-OFF WHEN AUTOMATIC FIRE EQUIPMENT OPERATES

6.5.1 Interlock of automatic fire-extinguishing equipment with gas supply

Where operation of automatic fire-extinguishing equipment could extinguish a *gas appliance* flame—

(a) all *burners* of the *gas appliance* shall have a *flame safeguard system*; or

(b) the installation shall be fitted with a system which will shut off the *gas* supply when the fire extinguishing system operates. The system shall require *pressure* proving of the downstream installation prior to restoration of the *gas* supply.

6.5.2 Interlock of automatic fire damper and gas supply

Where combustion air to a *gas appliance* may be affected by the activation of a *fire damper*, there shall be an *interlock* to cause the *gas* supply to the *gas appliance* to be shut off if the *fire damper* is activated.

6.5.3 Gas shut-off controls interfaced with fire alarm systems

Where automatic shut-off of *gas* supply occurs when the fire alarm system is activated, suitable measures shall be provided to prevent the release of unignited *gas* upon restoration of supply.

NOTE: Suitable measures include safeguarding of all *burners*, *pressure* proving or a *burner* shut-off system incorporating the automatic shut-off valve.

6.6 GAS APPLIANCE CONNECTION

NOTE: Refer to Clause 6.10 for specific *appliance* requirements.

6.6.1 Restriction on appliance connection

Multilayer piping and plastic coated semi-rigid stainless steel piping shall not be used as an *appliance* connection. Final connections to *appliances* shall be made using copper tube, steel pipe or a *certified hose assembly* unless, in the case of plastic coated semi-rigid stainless steel piping, it forms part of a *certified hose assembly* or limited flexibility connector.

6.6.2 Pipe connection

Connection pipe size shall be determined in accordance with Clause 5.2.4.

6.6.3 Means of isolation

A means of isolation shall be provided on the inlet connection of an *appliance*, in accordance with Table 6.4.

The means of isolation shall be *accessible* for operation and shall be either a *manual shut-off valve* or a quick connect device. Where a *hose assembly* is used to connect a *gas appliance*, the means of isolation shall be located in accordance with Clause 5.9.7.

TABLE 6.4

REQUIREMENTS FOR PROVISION OF A MEANS OF ISOLATION FOR AN APPLIANCE

Appliance type	Is means of isolation required?	
	Type of premises	
	Single residential	Commercial/industrial or residential apartment buildings
Cooking *appliances*	Optional	Yes
Water heaters including *pool heaters*	Yes	Yes
Space heaters	Optional	Yes
Ducted heaters	Yes	Yes
Gas lights	Optional	Yes
Others not listed	Yes	Yes

A2

6.6.4 Means of disconnection

The *gas appliance* connection shall include a means of disconnection. Where a means of isolation is provided to satisfy Clause 6.6.3 the means of disconnection shall be downstream of the means of isolation.

A2

6.6.5 Fitting of an appliance gas pressure regulator

An *appliance gas pressure regulator* shall be fitted to each *Type A appliance* except where—

(a) an *LP Gas appliance* is *certified* without a *regulator*;

(b) the *regulator* is an integral part of the *appliance*; or

(c) the *appliance* is an open *burner* such as a *gas* ring, laboratory Bunsen, or blow pipe, where the *gas pressure* cannot exceed 1.5 kPa for *natural gas* or 3 kPa for *LP Gas*. However, a *regulator* on an *appliance* with this type of *burner* is not to be removed.

Where the gas pressure regulator for an appliance is supplied as a separate component, it shall be installed as close as practicable to the appliance and accessible for servicing and adjustment.

For *gas pressure* control on *Type B appliances*, refer to AS 3814.

In New Zealand, an appliance *certified* in accordance with the Gas (Safety and Measurement) Regulations 2010 shall be treated as a *Type A appliance*.

6.7 FLUE DESIGN

6.7.1 Provision of a flue

Every *appliance* designed for connection to a *flue* shall be fitted with a *flue*, except where the *Technical Regulator* considers that, because of ventilation or other factors, a *flue* is not required.

6.7.2 Effect on building strength or fire resistance

The design strength or fire resistance of a building shall not be reduced by the installation of a *flue*.

NOTE: AS 3959 requires non-combustible roof penetration and *flue* materials in these areas.

6.7.3 Material

A2 Material used in the construction of a *flue* shall comply with Table 4.2.

6.7.4 Design requirements

Flues or chimneys shall be designed so that, under normal operating conditions of the *gas appliance*, all *flue gases* are exhausted to outside atmosphere unless otherwise specified in this Standard.

Changes of direction of a *flue* shall be minimized and any change in direction, shape or size shall be gradual to minimize restriction to the flow of *flue gases*.

Natural draught flues fitted to *gas appliances* shall be designed to run vertically for the maximum possible distance before any change in direction unless the *gas appliance* is designed to accept a horizontal *flue* connection. Any lateral run in a *flue* shall be as short as possible and not exceeding 50% of the total *flue* height, and shall rise not less than 20 mm per 1 m run.

The minimum height of a *natural draught flue* shall be as specified in the *appliance manufacturer's instructions* or a minimum of 1.2 m if not so specified.

The diameter or cross-sectional area of *open flues* shall comply with Appendix H.

6.7.5 Flue gases not to cause a nuisance

Where *flue gases* may enter a building or cause a nuisance to any person in the vicinity, this shall be prevented.

NOTE: Means of prevention include flueing to above roof height, special selection of the *flue terminal* and terminal location, and *power flueing*. Environmental authorities may have additional requirements for such situations.

6.7.6 Common or combined flues

Where more than one *gas appliance* is connected to a *common flue*, each *gas appliance* shall have a *flame safeguard system*. No *flue* shall discharge into a *common flue* concurrently carrying *flue gases* from another *appliance* burning any fuel other than *gas*. Additionally:

(a) The *burners* of the *appliances* connected to the *common flue* shall be of the same type such that all are—

  (i) *atmospheric burners*;

  (ii) *forced draught burners*; or

  (iii) *induced draught burners*.

(b) The temperature of the *combustion products* entering the *common flue* shall not at any time exceed that given in Table 6.5, or a temperature of 100°C below the lowest ignition temperature of any other combustible *gas* present, whichever is the lesser.

  NOTE: The requirements of (b) above can be satisfied by any one of the following:

  (i) Having *draught diverters* or draught stabilizers in positions such that *combustion product* dilution occurs in the *common flue*.

  (ii) Providing a device or method that will achieve sufficient *combustion product* dilution in the *common flue*.

  (iii) Providing a *temperature limit device* in the *flue* at each *appliance*.

(c) Means to prevent reverse flow in any *appliance* shall be provided.

NOTE: The use of a *draught diverter*, *flue* break, or a *flue* damper interlocked with the *appliance* may meet this requirement.

TABLE 6.5

COMBUSTION PRODUCT TEMPERATURES

Fuel gas	Temperature, °C
NG	440
LP Gas	350
SNG	350

6.7.7 Draught diverters

6.7.7.1 *Flue with draught diverters*

The *flue* of a *gas appliance* shall include a *draught diverter*, except where—

(a) a *draught diverter* is an integral part of the *gas appliance*;

(b) the *gas appliance* is a room-sealed type, an incinerator, or a pottery kiln;

(c) the *gas appliance* is designed for installation under a ventilated canopy or hood or a ventilated canopy or hood is part of the *appliance* and it is acceptable to the *Technical Regulator*; or

(d) the *gas appliance* is designed to operate with a forced or *induced draught burner*.

Where a *draught diverter* is fitted, the *flue* shall discharge the total *flue gases* at the *flue terminal* without spillage from the *draught diverter*.

6.7.7.2 *Flue without draught diverters*

Where a *draught diverter* is not fitted, one of the following shall be provided, where applicable:

(a) Means to prevent the discharge of *flue gases* to atmosphere other than at the *flue terminal*, except where such discharge will not affect the operation of the *gas appliance* and not be a hazard to persons or property.

(b) Means to automatically shut-off the main *burner* of a *gas appliance* designed to operate with a forced or *induced draught burner*, where interruption to the normal free discharge of *flue gases* at the *flue terminal* may be a hazard.

6.7.8 Power flues

Where satisfactory flueing relies on the operation of an extractor fan—

(a) each *gas appliance* shall be fitted with a *safety shut-off system*; and

(b) a sensing device shall be fitted in the *flue* to prevent the flow of *gas* to each *burner* when the fan is ineffective.

NOTE: *Gas appliances* with a permanent pilot need to be *interlocked* to cause only the main *burner* to shut off.

6.7.9 Flue cowls

A2 A *flue cowl* shall be fitted to the *flue terminal* unless the flue and appliance are designed to operate without a cowl.

NOTES:

1 Where a *flue* and *appliance* do not require a *flue cowl* to be fitted, consideration should be given to minimizing the possibility of objects or substances entering the *flue*.

2 Refer to Clause 6.9.5 for *flue* termination in a roof.

6.7.10 Condensate drains

Where necessary, provision shall be made for the draining of *condensate* from the *flue*.

6.7.11 Use of existing flue or chimney

An existing chimney or *flue* shall be used for flueing a *gas appliance* only after examination and the correction of any faults.

NOTE: Poor design of existing *flues* and chimneys can cause *combustion products* to enter into the room.

An existing chimney or *flue* that has been used for fuel other than *gas* shall be—

(a) swept clear of soot and other loose material;

(b) checked for soundness of construction and freedom from leakage; and

(c) checked for adequate size.

Any damper plate shall be removed or permanently fixed fully open, except where a damper is necessary and in accordance with the *manufacturer's relevant instructions*.

6.8 FLUE INSTALLATION

6.8.1 Provision for removal of gas appliance

Where removal of a *gas appliance* is likely to require the movement or displacement of the *flue*, the *flue* shall be installed so that such movement or displacement does not disturb the roof seal or flashing.

NOTE: Provision of a slip socket or bolted sleeve at the *gas appliance flue* connection is an acceptable method of connecting the *flue* to a *gas appliance* and satisfying this requirement.

6.8.2 Support independent of gas appliance

Flues shall be supported independently of the *appliance* unless the *appliance* is designed to support the *flue*. *Flues* shall be securely fixed and adequately supported by bracket(s) fastened to the building structure at suitable points, to ensure the stability of the *flue* unless the *flue* is designed to be structurally independent of the building.

6.8.3 Soft-soldered flue joints

Flues with any soft-soldered joints shall be designed and supported to prevent stress being imparted to the soft-soldered joints.

6.8.4 Flue joints

Flue joints shall seal adequately, with a sealing agent used if necessary, and—

(a) where subjected to the weather, have downward facing sockets; or

(b) where protected from the weather, have upward facing sockets.

6.8.5 Weatherproofing through a roof or wall

Where a *flue* passes through a roof or an external wall, the penetration shall be made permanently weatherproof.

A2

6.8.6 Chimneys

The brick or masonry work in *chimneys* shall be completely sealed from all cavities to give smooth unobstructed flow paths for *flue gases* and thereby maximize their buoyancy effect. A *flue* pipe extending into a *chimney* shall—

(a) be arranged to prevent any falling or loose material from obstructing or entering the *flue* pipe; and

(b) not extend so far into the *chimney* that it causes a restriction.

A2 Where the integrity of the chimney is unsatisfactory a *chimney liner* shall be installed.

NOTES:

1 Seals between any metal *flue* pipes and *chimney*s should be *accessible* for inspection and maintenance.

2 Consideration should be given to temperature and *condensation* issues.

6.8.7 Clearance around a draught diverter

There shall be at least 75 mm clearance between a *draught diverter* relief opening and any wall surface.

6.8.8 Prohibited locations for flues

Flues shall not be located in, or pass through ducts such as lift wells, clothes chutes, rubbish chutes, air ducts or ventilating ducts from which any leaking *flue gases* could spread within the building.

6.8.9 Concealed metal flues

Where part of a metal *flue* passes through an area where it is not readily examinable, that part shall be—

(a) metal sleeved;

(b) twin walled; or

(c) stainless steel or other corrosion resistant material.

6.8.10 Application of twin wall flues

Twin wall flue shall only be used as follows:

(a) Where a *twin wall flue* is used within a cavity wall in a domestic location, the *appliance gas consumption* shall not exceed 50 MJ/h (14 kW).

(b) For *appliances* having a *flue gas* temperature of not more than 300°C.

NOTE: *Certified appliances* with a *draught diverter* will meet the maximum *flue gas* temperature requirement.

(c) The clearance between a *twin wall flue* and a *combustible surface* shall be at least 10 mm.

NOTE: The clearance is measured from the outer surface of the *flue*, (i.e., not measured from any spacers, which may touch the *combustible surface*).

6.8.11 Clearance between a single wall flue and a combustible surface

The clearance between a single wall *flue* and a *combustible surface* shall be at least that given in Table 6.6.

TABLE 6.6

REQUIRED CLEARANCE BETWEEN A SINGLE WALL FLUE AND A COMBUSTIBLE SURFACE

Application	Clearance minimum, mm	
	Unprotected combustible surface	Protected combustible surface
Water heater, space heater or inbuilt oven with: —*Flues* not exceeding 150 mm ID —*Flues* exceeding 150 mm ID —*Flues* 250 mm × 50 mm installed on an outside wall	 25 75 25	 25 50 25
Other rectangular *flues*	75	50
Incinerator—Not sanitary	450	300
Incinerator—Sanitary	75	50
Pottery kiln	600	450
Any other application	The clearance shall be sufficient to ensure the temperature limitation of 50°C above ambient is not exceeded	

6.8.12 Protection of combustible surfaces

Where a *combustible surface* requires protection to satisfy the requirement of Clause 6.8.11 the method used shall provide protection as in AS/NZS 2918 or at least equivalent to one of the following methods:

(a) *Fire resistant material* attached to the *combustible surface* and covered with sheet metal with a minimum thickness of 0.4 mm.

(b) Sheet metal having a minimum thickness of 0.4 mm spaced out at least 25 mm from the *combustible surface* using non-combustible spacers.

(c) Sleeving the *flue* with a duct of 0.4 mm sheet metal that has an air space around the *flue* of at least 25 mm.

See Figure 6.1 for details.

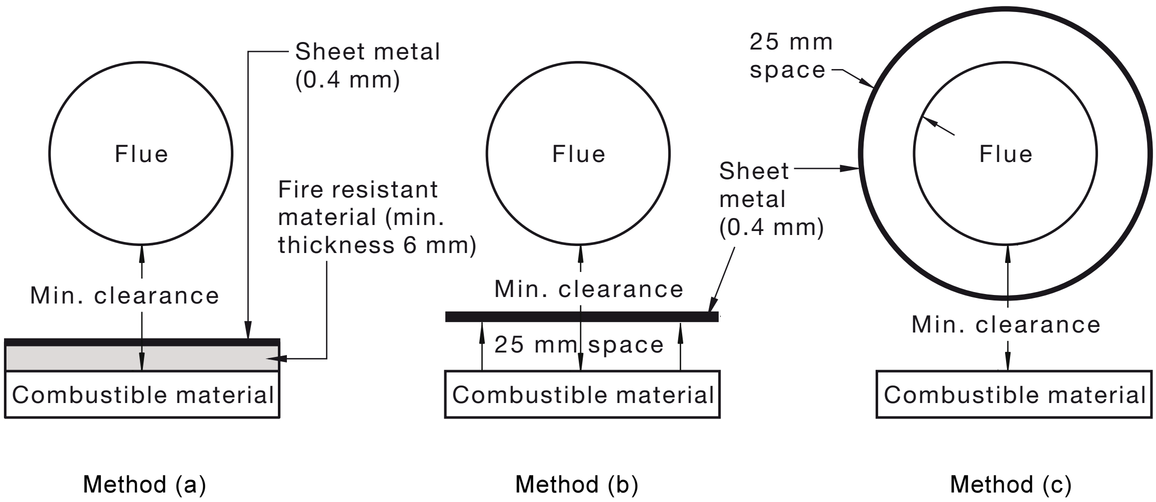


FIGURE 6.1 METHODS OF PROTECTING A COMBUSTIBLE SURFACE

6.8.13 Protection of adjacent non-combustible materials from heat of flue

Where a *flue* is fitted adjacent to or within a wall or partition made of non-*combustible material*, provision shall be made to prevent the temperature of the wall or partition external surfaces exceeding 50°C above ambient.

NOTES:

1 This requirement also applies to a *combustible surface* near a flue or *chimney*, which is protected by a heat shield or *fire resistant material*.

2 Clause 6.8.10 details minimum clearances between twin wall metal *flue* and *combustible surfaces*. Clause 6.8.11 details these clearances for single wall *flues*. If the requirement of the applicable Clause is met, the intent of this Clause will be satisfied.

6.8.14 Clearance from wiring and other services

The clearance between any services constructed of materials affected by heat from a *flue*, including electrical wiring or fittings, telephone cable, communication wiring or plastic water pipe, shall not be less than—

(a) 75 mm where the *flue* or *gas appliance* includes a *draught diverter*; or

(b) 150 mm where the *flue* or *gas appliance* does not include a *draught diverter*.

NOTES:

1 This clearance may be reduced where the two are separated by thermal insulation material.

2 High temperature industrial *appliance flues* may require additional clearance. Refer to the *manufacturer's installation instructions*.

6.9 FLUE TERMINALS

6.9.1 Terminating an open flue—Location

A2 *Flue terminals* or *flue cowls* of an *open flue* shall be located in relation to any associated building and to neighbouring structures so that wind from any direction is not likely to create a downdraught in the *flue* or chimney.

A2 Except where Clause 6.9.3 applies, *flue terminals* fitted to *open flues* shall—

(a) be at least 1 m horizontally from a neighbouring structure; or

(b) if less than 1 m horizontally from a neighbouring structure, be at least 500 mm above that structure;

(c) be at least 1.5 m from any opening into a building; and

(d) be at least 200 mm from another *flue terminal*.

A2

6.9.2 Terminating a flue above a roof

A2 Where any flue terminal is to be located above a roof, the following applies:

(a) The *flue terminal* shall be at least 500 mm from the nearest part of the roof.

(b) If the roof is designed for personal or public use, the end of the *flue* shall be at least 2 m above the roof level and 500 mm above any surrounding parapet and be supported.

(c) The *flue terminal* shall be at least 200 mm from the nearest part of any *chimney*.

NOTES:

1 This distance is measured before the *flue cowl* (if required) is fitted to the *flue terminal*.

2 This Clause (6.9.2) does not apply in situations covered by Clause 6.9.3.

6.9.3 Location of flue terminals of balanced flue, room-sealed, fan-assisted or outdoor appliances

The location of the *flue terminal* of a *balanced flue appliance*, *room-sealed appliance*, a *fan-assisted appliance* or an *appliance* designed for *outdoor* installation shall comply with Figure 6.2.

For New Zealand only, minimum clearances required for *flue terminals* from GMS up to 25 m^3/h are given in Table 6.7. For GMS larger than 25 m^3/h the clearance shall be increased so that the *combustion products* do not affect the GMS and combustion air to the *appliance* could not contain any vented *gas* or leakage from the GMS.

A2
6.9.4 Terminating a flue under a covered area or in a recess

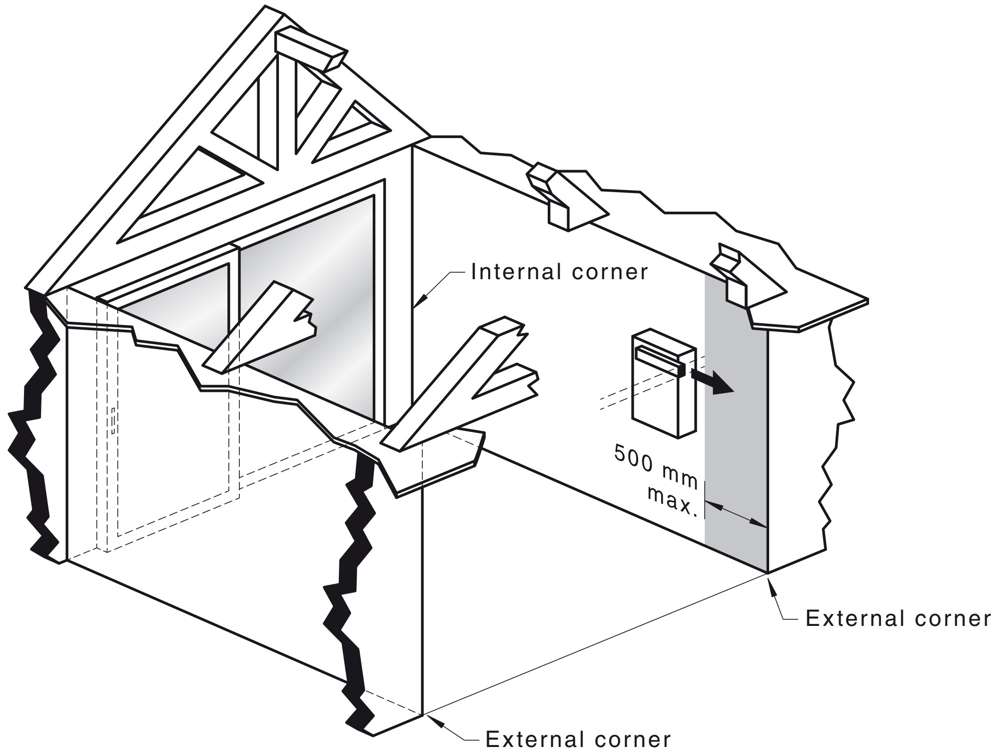
Where the *flue terminal* of a *balanced flue appliance*, *room-sealed appliance*, a *fan-assisted appliance* or the *flue terminal* of an *appliance* designed for *outdoor* installation is to be
A2 installed under a covered area, or in a recess, one of the following options shall be applied to achieve ready dispersion of combustion products and avoidance of nuisance—

(a) the covered area or recess 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

A2 (b) in the case of a *fan-assisted appliance* only, when one side is open, the *flue terminal* shall be within 500 mm of the opening, and discharging in the direction of the opening [see Figure 6.2(a)]. There shall be no other *flue terminals*, *gas meter*, electricity meter, fuse box or openings into the building along the wall within the 500 mm distance. The *flue 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 I.

A2

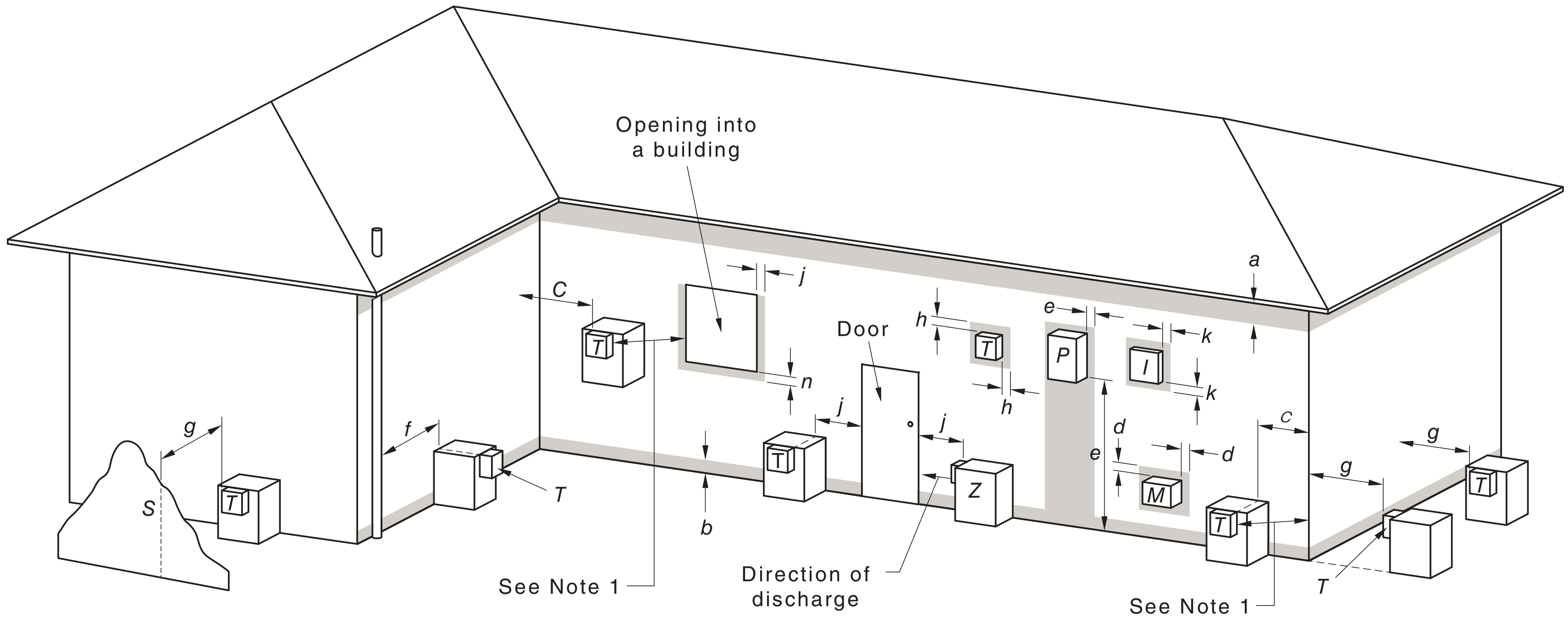


(a)

NOTE: There shall be no other flue terminals, gas meters, electricity meters, fuse boxes or openings into the building along the wall within the 500 mm distance as shown by the shaded area.

FIGURE 6.2 (in part) LOCATION OF FLUE TERMINALS OF BALANCED FLUE, ROOM-SEALED, FAN-ASSISTED OR OUTDOOR APPLIANCES

A2



LEGEND:
I = Mechanical air inlet
M = Gas meter
P = Electricity meter or fuse box
S = Structure
T = Flue terminal
Z = Fan-assisted appliance only
Shading indicates prohibited area for flue terminals

(b)

FIGURE 6.2 (in part) LOCATION OF FLUE TERMINALS OF BALANCED FLUE, ROOM-SEALED, FAN-ASSISTED OR OUTDOOR APPLIANCES

Ref.	Item	Minimum clearances mm	
		Natural draught	Fan assisted
a	Below eaves, balconies and other projections:		
A2	For *appliance*s up to 50 MJ/h input	300	200
	For *appliance*s over 50 MJ/h input	500	300
b	From the ground, above a balcony or other surface *	300	300
c	From a return wall or external corner *	500	300
d	From a *gas meter* (M) (see Note 5) (see Clause 5.11.5.9 for vent terminal location of regulator) (see Table 6.7 for New Zealand requirements)	1 000	1 000
e	From an electricity meter or fuse box (P)† (see Note 5)	500	500
f	From a drain pipe or soil pipe	150	75
g	Horizontally from any building structure * or obstruction facing a terminal	500	500
h	From any other *flue terminal*, cowl, or combustion air intake *	500	300
j	Horizontally from an openable window, door, non-mechanical air inlet, or any other opening into a building with the exception of sub-floor ventilation:		
	*Appliance*s up to 150 MJ/h input*	500	300
	*Appliance*s over 150 MJ/h input up to 200 MJ/h input*	1 500	300
	*Appliance*s over 200 MJ/h input up to 250 MJ/h input*	1 500	500
	*Appliance*s over 250 MJ/h input*	1 500	1 500
A2	All *fan-assisted appliance*s, in the direction of discharge	—	1 500
k	From a mechanical air inlet, including a spa blower	1 500	1 000
n	Vertically below an openable window, non-mechanical air inlet, or any other opening into a building with the exception of sub-floor ventilation:		
A2	For space heaters up to 50 MJ/h input	150	150
	For other *appliance*s up to 50 MJ/h input	500	500
	For *appliance*s over 50 MJ/h input and up to 150 MJ/h input	1 000	1 000
	For *appliance*s over 150 MJ/h input	1 500	1 500

* Unless *appliance* is *certified* for closer installation.

† Prohibited area below electricity meter or fuse box extends to ground level.

NOTES:

1 Where dimensions *c, j* or *k* cannot be achieved an equivalent horizontal distance measured diagonally from the nearest discharge point of the terminal to the opening may be deemed by the *Technical Regulator* to comply.

2 See Clause 6.9.4 for restrictions on a *flue terminal* under a covered area.

A2 3 See Figure J3 for minimum clearances required from a *flue terminal* to an *LP Gas cylinder*. A *flue terminal* is considered to be a source of ignition.

A2 4 For *minimum clearances* not addressed above acceptance should be obtained from the *Technical Regulator*.

5 Minimum clearances *d* and *e* also apply to any combustion air intake openings of appliances.

FIGURE 6.2 (in part) LOCATION OF FLUE TERMINALS OF BALANCED FLUE, ROOM-SEALED, FAN-ASSISTED OR OUTDOOR APPLIANCES

TABLE 6.7

MINIMUM CLEARANCES REQUIRED FOR FLUE TERMINALS FROM GAS MEASUREMENT SYSTEMS (NEW ZEALAND ONLY)

Ref.	Clearances	GMS up to 25 m^3/h (G16)		
		Venting regulator relief valve	Automatic shut-off device regulator	No regulator
d	Horizontal distance, mm	800	400	400
	Vertical above, mm	1000	300	300
	Vertically below (*Natural gas*), mm	300	300	300
	Vertically below (*LP Gas*), mm	1500	800	800

NOTES:

1 Clearance distances are measured from the nearest point of the GMS.

2 This table may be used as guidance for *check meter* installations.

6.9.5 Terminating a flue in a roof space

A2 In New Zealand a *flue terminal* shall not be located in a roof space.

In Australia a *flue terminal* is permitted in a roof space subject to all of the following:

(a) The *appliance* shall not be a decorative *gas* log fire, incinerator, pottery kiln or other *Type B appliance*.

(b) The total *gas consumption* shall not exceed 80 MJ/h.

(c) The total *gas consumption* of all *appliance*(s) to be *flue*d into the roof space shall not exceed 3 MJ/h per cubic metre of roof space.

A2 (d) The *flue terminal* shall be located to achieve at least 500 mm from any *combustible material* or part of the building structure.

(e) Where the *flue terminal* is located less than 1 m from a metal clad roof, a metallic deflector plate not less than 600 mm × 600 mm shall be fitted above the *flue terminal* to the underside of the rafters.

(f) Ventilation shall be provided into the roof space by—

(i) in the case of an unsealed roof, the normal air gaps between the tiles; or

(ii) in the case of a sealed roof, two openings located on opposite sides or ends of the roof, each with a minimum free ventilation area of 50 000 mm^2.

NOTE: A sealed roof includes tiling with sarking or other insulating material under the tiles, metal decking, corrugated roofing or any other roofing method that does not allow sufficient roof ventilation.

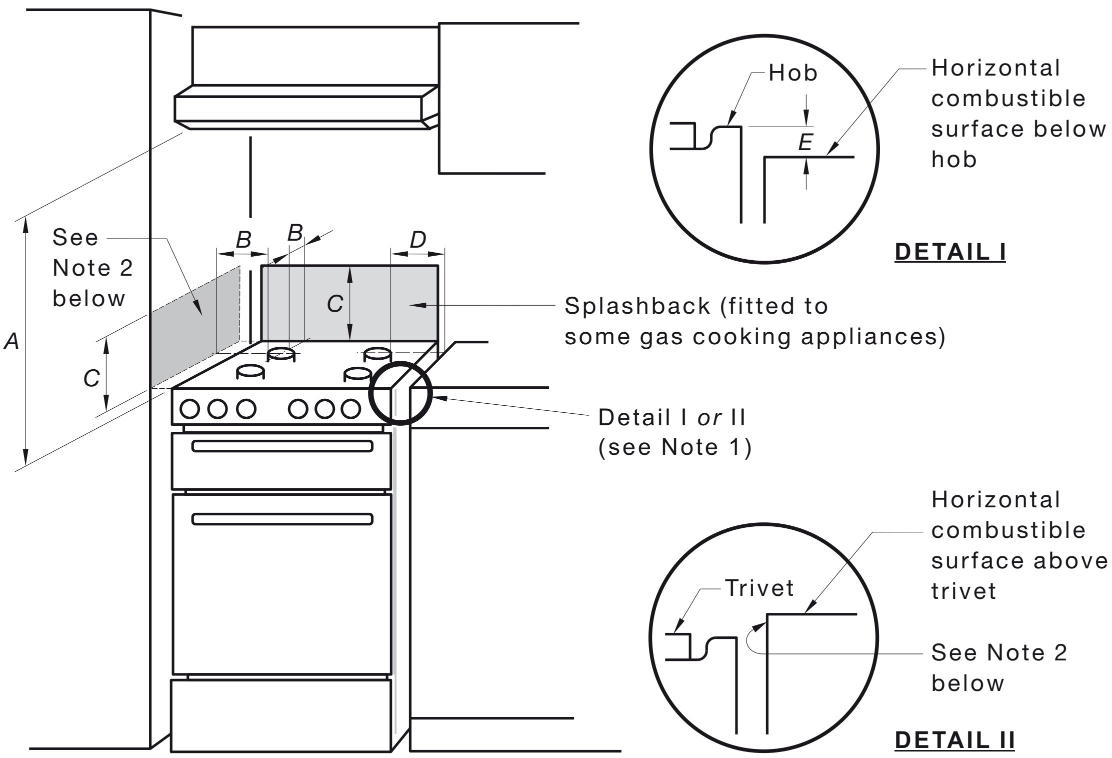
A2 A *flue terminal* shall not be located within a roof space that is utilized for heat recovery ventilation.

6.10 ADDITIONAL REQUIREMENTS FOR INSTALLATION OF SPECIFIC GAS APPLIANCES

6.10.1 Domestic gas cooking appliances

6.10.1.1 *Clearance around a gas cooking appliance*

The required clearance between a *gas* cooking *appliance*, other than those covered under Clause 6.10.1.7, and a *combustible surface* shall be in accordance with the cooking *appliance manufacturer's specification*. In the event that clearances are not specified, clearances shall be as in Figure 6.3 and as follows:



NOTES:

1 Details I and II relate to Requirement 3 of Clause 6.10.1.1(c).

2 In this case, any vertical *combustible surface* needs to be protected in accordance with Requirement 2 of Clause 6.10.1.1(b).

FIGURE 6.3 REQUIRED CLEARANCES AROUND DOMESTIC GAS COOKING APPLIANCES

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

Range hoods and *exhaust fans* shall be installed in accordance with the *manufacturer's relevant 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 6.10.1.2. However, this clearance to any surface shall not be less than 450 mm.

(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 6.10.1.2 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*.

(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 10 mm or more, or the horizontal *combustible* surface shall be above the *trivet*. See Details I and II in Figure 6.3.

NOTES:

1 Requirement 3 does not apply to a freestanding or elevated *gas* cooking *appliance* which is designed to prevent flames or the cooking vessels from extending beyond the periphery of the *gas appliance*.

2 The 'cooking surface area' is defined as that part of the *gas appliance* where cooking normally takes place and does not include those parts of the *gas appliance* containing control knobs.

3 Consideration is to be given to window treatments and painted surfaces on glass splashbacks when located near cooking *appliance*s.

6.10.1.2 *Protection of a combustible surface near a gas cooking appliance*

In order to meet the requirements of Clause 6.2.5, any *combustible surface* within the
A2 clearance zone specified in Clause 6.10.1.1 shall be protected in accordance with Appendix C for the applicable facing and backing materials.

6.10.1.3 *Multiple cooker installations in domestic science classrooms*

Where multiple domestic cooking *appliances* are installed in schools and the like, adequate permanent natural ventilation openings shall be provided direct to outside to ensure that products of combustion are adequately diluted and the effect on *indoor* air quality is minimized. At least two permanent openings shall be provided at high and low level in accordance with Clauses 6.4.4.3 and 6.4.4.5.

6.10.1.4 *Clearance above a high level griller*

The clearance above the *burner* of a high level griller to a *combustible surface* shall be at least that given in Figure 6.3 unless the *appliance* has been *certified* for a lesser clearance.

NOTE: A high level griller may be separately mounted or be part of another *gas* cooking *appliance*.

6.10.1.5 *Clearance from oven flue of elevated gas cooking appliance*

The clearance between an overhead surface and the oven *flue* outlet of an elevated *gas* cooking *appliance* shall not be less than 200 mm.

6.10.1.6 *Connecting an elevated cooking appliance*

The final *gas* connection to an *elevated cooking appliance* shall be of adequate length to allow sufficient withdrawal of the *appliance* for disconnection and be either—

(a) annealed copper pipe; or

(b) a *hose assembly.*

NOTE: The *appliance* may need to be secured against accidental movement if installed on a hard surface.

A2 **6.10.1.7** *Indoor barbecues in residential premises*

Indoor barbecues in residential premises shall comply with AS/NZS 5263.1.1 or AS 4551 and be installed such that—

(a) measured horizontally, a vertical *combustible surface* less than 200 mm from the cooking surface area is protected in accordance with Clause 6.10.1.2 for a height of 150 mm; and

(b) the clearances shown in Table 6.8 are observed.

NOTES:

1 This Clause (6.10.1.7) applies to *gas appliances* designed for use without a cooking vessel where cooking fats can fall on to and flare up from a heated perforated plate, volcanic rock or similar refractory material.

2 Any *combustible surfaces* less than 1200 mm but not less than 600 mm from the cooking surface may be protected in accordance with Clause 6.10.1.2.

3 The 'cooking surface area' is defined as that part of the *gas appliance* where cooking normally takes place and does not include those parts of the *gas appliance* containing control knobs.

TABLE 6.8

COOKING SURFACE AREA MINIMUM CLEARANCES

Cooking surface area	Minimum clearance, mm
Vertically to an overhead grease filter	1200
Vertically to a *combustible surface*	1200
Vertically to a non-*combustible surface*	600
Horizontally to a vertical *combustible surface*	200

6.10.1.8 *Installation of LP Gas cooktops*

NOTE: For safety, *LP Gas cylinders* should be located outside the building. See Appendix J for guidance on installation.

LP *Gas* cook tops shall be installed as in Clause 6.10.1.1 and Clause 6.10.1.2.

The following apply for connection to the cooktop:

(a) Hose assemblies manufactured for *LP Gas* use shall be used.

(b) Hoses shall not pass through walls or dividers.

(c) Copper piping shall be used where the piping from the *LP Gas cylinder* to the *LP Gas* cook top, passes through a wall or *cupboard*.

In New Zealand, where the *LP Gas cylinder* is located inside, the following conditions apply:

(i) The *cylinder* connection system shall be suitable for *indoor* use.

(ii) *Cylinders* shall not be more than 25 litres water capacity (9 kg *cylinder*).

(iii) The *cylinder* shall not be in the same compartment as a power point or electrical *appliance*, for example waste disposal unit or dishwasher.

(iv) The compartment in which the *cylinder* is located shall be ventilated directly to the outside of the building, with a vent of at least 1 000 mm^2 at low level.

(v) Hoses in excess of 1 m shall not be used.

(vi) Jubilee clips shall not be used.

6.10.1.9 *Connecting a freestanding cooking appliance using a hose assembly—High level connection*

Where a *freestanding cooking appliance* is to be connected with a *hose assembly* using a high level connection, the following shall apply:

(a) The cooking *appliance* shall be designed and *certified* for that type of connection.

(b) The *hose assembly* length shall be between 1 m and 1.2 m.

(c) The height of the *consumer piping* connection point above the floor shall be approximately equal to the height of the cooking *appliance* connection point.

(d) The connection point in Item (c) shall face downward and be approximately 150 mm to the side of the cooking *appliance* connection point when the *appliance* is in the installed position.

NOTE: Requirements in Items (b), (c) and (d) are to ensure the *hose assembly* is kept clear of the floor when the *appliance* is in the installed position. The distance between the connection points enables the cooking *appliance* to be 'pushed in' as near as possible to the rear wall.

(e) A restraining chain or wire of adequate strength shall be fixed to the *appliance* and the wall within 50 mm of each connection point. The length of the chain or wire shall not exceed 80% of the length of the *hose assembly*.

NOTE: The restraining chain or wire is to prevent stress being imparted onto the *hose assembly* when the cooker is moved out of its normal operating position.

(f) Where a domestic cooker is connected to *consumer piping* using a *hose assembly*, the *hose assembly* used shall be *certified* to AS/NZS 1869, Class B or Class D.

6.10.1.10 *Under cooker connection*

A *freestanding cooking appliance* having an under cooker connection point shall not be connected to that point using a *hose assembly*.

6.10.1.11 *Stabilization of a freestanding cooking appliance*

The method recommended in the *manufacturer's instructions* to prevent the tilting of a *freestanding cooking appliance*, when in the installed position, shall be used.

6.10.1.12 *Inbuilt oven*

The following requirements apply:

(a) The location of an inbuilt oven shall be such that it will allow operation of the oven and complete removal from the recess.

(b) The size of the recess shall be sufficient to provide adequate clearance between the casing of the oven and adjacent *combustible material*.

NOTE: Refer to *manufacturer's installation instructions* for details of required clearances.

(c) The base of the recess shall be capable of supporting the full weight of the oven.

(d) Unless an inbuilt oven has been *certified* for connection using a *hose assembly* as specified in the *appliance manufacturer's instructions*, and the use of the *hose assembly* complies with Clause 5.9, the final *gas* connection shall be of annealed copper pipe of adequate length to allow sufficient withdrawal of the oven from the recess for disconnection.

(e) An electrical connection in accordance with Clause 6.2.8 shall be *accessible*, located outside and adjacent to the oven recess. Any penetration of a partition for the power supply cord shall be large enough to allow the plug to pass through.

6.10.1.13 *Single boiling burners*

A single boiling *burner* (ring *burner*) shall stand on a fire-resistant base, and comply with the clearance requirements of Clause 6.10.1.1.

A2 **6.10.1.14** *Domestic gas cooking appliances in combined living/sleeping areas*

In a combined living/sleeping area, a domestic cooking appliance shall only be installed under a rangehood or exhaust fan which is ducted to outside.

NOTE: This clause applies to buildings approved for construction after adoption of this Standard by the relevant Technical Regulator.

6.10.1.15 *Commercial catering equipment in residential premises*

Commercial catering equipment shall only be installed in residential premises if permitted in the manufacturer's installation instructions. The gas installation shall comply with Clause 6.10.2 and include an exhaust system complying with AS 1668.1 and AS 1668.2 that is interlocked to the appliance gas supply.

6.10.2 Commercial catering equipment

NOTE: Health Authorities or national building codes may require an exhaust system to be fitted where these *gas appliances* are installed. Such systems should comply with AS/NZS 1668.1 and AS 1668.2.

6.10.2.1 *Combination cooking ranges*

Where two or more *gas appliances* are to be connected together to form a combination cooking range—

(a) the *gas* supply to the group of *gas appliances* shall be from one source;

(b) where multiple *appliances* are connected, no more than six *gas appliances* shall be connected together; and

(c) the connecting pipe shall—

    (i) be of adequate size to allow all *gas appliances* to operate at maximum *gas consumption* simultaneously; and

    (ii) have a *manual shut-off valve*, which will shut off all the *gas appliances*, fitted in an *accessible* location.

NOTE: Supply from more than one source may create a hazard if there is ever a need to turn off the *gas* supply to the group of *gas appliances* in an emergency.

6.10.2.2 *Clearances to a grease filter*

A2 The clearance between any part of a grease filter and the nearest part of the cooking surface or trivet shall not be less than the clearance specified in Table 6.9.

TABLE 6.9

CLEARANCES TO GREASE FILTERS

Gas appliance	Minimum clearance, mm
Kebab cooker	200
Solid grill plate, deep fryer (top of pan)	600
Open flame *gas appliance* (i.e., hotplate *burner*)	1050
A2 Target top Chinese cooking table, griddle, barbecue, char *griller*/broiler or open top flare *griller*/broiler	1350

NOTES:

A2 1 Where multiple *appliances* are serviced by one extraction system, the distance from the cooking surface of each *gas appliance* to the grease filter shall be such that the minimum clearance in this table is applied to each respective *appliance*.

2 For other commercial catering equipment, refer to the *manufacturer's relevant instructions*.

6.10.2.3 *Clearances around commercial catering equipment*

The clearance to *combustible surfaces* from commercial catering equipment shall comply with the *gas appliance manufacturer's instructions* and shall not be less than the clearance as shown in Table 6.10.

TABLE 6.10

MINIMUM CLEARANCES AROUND COOKING SURFACE AREA

	Cooking surface area	Minimum clearance, mm
(a)	Above the cooking surface of a *gas appliance* not covered in Table 6.9	600
(b)	Subject to Item (c) below, from a cooking surface area having an open flame and no means of preventing cooking vessels from overhanging the edge of the *gas appliance*.	250
(c)	From the side of an open flame *gas appliance*, where the *combustible surface* is at least 100 mm below a cooking surface area	50
(d)	From a *gas appliance* flueway or rear of a *gas appliance* with a 'splashback'	50
(e)	From the rear or side of a *gas appliance* which is not an open flame *gas* cooking *appliance*	50

NOTES:

1 The cooking surface area is defined as being that part of the *gas appliance* where cooking normally takes place and does not include those parts of the *gas appliance* containing control knobs.

2 Example: If a timber preparation table is adjacent to a commercial range, and the table has a *combustible surface* that is 100 mm below the *hob*, then 50 mm clearance is required from the range. Any *combustible surface* higher than that would need to have at least 250 mm clearance, or be protected.

3 These clearances do not apply where an adjacent surface is of a non-*combustible material* or is A2 combustible but is protected with *fire resistant material in* accordance with Appendix C, Paragraphs C2 and C3. The *fire resistant material* may be covered by ceramic tiles or stainless steel to meet appropriate requirements relating to health protection.

4 Care should be taken where a *combustible surface* is covered by a non-*combustible material*. For example, covering a *combustible surface* with stainless steel will not prevent heat transfer, and in some circumstances a hazardous situation could arise.

5 Refer to Clause 6.3.7 for requirements regarding *gas appliances* above a source of cooking vapour, steam or grease.

6.10.2.4 *Commercial catering equipment on a combustible surface*

Where commercial catering equipment is installed on a *combustible surface*, the surface shall be protected by *fire resistant material* unless the lowest *burner* on the *gas appliance* is over 200 mm above the mounting surface, and a heat shield below the *burner* is incorporated in the design of the *gas appliance*. The protection shall extend at least 50 mm beyond the perimeter of the *gas appliance* and be impervious to cooking fats.

Where the lowest *burner* on the *appliance* is over 200 mm above the mounting surface, and a heat shield below the *burner* is incorporated in the design of the *appliance*, no protection is required.

A2

6.10.2.5 *Domestic gas cooking appliances in commercial installations*

Domestic cooking *appliances* installed in commercial kitchens shall comply with the requirements of Clause 6.10.2.1 to 6.10.2.4.

6.10.3 Instantaneous water heaters

6.10.3.1 *Prohibited locations*

An instantaneous *water heater*, other than a room-sealed type, shall not be installed in a—

(a) *bedroom*;

(b) *bathroom*;

(c) toilet; or

(d) combined living/sleeping room.

6.10.3.2 *Flueless instantaneous water heater*

In Australia, a flueless instantaneous *water heater* shall not be installed *indoors*.

In New Zealand, flueless instantaneous *water heaters* may be installed *indoors* subject to the following:

(a) The input of any flueless *water heater* installed *indoors* shall not exceed 0.4 MJ/h/m^3 of room volume (100 W/m^3).

(b) Flueless *water heaters* shall not be fitted underneath projecting shelves or *cupboard*s, nor with a clearance less than 150 mm from side walls, and the *flue terminals* shall not be less than 600 mm below ceilings.

6.10.4 Storage water heaters

When a storage *water heater* is to be installed in a *bathroom* or toilet, the *gas consumption* shall not exceed 40 MJ/h.

6.10.5 Pool heaters (including those for swimming, spa and therapeutic pools)

6.10.5.1 *Prohibited locations*

A *pool 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.

6.10.5.2 *Supporting base*

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

6.10.5.3 *Control systems*

Pool heaters shall have the following controls:

(a) A control system to ensure the water temperature in the pool does not exceed 40°C.

(b) A manual reset high *temperature limit device* independent of the control system to prevent the water temperature in the pool exceeding 45°C.

(c) Controls to ensure water is flowing through the heater before the main *gas* valve admits *gas* to the *burners*.

6.10.5.4 *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 unlagged metallic pipe unless stated otherwise in the *pool heater manufacturer's relevant instructions*.

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

6.10.5.5 *Non-return valve*

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

6.10.5.6 *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.

6.10.6 Space heaters

6.10.6.1 *Limitation on installation*

A space heater other than a room-sealed type shall not be installed in a *bathroom* or toilet.

A space heater installed in a *bedroom*, a room used for sleeping or a room generally kept closed shall be—

(a) a room-sealed heater; or

A2 (b) a flued heater fitted with a flame safeguard system and with permanent ventilation provided in accordance with Clause 6.4.4, irrespective of the heater rating.

6.10.6.2 *Open flued appliance with rear register*

Appliances with rear registers shall be installed such that the operation of the air circulation fan does not lower the air *pressure* in the room in which the *appliance* is installed.

NOTES:

1 Unequal *pressure* could cause *flue* spillage.

2 A relief grille may be required between the rooms to equalize the air *pressure*.

6.10.6.3 *Restrictions on installation of flueless space heater*

Where a flueless space heater is to be installed the following, as appropriate, shall apply:

(a) The maximum *gas consumption* of the heater(s) shall not exceed that given in Table 6.11. In residential *premises*, the combined *gas* consumption of all the heaters in the room is not to exceed 25 MJ/h.

(b) The room where the heater is to be installed shall be isolated from sleeping rooms.

NOTE: The provision of an unventilated door on the sleeping area would satisfy this requirement.

(c) The heater shall not be recessed in a wall unless the heater is designed and *certified* for such installation.

(d) There shall be a minimum vertical clearance of 600 mm between the top of the heater and any overmantle, shelf or other projection directly above the heater.

(e) Where a heater is to be installed in a fireplace the chimney shall be closed off.

(f) The air supply requirements of Clause 6.4.4 shall be met.

NOTE: See Appendix N for special requirements set out by *Technical Regulators* in Victoria, Western Australia and South Australia.

TABLE 6.11

MAXIMUM GAS CONSUMPTION OF FLUELESS SPACE HEATERS

Appliance location	Appliance type	Maximum gas consumption per cubic metre of room volume, $MJ/h/m^3$
In habitable space	Thermostatically controlled	0.4
	Not thermostatically controlled	0.2
In passageway or lobby	Either thermostat or non-thermostat control	0.4

NOTE: Refer to Clause 6.4.6.

6.10.6.4 *Installation of space heater in an institution*

Any space heater installed in an institution shall be securely fixed independently of the pipework.

NOTES:

1 An institution is to be taken to include a home for the aged, a sanatorium, a convalescent home, a school or a kindergarten.

2 Installations in such institutions may require secondary guards to be fitted to the heater and its *flue* outlet.

3 Suitable *flue* guards should be obtained from the *appliance* manufacturer.

6.10.7 Overhead radiant heaters

NOTE: This Clause does not apply to overhead radiant tube heaters, see Clause 6.10.13.

6.10.7.1 *Overhead radiant heaters installed indoors*

An overhead radiant heater installed *indoors* shall comply with all of the following:

(a) Be at a height complying with the *manufacturer's installation instructions*, but not less than 2.5 m above floor level.

(b) Be supported independently of the *consumer piping*.

(c) Have a minimum clearance to *combustible material* above the heater as specified in Table 6.12 unless adequate protection is provided to ensure that the temperature of the *combustible material* does not exceed 65°C above ambient.

TABLE 6.12

CLEARANCE TO COMBUSTIBLE MATERIAL ABOVE OVERHEAD RADIANT HEATERS

Maximum input, MJ/h	Minimum clearance above gas appliance, mm
6	750
12	900
Greater than 12	1 100

6.10.7.2 *Overhead radiant heaters installed outdoors or in quasi-outdoor situations*

An overhead radiant heater installed *outdoors* or in a *quasi-outdoor* situation shall comply with all of the following:

(a) Be wall-mounted.

(b) Be at a height complying with the *manufacturer's installation instructions*, but in no instance be less than 1.8 m above floor level.

(c) Be supported independently of the *consumer piping*.

(d) Have a minimum clearance to *combustible material* above the heater as specified in Table 6.12 unless either—

  (i) adequate protection is provided to ensure that the temperature of the *combustible material* does not exceed 65°C above ambient; or

  (ii) the *appliance* has been *certified* for lesser clearance.

6.10.8 Patio heaters

6.10.8.1 *Limitation on installation*

A patio heater *certified* for *outdoor* installation shall not be installed *indoors*.

6.10.8.2 *Pole mounted*

A pole mounted patio heater shall be installed to comply with all of the following:

(a) A patio heater *certified* for pole mounting shall not be installed in a bracket arrangement unless *certified* for that application.

(b) Be secured to prevent tilting.

NOTE: A manufacturer supplied weighted base is deemed to be acceptable.

(c) If connected to fixed *consumer piping*, be installed to prevent strain on the *consumer piping*.

(d) If connected by *hose assembly*—

  (i) be located so as not to cause a hazard;

  (ii) be located with at least the *manufacturer's recommended clearances* to any *combustible surface*; and

  (iii) be supplied with a means to prevent stress on the hose. This may be either of the following:

    (A) A restraining chain or wire of adequate strength for fixing to the *appliance* or table and the *cylinder*. The length of the chain or wire shall not exceed 80% of the length of the *hose assembly*.

    (B) A device that adequately supports the *cylinder* and prevents displacement.

6.10.8.3 *Suspended other than by pole mounting*

A patio heater designed to be suspended other than by pole mounting shall be installed to comply with all of the following:

(a) Be at a height complying with the *manufacturer's instructions*, but not less than 2.5 m between floor level and the heating surface when installed *indoors* (applies only where the *appliance* is *certified* for *indoor* installation) or not less than 1.8 m above floor level when installed *outdoors* or *quasi-outdoors*.

(b) Have at least the *manufacturer's recommended clearances* to any *combustible surface*.

(c) Be supported independently of the *consumer piping*.

6.10.9 Decorative flame effect fires, other than flame effect gas space heaters

6.10.9.1 *Prohibited installation*

A *decorative flame effect fire*, other than a room-sealed type, shall not be installed—

(a) in a *bathroom* or toilet; or

(b) if its *gas consumption* exceeds 72 MJ/h.

6.10.9.2 *Requirements for fireplace and chimney*

Open flame type *decorative flame effect fires* (*Type 1*) shall be installed in non-combustible fireplaces fitted with a vertical chimney or *flue* of a minimum cross-sectional area of 40 000 mm^2 (i.e., 200 mm × 200 mm, or approximately 230 mm in diameter) or smaller if specified in the *appliance manufacturer's instructions*. The chimney, hearth, fireplace back (where applicable) and other parts of the fireplace shall be of suitable construction for use with solid fuel.

The adequacy and effectiveness of any fireplace and chimney into which a *decorative flame effect fire* is installed shall be checked before and after installation. There shall be no significant spillage of *flue gases* under stabilized operating conditions.

NOTES:

1 A smoke candle or other suitable device should be used to check for spillage.

2 Local building regulations provide requirements for the construction of hearths, chimneys and fireplaces into which these *appliances* can be installed.

6.10.9.3 *Damper not permitted in chimney or flue*

A damper shall not be fitted in a chimney, *flue* or on any fire box associated with the installation of a *decorative flame effect fire*. Any damper, which is already in existence, shall either be removed or permanently fixed in the fully open position.

6.10.9.4 *Flue cowl requirements*

The fitting of a *flue cowl* to a masonry chimney into which a *Type 1 decorative flame effect fire* is installed is optional, unless specifically required in the *appliance manufacturer's instructions*. If fitted, the *flue cowl* shall be of 225 mm *nominal diameter*, unless a smaller diameter is specified in the *appliance manufacturer's instructions*.

Where a *flue* is installed for a *Type 1 decorative flame effect fire*, a *flue cowl* shall be fitted. The *flue* and *flue cowl* shall be of 225 mm *nominal diameter* or less if otherwise specified in the *appliance manufacturer's instructions*.

Where a *Type 2 decorative flame effect fire* is installed, a *flue cowl* of same *nominal diameter* as the *flue* shall be fitted.

6.10.9.5 *Ventilation requirements*

Notwithstanding the requirements in Clause 6.4.4, one or more ventilation openings with a combined free ventilation area of not less than the equivalent cross-sectional area of the *flue cowl* shall be provided for each *decorative flame effect fire*. Where a cowl is not fitted to a chimney for a *Type 1 decorative flame effect fire* the ventilation opening area shall be in accordance with Clause 6.4.4.3 or 40 000 mm^2 whichever is the greater. The chimney in which the *appliance* is installed shall not be considered as a ventilation opening.

6.10.10 Ducted air heaters

6.10.10.1 *Location*

Ducted warm air *gas appliances* shall be located to minimize noise transmission to the heated area.

6.10.10.2 *Interaction of heating air and air for combustion*

The central heating system shall be constructed so that the operation of the circulating fan has no adverse effect on the *flue* system or the ventilating and combustion air flow of the ducted air heater or any other *gas appliance*.

6.10.10.3 *Ductwork not to prevent lighting or servicing*

Ductwork shall not interfere with access for lighting or servicing the *gas appliance*.

6.10.11 Air curtains

NOTE: AS 3814 provides operational limits for air curtains which should be checked on commissioning.

Gas-fired air curtains shall—

(a) be above an external door;

(b) have an *interlock* provided which causes the main *burner* to shut down when the door commences to close, if the *gas consumption* of the air curtain, or total *gas consumption* of all air curtains in an area, exceeds 0.2 MJ/h/m^3 of room volume;

NOTE: Where the air curtain is to be installed above automatic doors, some *Technical Regulator*s do not require an *interlock* if additional ventilation is provided in the area serviced by the air curtain.

(c) have the outlet grille—

(i) facing vertically downwards;

(ii) at least 2 m above floor level; and

(iii) with a 75 mm clearance, around the perimeter, to a *combustible surface*; and

(d) have a clearance of at least 150 mm between the air intake of the *gas appliance* and a neighbouring structure.

6.10.12 Direct fired air heaters

NOTE: AS 3814 provides operational limits for *direct-fired air heaters* which should be checked on commissioning.

6.10.12.1 *Prohibited locations*

A *direct-fired air heater* shall not be installed in—

(a) a residential *premises*;

(b) any type of hospital;

(c) a nursing home, rest home, convalescent home, sanatorium, rehabilitation centre or centre for the mentally handicapped; or

(d) a classroom, lecture room or office in an educational institution.

NOTE: A school, college or the like, kindergarten, pre-school centre, child minding centre or infant welfare centre is to be considered as an educational institution.

6.10.12.2 *Restriction on air supply*

The air supply for a *direct-fired air heater* shall be provided directly from outside.

6.10.13 Overhead radiant tube heaters

NOTES:

1 Where a multi-*burner flue* system with a common fan is to be installed, the *Technical Regulator* may require to be specifically advised prior to the commencement of any work.

2 Table 6.11 may apply to this Clause.

6.10.13.1 *Requirements for installation*

An overhead radiant tube heater shall—

(a) be installed at a height complying with the *manufacturer's installation instructions*, but not less than 3.5 m above floor level unless variation is approved by the *Technical Regulator*; and

(b) be supported independently of the *consumer piping*.

6.10.13.2 *Requirements for an installation where atmosphere is contaminated*

Where a heater is to be installed in an area where excessive dust or lint or any flammable vapours are present, the following shall apply:

(a) Combustion air shall be ducted from outside.

(b) The *flue* shall be extended to outside.

NOTE: The *Technical Regulator* should be consulted as in some instances this flueing requirement may not be necessary.

6.10.13.3 *Clearances required around the heater*

The following clearances around the heater shall apply:

(a) There shall be sufficient clearance from a *combustible surface* or electrical wiring to ensure that, with continuous operation of the heater, the surfaces or wiring will not exceed 65°C above ambient.

(b) The heater shall be clear of any sprinkler system, overhead crane or other area where damage or interference to the heater may occur.

6.10.14 Laundry dryers

6.10.14.1 *Laundry dryer with exhaust fan*

Laundry dryers incorporating an *exhaust fan* shall have—

(a) a fan *interlock* with the *gas* supply; and

(b) a high limit switch to shut off the *gas* if safe temperature limits are exceeded, for example, by blockage in the lint trap or *flue*.

6.10.14.2 *Exhaust duct required*

An exhaust duct shall be fitted where—

(a) the *gas consumption* of the dryer exceeds 10 MJ/h; or

(b) the dryer is installed in a *bedroom* or *bathroom*.

6.10.14.3 *Exhaust duct requirements*

Exhaust ducts shall have a smooth interior surface and shall discharge outside the building. Such ducts shall not discharge into brickwork, chimneys, roof spaces or wall cavities.

Where exhaust ducts from dryers are to be combined, the ducting shall be sized in accordance with the *manufacturer's instructions*.

Where an exhaust duct extension is more than 900 mm long, an access opening shall be provided near the dryer for lint removal.

An exhaust duct from a laundry dryer shall not be combined with a *flue* from another *appliance*.

Exhaust ducts shall be terminated according to the *appliance manufacturer's instructions*.

NOTES:

1 'Exhaust duct', when related to a laundry dryer, is defined as a duct connected to a laundry dryer for the removal of air, water vapour and *combustion products* to a discharge point outside the building. The removal of the *combustion products* is a minor aspect of its function.

2 Flexible *flues* and *flue* liners are considered to be smooth.

6.10.14.4 *Ventilation requirements*

Ventilation openings shall be provided to ensure adequate air supply for combustion and to replace air discharged through the exhaust duct(s).

6.10.14.5 *Exhausting into a room or enclosure*

Where a dryer with a *gas consumption* of 10 MJ/h or less exhausts into a room or *enclosure*, that room or *enclosure* shall be ventilated.

The minimum ventilation opening shall be 26 000 mm^2 for each dryer, half to be provided within 300 mm of the ceiling and the remainder within 300 mm of the floor.

6.10.14.6 *Dryers for community use—Operating instructions to be displayed*

Clothes dryers installed for community or commercial use shall have operating instructions permanently displayed in a prominent position and have a notice permanently and prominently displayed warning the users that clothing or other materials containing flammable solvents shall not be placed in the dryer.

6.10.15 Gas lights

Gas lights shall not be installed in rooms used for sleeping, rooms generally kept closed or *bathrooms*. In other locations the total input rating of *gas* lights shall not exceed 0.2 MJ/h/m^3 (50 W/m^3) of room volume.

Internal pendant lights shall be supported independently of the supply pipe.

Bracket and pendant lights of the enclosed type shall have a minimum clearance from *combustible materials* of 450 mm vertically and 125 mm horizontally.

6.10.16 Incinerators

NOTE: Because of combustion and flueing considerations it is common for an incinerator to be installed without a *draught diverter*. The *manufacturer's instructions* detail requirements for such installations. In some areas, fire authorities and local environmental authorities have regulations for these types of *appliances*. Those authorities should be contacted before commencing an installation.

6.10.16.1 *Required clearances to combustible surfaces*

The maximum surface temperature of any *combustible surface* around an incinerator shall not exceed 65°C above ambient, but in no case shall the clearances to *combustible surfaces* be less than those given in Table 6.13.

TABLE 6.13

CLEARANCE TO COMBUSTIBLE SURFACES AROUND AN INCINERATOR

Part of incinerator	Minimum clearance to combustible surface, mm
Sides and top	1000
The front	1050
Horizontal surface above the charging door	1200

NOTES:

1 The clearance to the horizontal surface above a charging door may be reduced to 600 mm provided that surface is protected. The protection required shall be at least equal to that given by 0.4 mm sheet metal spaced out 25 mm by non-*combustible* spacers. The protection shall extend at least 450 mm beyond all sides of the charging door.

2 An incinerator that is designed to retain the flame within the *appliance* during loading is exempt from the minimum clearance above the charging door.

6.10.16.2 *Flueing of an incinerator*

A *flue* connected to an incinerator shall comply with the following as appropriate:

(a) Terminate to outside atmosphere in a location relative to neighbouring structures so that wind from any direction will not be likely to create downdraught in the *flue*.

(b) Not be interconnected with the *flue* from any other type of *appliance*.

(c) Where two or more incinerator *flues* are to be combined, the *Technical Regulator* shall be consulted prior to commencement of work.

(d) If constructed of metal other than stainless steel—

  (i) be *accessible* for visual examination for the entire length; and

  (ii) the metal shall be at least as durable as 1.6 mm mild steel.

(e) Have provision for the removal of ash—

  (i) in any lateral run of *flue* exceeding 3 m; and

  (ii) in any vertical *flue* exceeding 900 mm.

(f) If constructed of masonry there shall be a minimum clearance of 300 mm to *combustible material*. This clearance may be reduced if the *combustible material* is shielded or protected. In no case is the surface temperature of the *combustible material* to exceed 65°C above ambient.

6.10.16.3 *Operating instructions to be displayed*

Operating instructions shall be permanently displayed in a prominent position adjacent to the incinerator. These instructions shall detail types and quantities of waste that may be incinerated, and the cleaning instructions.

6.10.17 Pottery kiln

NOTE: Because of combustion and flueing considerations it is not unusual for a pottery kiln to be installed without a *draught diverter*. The *manufacturer's instructions* detail requirements for such installations. Some Local Government Authorities have requirements for the installation of these *appliances*. The relevant Local Government Authority should be contacted prior to the commencement of any work.

6.10.17.1 *Support to be non-combustible and of adequate strength*

The floor or supports on which the kiln shall be installed shall be non-*combustible* and of adequate strength for the fully loaded kiln.

6.10.17.2 *Flame safeguard system required*

A pottery kiln *burner* system shall be fitted with a *flame safeguard system* in accordance with AS 3814.

6.10.17.3 *Clearances between a hood or canopy and combustible material*

There shall be a clearance of at least 450 mm between the canopy, hood and ducting, and any *combustible material*, unless the material is adequately protected.

6.10.17.4 *Flueing of a pottery kiln*

A *flue* connected to a pottery kiln shall comply with the following as appropriate:

(a) Terminate to outside atmosphere in a location relative to neighbouring structures so that wind from any direction will not be likely to create downdraught in the *flue*.

(b) Not be interconnected with the *flue* of another *appliance*.

(c) If constructed of metal other than stainless steel—

 (i) be *accessible* for visual examination for the entire length; and

 (ii) the metal shall be at least as durable as 1.6 mm mild steel.

(d) If constructed of masonry there is to be a minimum clearance of 300 mm to *combustible material*. This clearance may be reduced if the *combustible material* is shielded or protected. In no case is the surface temperature of the *combustible material* to exceed 65°C above ambient.

6.10.17.5 *Flue dampers*

Flue dampers, where fitted, shall be unable to close completely while the kiln *burner* is firing. *Flue* dampers shall not produce unsafe operating conditions irrespective of their position.

6.10.18 Refrigerator

6.10.18.1 *Prohibited locations*

A refrigerator shall not be located in a pantry, larder or *bedroom* unless installed in accordance with Clause 6.10.18.3.

6.10.18.2 *Required clearances*

Unless otherwise specified in the *appliance manufacturer's instructions*, refrigerators shall be installed with a minimum clearance of 50 mm from the back wall, and 300 mm clearance from the *flue* outlet.

6.10.18.3 *Requirements where refrigerator is to be in a sealed recess.*

Where a refrigerator is to be installed in a sealed recess, the recess shall have two openings to outside. One opening shall be located at the top of the recess and the other at the bottom. The free ventilation area of each opening shall comply with Table 6.14.

TABLE 6.14

VENTILATION FOR A REFRIGERATOR IN A SEALED RECESS

Refrigerator storage capacity, L	Free area of ventilation, mm^2
Up to 100	32 500
100 to 200	45 000
Exceeding 200	65 000

6.10.18.4 *Requirement for annealed copper tube connection*

Where annealed copper tube is to be used for the final *gas* connection to the refrigerator, the tube shall be formed into a loop to avoid work hardening of the tube due to flexing from vibration caused by door operation.

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6.10.19 Gas barbecues and radiant gas heaters for *outdoor* use

Gas barbecues and radiant gas heaters designed for *outdoor* use shall be installed *outdoors* or in areas complying with diagrammatical representations in Appendix I 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 6.9.4.

Any enclosure in which the *appliance* is installed shall comply with one of the following:

(a) An enclosure with walls on all sides, but at least one permanent opening at ground level and no overhead cover.

(b) Within a partial enclosure that includes an overhead cover and no more than two walls.

(c) Within a partial enclosure that includes an overhead cover and more than two walls, the following shall apply—

  (i) at least 25% of the total wall area is completely open; and

  (ii) at least 30% of the remaining wall area is open and unrestricted.

In the case of balconies or verandahs, at least 20% of the total of the side, back and front wall areas shall remain open and unrestricted.

6.11 COMMISSIONING

6.11.1 General

Commissioning requirements apply to both new and existing gas *installations*. Commissioning of existing *gas installations* is required after making modifications or undertaking servicing or repair activities.

Specific commissioning requirements apply for *appliances*.

6.11.2 Australian requirements

A *Type A gas appliance* shall be commissioned by the suitably authorized person who—

(a) installs the *appliance* when *gas* is available at the time of installation; or

(b) makes *gas* available to the *appliance* if *gas* was not available at the time of installation.

A *Type B gas appliance* shall be commissioned in accordance with the requirements of the *Technical Regulator* and by a person meeting the requirements of the *Technical Regulator*.

NOTES:

1 In the case of a non-reticulated *LP Gas* installation the commissioning of the *appliance* is the responsibility of the person who installed the *appliance*.

2 Commissioning requirements for *Type B appliances* are detailed in AS 3814.

6.11.3 New Zealand requirements

Every part of a *gas* installation shall be commissioned prior to initial use.

If the *gas* supply to the installation is insufficient or otherwise unsuitable the installer shall notify the *gas* supplier and leave the installation or the *gas appliance*(s) disconnected.

NOTE: Requirements for the testing and commissioning of gasfitting are specified in the Gas (Safety and Measurement) Regulations 2010.

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6.11.4 Appliance commissioning

Appliance commissioning shall take full account of the *manufacturer's instructions* and all aspects of the *gas installation* that may impact appliance operation. *Appliance* commissioning shall include but not be limited to 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) Checking for flame abnormality in accordance with *manufacturer's instructions*.

(e) Operating the *appliance* at the maximum *gas consumption* to bring to normal operating temperature.

(f) After Step (e) where appropriate, testing for spillage of combustion products. For a flued appliance, testing shall be performed in accordance with Appendix R.

(g) Testing of any safety devices for correct operation.

(h) Informing the consumer, when present, on the safe and correct operation of the appliance and any auxiliary equipment.

(i) 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 O for detailed guidelines for gas appliance commissioning.

2 See Appendix Q for a checklist for checking compliance of the gas installation prior to and during commissioning.

APPENDIX A

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
1074 Steel tube and tubulars for ordinary service

1210 Pressure vessels

1345 Identification of the contents of pipes, conduits and ducts

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

1464 Plastics pipes and fittings for gas reticulation - Unplasticized PVC (UPVC)
1464.1 Part 1: Pipes

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

A2 1668 The use of ventilation and airconditioning in buildings
1668.2 Part 2: Mechanical ventilation in buildings

2129 Flanges for pipes, valves and fittings

2738 Copper and copper alloys—Compositions and designations of refinery products, wrought products, ingots and castings

2944 Plastics pipes and fittings for gas reticulation
2944.1 Part 1: Polyamide pipes
2944.2 Part 2: Polyamide fittings

3688 Water supply—Metallic fittings and end connectors

3814 Industrial and commercial gas-fired appliances

4041 Pressure piping

4176 Multilayer pipes for pressure applications—Multilayer pipe systems for consumer gas installations with a maximum operating pressure up to and including 5 bar (500 kPa)
4176.8 Part 8: Specifications for systems

A2 4551 Domestic gas cooking appliances

4553 Gas space heating appliances

4566 Flue cowls—Gas appliances

4567 Twin wall metal flues—Gas appliances

4617 Manual shut-off gas valves

4623 Jointing compounds and materials for use in gas pipe joints

AS
4627 Quick-connect devices for gas

4629 Automatic shut-off valves and vent valves

4631 Limited flexibility connectors for gas

5200 Plumbing and drainage products
5200.053 Part 053: Stainless steel pipes and tubes for pressure applications

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

6993 Buried, high-impact poly(vinyl chloride) (PVC-HI) piping systems for the supply of gaseous fuels
6993.1 Part 1: Pipes for a maximum operating pressure of 1 bar (100 kPa) (ISO 6993-1:2006, MOD)
6993.3 Part 3: Fittings and saddles for a maximum operating pressure of 1 bar (100 kPa)

AS/NZS
1167 Welding and brazing—Filler metals
1167.1 Part 1: Filler metal for brazing and braze welding

1260 PVC-U pipes and fittings for drain, waste and vent application

1477 PVC pipes and fittings for pressure applications

1518 External extruded high-density polyethylene coating systems for pipes

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

A2 1668 The use of ventilation and airconditioning in buildings
1668.1 Part 1: Fire and smoke control in buildings

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

2208 Safety glazing materials in buildings

2492 Cross-linked polyethylene (PE-X) pipes for pressure applications

2537 Mechanical jointing fittings for use with crosslinked polyethylene (PE-X) for pressure applications
2537.5 Part 5: Plastics pipes and fittings—Crosslinked polyethylene (PE-X) pipe systems for the conveyance of gaseous fuels—Metric series—Specifications—Fittings for mechanical jointing (including PE-X/metal transitions) (ISO 14531-3:2006, MOD)

2648 Underground marking tape
2648.1 Part 1: Non-detectable tape

2918 Domestic solid fuel burning appliances—Installation

4129 Fittings for polyethylene (PE) pipes for pressure applications

AS/NZS	
4130	Polyethylene (PE) pipes for pressure applications
4645	Gas distribution networks
4645.1	Part 1: Network management
4645.2	Part 2: Steel pipe systems
4645.3	Part 3: Plastics pipe systems
5263	Gas appliances
5263.1.1	Part 1.1: Domestic gas cooking appliances
5263.1.3	Part 1.3: Gas space heating appliances
60079	Explosive atmospheres
60079.10.1	Part 10.1: Classification of areas—Explosive gas atmospheres
NZS	
3501	Specification for copper tubes for water, gas and sanitation
4219	Seismic performance of engineering systems in buildings
ISO	
49	Malleable cast iron fittings threaded to ISO 7-1
ASME	
B1.20.1	Pipe threads, general purpose (Inch)
B16.5	Pipe flanges and flanged fittings
B16.9	Factory-made wrought steel butt-welding fittings
B16.11	Forged fittings, socket-welding and threaded
B36.19M	Stainless steel pipe
ASTM	
A53/ A53M	Specification for pipe, steel, black and hot-dipped, zinc-coated, welded and seamless
A106	Specification for seamless carbon steel pipe for high-temperature service
A269	Specification for seamless and welded austenitic stainless steel tubing for general service
BS	
1640	Specification for steel butt-welding pipe fittings for the petroleum industry
1640-1	Part 1: Wrought carbon and ferritic alloy steel fittings
1640-3	Part 3: Wrought carbon and ferritic alloy steel fittings. Metric units
3799	Specification for steel pipe fittings, screwed and socket-welding for the petroleum industry
7838	Specification for corrugated stainless steel semi-rigid pipe and associated fittings for low-pressure gas pipework of up to DN 50
8537	Copper and copper alloys. Plumbing fittings. Specification for press ends of plumbing fittings for use with metallic tubes
DVGW	
VP614	Permanent Tube Connections For Metallic Gas Pipelines— Pressed Joints

A2

EN	
1759	Flanges and their joints—Circular flanges for pipes, valves, fittings and accessories, class designated
1759-1	Part 1: Steel flanges NPS ½ to 24
10241	Steel threaded pipe fittings
14324	Brazing—Guidance on the application of brazed joints
ANSI	
LC-4	Press-connect metallic fittings for use in fuel gas distibution systems
API	
SPEC 5L	Specificatin for line pipe

APPENDIX B

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 A1 is presented as a ready reference for conversion between different units of measurement.

TABLE A1

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)	0.001055	megajoules (MJ)
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°C	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

A2

FIRE RESISTANT MATERIAL AND ACCEPTABLE METHODS OF PROTECTION OF COMBUSTIBLE SURFACES

(Normative)

C1 INTRODUCTION

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

Therefore the material shall provide a given thermal insulation—and not itself be combustible—and have, if necessary, 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/m^2K.

NOTE: The heat transfer coefficient U (W/m^2K), thermal resistance R (m^2K/W), thermal conductivity k (W/mK) and thickness t (m) 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?

$$
\begin{aligned}
t &= k/U \\
&= 0.21/20 \\
&= 0.0105 \text{ m} \\
&= 10.5 \text{ mm}
\end{aligned}
$$

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?

$$
\begin{aligned}
t &= k/U \\
&= 0.11/20 \\
&= 0.0055 \text{ m} \\
&= 5.5 \text{ mm}
\end{aligned}
$$

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.

A2

C4 ACCEPTABLE METHODS OF PROTECTION FOR DOMESTIC APPLICATIONS

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

TABLE C1

ACCEPTABLE METHODS FOR PROTECTION OF COMBUSTIBLE SURFACES

Facing material	Minimum thickness mm	Backing material	Minimum thickness mm
Ceramic tiles	5	Gypsum based wall board	10
		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 6.2.5		

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

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

APPENDIX D
PURGING
(Informative)

D1 INTRODUCTION

Purging is carried out to avoid the possibility of an explosive air/*gas* mixture existing or forming in *consumer piping*, *appliances* or confined spaces. *Purging* is the displacement of—

(a) air, or an inert *gas*, by a fuel *gas*; or

(b) a fuel *gas* by air, or an inert *gas*.

Nitrogen is the preferred inert *gas*.

D2 PRECAUTIONS BEFORE PURGING COMMENCES

The following precautions should be taken before *purging* commences:

(a) Do not commence any *purging* operation until a *purge* area has been defined, made safe and cleared of all *ignition sources*, e.g., naked flames, pilot lights, electrical switchgear, etc.

(b) Do not allow smoking or cell/mobile phones in or near the *purge* area.

D3 PURGING A SUB-METER

Where a *sub-meter* is to be *purged*, a volume of *purging* medium equal to five times the volume held by the meter is required to achieve an acceptable *purge*. Observe the test dial or index to ensure the correct amount has passed through the meter.

NOTES:

1 The volume of a meter is indicated on its badge.

2 Where the GMS/meter owner or *gas* supplier permits other personnel to *purge* the *consumer billing meter*, the above method should be used.

D4 PURGING A SMALL VOLUME INSTALLATION WITH GAS TO REMOVE AIR

D4.1 Pipe length in a small volume installation

A small volume *gas installation* is one with a total installed pipe volume of up to 0.03 m^3 (30 L). The values given in Table D1 give volumes in litres per metre of pipe length. These volumes when multiplied by installed pipe length give the volume of the *gas* installation. All branches as well as the *main run* are to be considered in determining the volume of the installation. Where the volume exceeds 30 L refer to Paragraph D5.

D4.2 Commencing the purge

Follow this procedure when commencing the *purge*:

(a) Plan a method of *purging* that will ensure that no pockets of air will be left within any part of the *consumer piping*.

(b) Ensure that all *appliance* connections are *gastight*, all *appliance gas* valves are turned off and there are no open ends.

(c) Where possible, select an *appliance* located outside (e.g., a *water heater*) or an *appliance* located at the end of the installation (with the longest piping from the meter). Where adequate ventilation cannot be assured use flexible piping to direct the *purged gas* to outside. In other situations an *appliance* with an open *burner* or *burners* such as a cooking *appliance* can be used for *purging*.

(d) Ensure the area is well ventilated, unconfined and free of possible *ignition sources*, mechanical air inlets or other potential hazards.

(e) Branches which do not have an *appliance* connected also require *purging*. Ensure such branches are fitted with a plug or cap.

Special care should be taken to ensure that heavier than air *gases*, e.g., *LP Gas*, are fully dispersed before applying an *ignition source*. Do not *purge* into a combustion chamber or other confined space.

D4.3 Purging through an appliance fitted with an open burner

Carry out the *purge* as follows:

(a) Turn on one *burner gas* control valve until the presence of *gas* is detected.

(b) Let the *gas* flow for a few seconds longer, then turn off and allow sufficient time for any accumulated *gas* to disperse before proceeding.

(c) Turn on one *gas* control valve again and keep a continuously burning flame at the *burner* until the *gas* is alight and the flame is stable.

(d) Continue to *purge* until *gas* is available at each *appliance*.

TABLE D1

APPROXIMATE VOLUME OF PIPE

Pipe material and Standard	Approximate volume of pipe, L/m Nominal size DN															
	15	16	18	20	23	25	32	40	50	63	65	75	80	90	100	110
Copper— NZS 3501	0.13	N/A	N/A	0.28	N/A	0.50	0.79	1.14	2.02	N/A	3.16	N/A	4.55	6.20	8.10	N/A
Copper— AS 1432 (Type B)	0.09	N/A	0.15	0.22	N/A	0.41	0.67	0.99	1.83	N/A	2.92	N/A	4.17	5.75	7.58	N/A
Steel— AS 1074 medium	0.21	N/A	N/A	0.37	N/A	0.59	1.02	1.39	2.21	N/A	3.72	N/A	5.13	N/A	8.68	N/A
PVC-HI— AS ISO 6993.1	0.25	N/A	N/A	0.39	N/A	0.66	1.10	1.44	2.26	N/A	3.72	N/A	5.19	6.78	8.59	N/A
Polyethylene— AS/NZS 4130 series 2 SDR 11	N/A	0.07	N/A	0.15	N/A	0.28	0.52	0.82	1.29	2.04	N/A	2.92	N/A	4.19	N/A	6.28
Polyamide— AS 2944.1 SDR 25	N/A	0.15	0.20	0.25	0.34	0.41	0.67	1.05	1.65	2.60	N/A	3.71	N/A	5.32	N/A	7.95

NOTES:

1 All calculations use the mean internal diameter for the specified class of pipe.

2 For multilayer (composite) pipe volumes refer to *manufacturer's specifications*.

3 N/A = not applicable; this *nominal size* does not exist in the relevant Standard.

D4.4 Purging through an appliance fitted with a flame safeguard device

D4.4.1 *General*

Where *purging* is to be carried out through this type of *appliance*, ensure the main *burner gas* control is turned to the 'OFF' position before proceeding as in Paragraphs D4.4.2 or D4.4.3.

D4.4.2 *Electronic flame safeguard device fitted*

Where an *appliance* is fitted with an electronic *flame safeguard system*, *purging* through the *appliance* is difficult. Manual ignition cannot be achieved.

Carry out the *purge* as follows:

(a) Isolate the electrical supply to the *appliance*.

(b) Fit a metallic bridging device across the *appliance* inlet union connection to ensure electrical continuity.

(c) Slacken the union to allow *gas* to flow out, but do not fully disconnect it.

(d) Turn on the *appliance manual shut-off valve* (where fitted).

(e) As soon as the presence of *gas* is detected, tighten the union and test with suitable leak detection solution.

(f) Allow sufficient time for any *gas* to disperse.

(g) Remove the bridging device.

(h) Turn on the power supply and activate the *ignition source*.

(i) Ignition may not be successful immediately and *lockout* may occur a number of times before combustion is satisfactory.

(j) Allow sufficient time for any unburnt *gas* to disperse before re-setting the system.

If the *appliance* is located in a confined space or small room, particular care should be taken to ensure that all *gas* has dispersed before actuating the *ignition source*. Where adequate ventilation cannot be assured connect flexible piping to the outlet of the *appliance manual shut-off valve* to direct the *purged gas* to outside.

D4.4.3 *Thermoelectric device fitted*

Where an *appliance* is fitted with this type of *flame safeguard system*, *purging* through a pilot alone can be quite time consuming.

To shorten the *purging* time—

(a) follow the steps (b) to (g) of the procedure in Paragraph D4.4.2;

(b) follow the normal *gas appliance* lighting sequence, applying a continuously burning flame to the pilot;

(c) continue to *purge* until the pilot flame remains alight and stable; and

(d) ensure the *appliance* main *burner* flame is stable and operates satisfactorily.

The use of a continuously burning flame may not be suitable with some *appliances*, for example, *balanced flue appliances*. Such *appliances* are normally fitted with an automatic *ignition source* which may have to be activated a number of times before successful ignition is achieved.

Do not use an *LP Gas* flame (or any other *gas*) for lighting *appliances* because overheating can damage the thermocouple lead.

D5 PURGING A LARGE VOLUME GAS INSTALLATION

A large volume *gas installation* in this context is one with a total installed pipe volume exceeding 0.03 m^3. Refer to Table D1.

A large volume *gas installation* should be *purged* to outside atmosphere. The *purge* outlet should be at least 6 m away from any *ignition source* and well clear of any opening into a building.

For guidance, refer to the technical references given in Paragraph D7.

D6 PURGING CONSUMER PIPING TO REMOVE GAS

Where *consumer piping* is to be opened for alteration, repair or extension, the section involved should be isolated from the *gas* supply at a convenient point and the piping vented to atmosphere and *purged* immediately. If the section involved exceeds the length shown in Table D2, the remaining fuel *gas* should be displaced by an inert *gas*.

During the *purge*, continuously check the air/*gas* ratios using a calibrated *gas* detector, set for the appropriate *gas*, to indicate when the *purge* is complete.

For large installations and where pipe size exceeds 100 mm, inert *gas* may need to be used as a buffer between air and *gas*. *Purging* procedures for such systems should be prepared on a case by case basis by the commissioning engineer or other *competent person*.

TABLE D2

PIPE LENGTH ABOVE WHICH AN INERT GAS PURGE IS REQUIRED

Nominal pipe size mm	Approximate pipe length m
50	25
65	15
80	10
100	5
150	3
Over 150	All

D7 Technical references

For large volume installations, the following may be consulted for guidance:

(a) NFPA56(PS), *Standard for Fire and Explosion Prevention During Cleaning and Purging of Flammable Gas Piping Systems*.

(b) IGE/UP/1, Edition 2, *Strength Testing, Tightness Testing and Direct Purging of Industrial and Commercial Installations*.

(c) IGE/SR/22, *Second Impression Purging Operations for Fuel Gases in Transmission, Distribution and Storage*.

(d) American Gas Association, *Purging Principles and Practice*, Third Edition.

APPENDIX E

TESTING FOR GASTIGHTNESS

(Normative)

E1 INTRODUCTION

This Appendix specifies procedures for *pressure* testing a *gas installation* and associated equipment. Refer to Paragraph E10 regarding the selection of a suitable test instrument.

E2 LIMITATION OF TESTS

This Appendix applies to *gas* installations where the volume of pipework does not exceed 30 L. For installations where the pipework exceeds 30 L, a specific written test procedure should be developed and used to determine the gastightness of the installation.

NOTES:

1 See Table D1 for guidance on approximate volume of pipework.

2 Guidance may be found in the technical references given in Paragraph E11.

E3 LEAKAGE TESTING OF INSTALLATIONS

E3.1 New installations

The following tests shall be carried out on all new installations:

(a) A pipework test, described in Paragraph E4, on the newly installed pipework before any *gas appliances* are connected.

(b) An installation test, described in Paragraph E5, including all *gas appliances*, prior to connection of the *gas* supply.

(c) A final connection test as described in Paragraph E7.

E3.2 Additions and alterations to installations

The following tests shall be carried out on all additions and alterations to existing installations:

(a) A leakage test, described in Paragraph E6, on the existing installation before commencing work.

(b) A pipework test, described in Paragraph E4, on the newly installed or altered pipework before any *gas appliances* are connected or reconnected and before being connected to the existing pipework.

(c) Either—

   (i) an installation test, described in Paragraph E5, including all newly installed or repositioned *gas appliances* and pipework, prior to connection or reconnection to the existing installation; or

   (ii) a leakage test, described in Paragraph E6, including all *appliances* and pipework, after connection or reconnection to the existing pipework.

(d) A final connection test as described in Paragraph E7.

For a satisfactory result to be obtained when the test in Item (c) is a leakage test the *pressure* loss over the test period shall be no greater than the *pressure* loss from the initial leakage test in Item (a).

E4 PIPEWORK TEST PROCEDURE

The pipework test shall be carried out as follows:

(a) Ensure the installation is disconnected at the meter or from the *cylinder.*

(b) Ensure all open ends are plugged or capped.

(c) Ensure all *gas appliances* are isolated.

(d) Connect a suitable test instrument.

(e) Pressurize the *consumer piping* to 7 kPa or 1.5 times the *operating pressure*, whichever is the greater.

(f) Isolate the *pressure* source and allow a suitable period (2 min) for the temperature of the testing medium within the *consumer piping* to stabilize.

(g) Measure the loss of *pressure* during a test period of 5 min.

The pipework can be considered *gastight* and the test satisfactory if there is no loss of *pressure* during the test period of 5 min.

NOTE: The test period does not include the temperature stabilization period required by Paragraph E4(f).

E5 INSTALLATION TEST PROCEDURE

The installation test shall be carried out as follows:

(a) Ensure the installation is disconnected at the meter or from the *cylinder*.

(b) Ensure all open ends are plugged or capped.

(c) Ensure all *gas appliance* valves are closed, and all *manual shut-off valves* opened.

(d) Connect a suitable test instrument.

(e) Pressurize the *consumer piping* to *operating pressure* or 2.0 kPa, whichever is the greater.

(f) Isolate the *pressure* source and allow a suitable period (2 min) for the temperature of the testing medium within the *consumer piping* to stabilize.

(g) Measure the loss of *pressure* during a test period of 5 min.

The pipework can be considered *gastight* and the test satisfactory if there is no loss of *pressure* during the test period of 5 min.

NOTE: The test period does not include the temperature stabilization period required by Paragraph E5(f).

E6 LEAKAGE TEST FOR EXISTING INSTALLATIONS

The leakage test for existing installations shall be carried out as follows:

(a) Depressurize the installation.

(b) Ensure the installation is disconnected at the *gas* meter or from the *cylinder*.

(c) Ensure all *gas appliance* pilots are turned off and all but the last control device (or tap) on each *gas appliance* is in the open position.

(d) Attach a suitable test instrument.

(e) Pressurize the installation to *operating pressure* or 2.0 kPa, whichever is the greater.

(f) Isolate the *pressure* source and allow a suitable period (2 min) for the temperature of the testing medium within the *consumer piping* to stabilize.

(g) Measure the loss of *pressure* during a test period of 5 min.

If the *pressure* loss is equal to or less than the maximum *pressure* drop specified in Item (i) or (ii) below, then the test is satisfactory except when limited for a final leakage test by Paragraph E7.

If the *pressure* loss is greater than the maximum allowable *pressure* drop, the installation fails the leakage test and the consumer shall be advised so that remedial action can be taken.

The maximum allowable *pressure* drop is as follows:

(i) In Australia, the *pressure* drop allowed by the *Technical Regulator*, if any.

(ii) In New Zealand, the *pressure* drop given in Table E1.

If it is not practicable to disconnect at the meter or from the *cylinder*, this test shall be performed only after specifically ensuring that the meter control valve or the *cylinder* valve is not passing *gas*.

NOTE: Watching the test instrument to ensure there is no *pressure* rise does not always ensure there is no leakage but merely shows that the leakage in does not exceed the leakage out.

TABLE E1

ACCEPTABLE PRESSURE DROPS FOR EXISTING INSTALLATIONS IN NEW ZEALAND ONLY

Volume of pipework, L	Maximum pressure drop, kPa
5	1.0
10	0.5
15	0.35
20	0.25
25	0.20
30	0.10

E7 TESTING A CONNECTION MADE AFTER A TEST PROCEDURE

Any connection made after a test has been completed shall be checked for leakage at *operating pressure*. A suitable leak detection solution or other suitable leakage detection method shall be used and the connection left *gastight*.

E8 ADDITIONAL TESTS FOR LP GAS PIPING UPSTREAM OF FIRST STAGE REGULATOR

The piping, *fittings* and joints between a *LP Gas tank* not exceeding 8 kL, or a *cylinder*, and a first stage regulator shall be checked for leakage at *tank* or *cylinder pressure* using a suitable leak detection solution or other suitable leakage detection method. There shall be no bubbling or other visible indication of *gas* leakage.

E9 ADDITIONAL TESTS FOR SYSTEMS WITH A PRESSURE RELIEF DEVICE

Where *consumer piping* includes a *pressure* relief device, the piping shall be tested according to the procedure in Paragraph E4 at a test *pressure* equal to the setting of the device. The regulator adjustment and the device setting shall be sealed on completion of the test, to prevent tampering which could lead to piping being subjected to a *pressure* above test *pressure*.

E10 SELECTING THE TEST INSTRUMENT

The instrument selected to test a *gas installation* shall be suitable for the application.

NOTE: Informative Table E2 provides guidance when testing an installation greater than 30 L in capacity.

TABLE E2
TEST INSTRUMENTS

Instrument	Test pressure range	Pipe volume	Limitations	Test time
Bubble leak detector	Up to 3 kPa	Up to 0.03 m^3 (30 L)	As *gas* will be the test medium, only suitable for existing installations	5 min
Manometer (water gauge)	Up to 10 kPa	Up to 0.3 m^3 (300 L)	Only suitable for low *pressure*s	5 min for each 30 L
Manometer (digital read-out))	Up to 200 kPa	Up to 0.3 m^3 (300 L)	Range of instrument and means of connection	5 min for each 30 L
Differential tester (e.g., Washington)	Up to 700 kPa	Any	No *pressure* indication. Needs to be part of a kit in conjunction with a Bourdon gauge	5 min
Single column compensated gauge (e.g., Kuhlman)	Up to 70 kPa	Up to 0.3 m^3	Instrument range to be selected to suit application	5 min
Electronic transducer *pressure* gauge/recorder with data or paper tape output	Up to 700 kPa	Any	Used where a record of the test is required	12 to 24 h as required

E11 Technical references

NOTE: The following can be consulted for guidance:

1 AS 4041, *Presure piping*.

2 IGE/UP/1, Edition 2, *Strength Testing, Tightness Testing and Direct Purging of Industrial and Commercial Installations*.

3 Energy Safety WA Guideline, *Gas Tightness Testing of Consumer Gas Piping Systems Above 200 kPa*.

APPENDIX F

SIZING CONSUMER PIPING

(Informative)

F1 INTRODUCTION

F1.1 General

The flow graphs (Figures F3 to F14) and tables (Tables F6 to F42) in this Appendix have been compiled through consistent application of the flow formulas used and make 'allowances' for *pressure* drop that occur due to fittings. The 'longest length' method of pipe sizing has been used.

The sizing of piping for materials or conditions other than those in the pipe sizing tables or graphs of this Appendix should be determined using recognized systems or formulae.

F1.2 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. In the case of steel pipe an internal roughness of 0.045 mm is assumed, while pipes of all other materials (copper, polyamide/nylon, PE and PVC) are taken to be smooth, that is, with zero roughness. Design may need to take into account any significant increases in height in *high-rise buildings* and the effect this may have on the flow rate of *gases* of different densities.

F1.3 Fitting allowance

A 'fitting allowance' equivalent to a 50% extension of the length has been incorporated in the graphs and tables. For example, when calculating the flow for a given type of *gas* in a pipe 20 m long 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. This allowance should be sufficient in almost all cases of domestic installations (provided the pipework is constructed in a manner consistent with good workmanship). However, for commercial or industrial installations that are 'compact' (short runs and numerous fittings) and require large diameter pipe (typically greater than 40 mm), this 50% fitting allowance may be insufficient.

F1.4 Equations used

For low flow rates the theoretically derived laminar equation was used. For higher flows, the equations (low *pressure* and high *pressure*) from the International Fuel Gas Code (IFGC) were employed. In the case of steel pipe, due to its internal roughness, the IFGC equations are not applicable and an algorithm based on the Churchill equation for friction factor was used.

NOTE: Due to the dimensional differences of the various products, tables for *multilayer pipe* systems are not included in this Appendix. Pipe sizing information should be obtained from the manufacturer or supplier.

F1.5 Gas properties

The properties of the *gases* were assumed as shown in Table F1.

TABLE F1

GAS PROPERTIES

Property (unit)	Natural gas	LP Gas (propane)
HHV (MJ/m^3)	38	96
Relative density, RD	0.6	1.5
Viscosity (μPa.s)	12	8

NOTES:

1 HHV = higher heating value; also known as gross calorific value.

2 Propane was used in calculations for *LP Gas* tables and pipe sizing graphs to allow for worst case scenario.

F1.6 Excessive gas velocity

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

F1.7 Allowable pressure drop

There is no restriction to *pressure* drop over *gas* pipe work specified in this Standard. The maximum permissible *pressure* drop is determined by the minimum *pressure* at the *gas* equipment inlet and the supply *pressure* to the pipe work. The minimum *pressure* required at *gas appliance* inlet is given in Table 5.1; some *appliance*s may require higher *pressures* than these.

Experience has shown that it is good practice to design *gas* pipe work with a *pressure* drop across the system of 10% to 20% of the supply *pressure* to the system. This practice limits the *gas* velocity minimizing the potential effects of flow noise and long-term erosion of the pipe work.

Where the supply and equipment inlet *pressure* requirement permit and the pipe work is such that only a minimal to moderate number of fittings are used and the pipe work supplies more than one *appliance*, the allowed *pressure* drop over the pipe work may be increased in order to increase the capacity of the pipe work. However, consideration of the effects of increased *gas* velocities through the pipe work should be taken into account (in particular, noise and erosion) before taking this action, as described immediately below.

According to the flow equations, an increase in the allowed *pressure* drop over a given section of 45% will result in an increased flow of approximately 20%. This is considered the upper limit of increased *pressure* drops over the respective values given in the pipe sizing tables without professional advice on the consequences of such an increase. However, this increase may only be applied provided the new (higher) flow value is lower than the highest value within the normal, selectable (non-shaded) area for pipe of the given diameter in the pipe sizing table (see the example below).

Example

An example of the effect where increased *pressure* drop can be implemented is seen in Table F16, with steel pipe of 32 mm DN and length 12 m. If the abovementioned conditions are met, the table value of 2434 MJ/h can be considered to be increased to 2921 MJ/h (i.e., 2434 × 1.2 = 2921). However the corresponding value for 10 m of 32 mm DN pipe (2683 MJ/h) cannot be similarly increased, as this would give a value of 3219 MJ/h (i.e., 2683 × 1.2 = 3219), which exceeds the maximum value outside the grey shaded value for 32 mm pipe in the table, which is 3022 MJ/h. This gives rise to the apparent anomaly that a 12 m length can be sized for greater flow than a 10 m length. However, the anomaly is explained by the need to avoid excessive *gas* velocities.

It should be noted however that an increase in design *pressure* drop of 45% cannot be applied to Natural *gas* supply *pressures* of 1.25 kPa as the required minimum *appliance* inlet *pressure* of 1.13 kPa cannot be achieved. Therefore a 20% increase in flow capacity can only be considered for Natural *gas* supply *pressures* of 1.5 kPa or greater.

Similarly an increase in design *pressure* drop of 45% cannot be applied to LP *Gas* supply *pressures* of 3.0 kPa as the required minimum *appliance* inlet *pressure* of 2.75 kPa cannot be achieved. Therefore a 20% increase in flow capacity can only be considered for LP *Gas* supply *pressures* of 70 kPa or greater.

F2 INFORMATION REQUIRED

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

(a) The type of *gas* to be used in the installation, its heating value and specific gravity.

(b) The input rating of each *gas appliance* (MJ/h) and the required input *pressure.*

(c) The diversity, if any, arising from use of different *gas appliances* at different times.

(d) The piping layout—length of run, and number and type of *fittings.*

(e) Available *pressure.*

(f) Allowable *pressure* drop.

F3 DESIGN PROCEDURE USING PIPE SIZING GRAPHS

F3.1 General

This procedure is applicable to small systems designed to operate at 10 kPa or less. For complex systems or systems designed to operate above 10 kPa, more rigorous design methods may be appropriate:

(a) Sketch the piping configuration for the installation, indicating the developed length of each pipe run and the input rating of the *gas appliance* to be connected. Multiply any input ratings in kW by 3.6 to convert to MJ/h if necessary. Label each junction and end point, so that each pipe section is uniquely identified.

(b) Tabulate the pipe runs and, working backwards from the most distant *gas appliance*, calculate the *gas* flow for each pipe section.

(c) Determine the length of the longest pipe run, i.e., from the meter to the most distant *gas appliance*.

(d) Determine the allowable *pressure* drop considering the supply *pressure* available and the minimum *pressure* required at the *appliance*.

(e) Divide the allowable *pressure* drop by this length, to determine the allowable drop per metre.

(f) Starting from the *gas meter*, use this *pressure* drop and the *gas* flow in each pipe section to determine the pipe size for that section from the applicable graph (Figures F3 to F14).

(g) For large, complex or extensive installations, the *pressure* at each point of branching from the *main run* of the network can be calculated and steps (d) and (e) repeated for the branch.

The graphs for the *gases* shown on Table F1 allow for an average number of elbows and *fittings*.

These graphs give adequate results for *gases* whose higher heating value and relative density are within ±15% of these values.

F3.2 Worked example 1—With allowable pressure drop of 0.0105 kPa/m

F3.2.1 *Introduction*

The following worked example is given to illustrate the method of pipe sizing for a typical *consumer piping* system. The information required is shown in Table F2.

TABLE F2

INFORMATION REQUIRED

Parameter	Value
Type of *gas*	*Natural gas* (HHV 39 MJ/m^3, RD 0.67—Within 15% of the values in Table F1)
Gas appliance ratings	As in Figure F1
Diversity	Design for full load on all *gas appliances*
Piping layout	As in Figure F1 with pipe lengths as shown
Available *pressure*	2.0 kPa at meter outlet
Allowable *pressure* drop	Design for 10% of available *pressure* (check that this gives an inlet *pressure* adequate for each *gas appliance*; if not design for a lesser *pressure* drop).

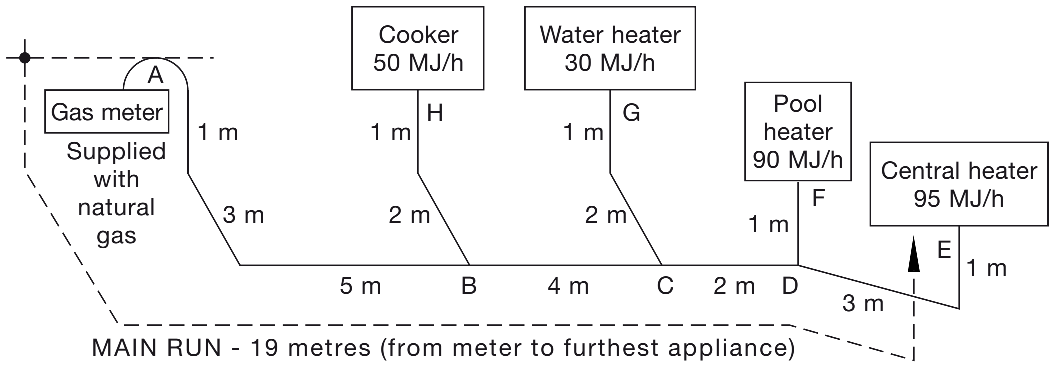


FIGURE F1 EXAMPLE OF CONSUMER PIPING LAYOUT

F3.2.2 *Sketch the layout*

Sketch the intended *consumer piping* layout (see Figure F1), include the *gas appliances*, and allocate a letter to each *gas appliance* position and each pipe junction.

F3.2.3 *Tabulate the pipe runs*

Draw up a table with a row for each pipe run, as in Table F3.0.

TABLE F3.0

INSTALLATION DETAILS

Pipe section	Length, m	Gas flow, MJ/h	Pipe size, mm
AB	9	50 + 30 + 90 + 95 = 265	
BC	4	30 + 90 + 95 = 215	
CD	2	90 + 95 = 185	
DE	4	95	
DF	1	90	
CG	3	30	
BH	3	50	

F3.2.4 *Determine the length of the longest pipe run*

The longest run of piping from the meter to the furthest *gas appliance* position is Section AE. The length of this is 19 m (AB + BC + CD + DE).

F3.2.5 *Determine the allowable pressure drop per metre*

The design *pressure* drop is 0.2 kPa. Divide this by the length of the longest pipe run, 19 m, to give the allowable *pressure* drop of 0.0105 kPa/m.

F3.2.6 *Determine the required pipe size using the pipe sizing graphs*

Select the pipe sizing graph appropriate to the type of *gas* available and the chosen piping material. If copper pipe complying with NZS 3501 is being used the applicable graph is Figure F4 (in this Example, reproduced in Figure F2.1 below). Mark the *pressure* drop value of 0.0105 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 the size in the installation table.

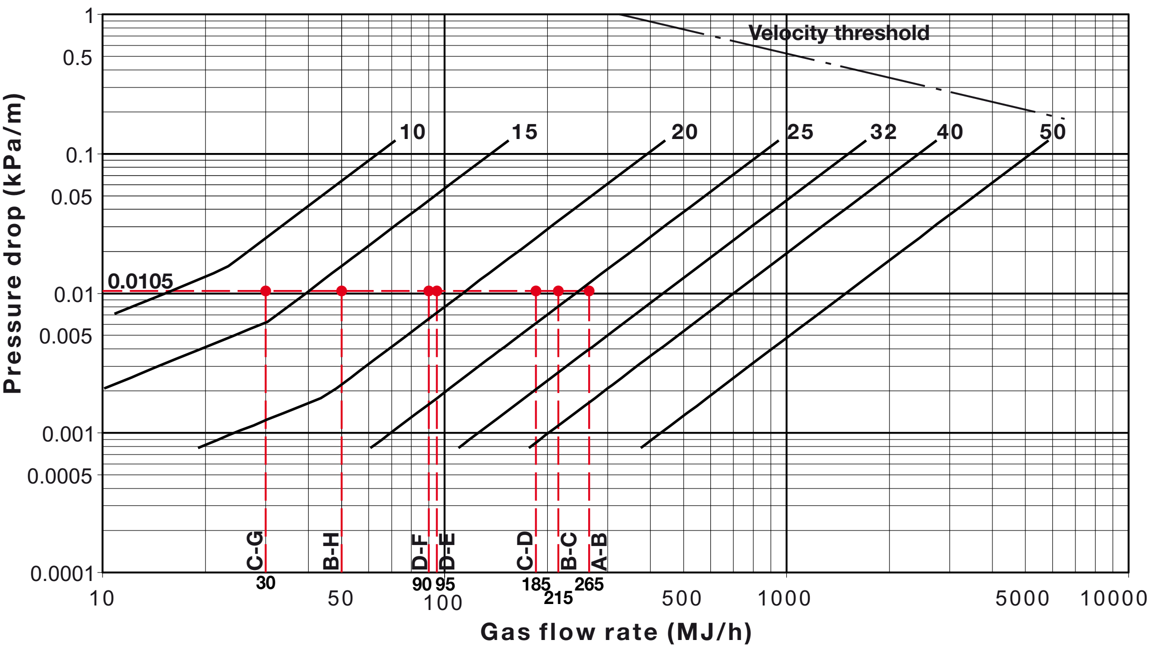


FIGURE F2.1 EXAMPLE 1—PIPE SIZING FOR NATURAL GAS IN COPPER PIPE TO NZS 3501

Section AB has a total flow rate of 265 MJ/h. Find 265 on the *gas* flow axis and draw a line up to the line at 0.0105 kPa/m for *pressure* drop. These lines intersect between the curves for 25 mm and 32 mm pipe sizes. The required pipe size is 32 mm, the larger size.

Repeat this procedure for each of the other pipe sections, entering the pipe sizes in the installation table, to give Table F3.1.

TABLE F3.1

INSTALLATION DETAILS—EXAMPLE 1

Pipe section	Length, m	Gas flow, MJ/h	Pipe size, mm
AB	9	50 + 30 + 90 + 95 = 265	32
BC	4	30 + 90 + 95 = 215	25
CD	2	90 + 95 = 185	25
DE	4	95	20
DF	1	90	20
CG	3	30	15
BH	3	50	20

NOTE: The results in this table differ from those in Table F6 due to the use of different pipe materials.

F3.3 Worked example 2—With increased allowable pressure drop

F3.3.1 *Introduction*

The worked example in Paragraph F3.2 uses an allowable *pressure* drop of 0.20 kPa (10% of the supply *pressure*). The Example in this Paragraph (F3.3) satisfies the criteria given in Paragraph F1.7 to increase the pipe work capacity by 20% by increasing the design *pressure* drop, as follows:

(a) Available *pressure* at the meter outlet is 2.0 kPa (see Table F2).

(b) Design allowable *pressure* drop becomes 0.29 kPa, that is, 1.45 × 0.20 kPa (45% increase in *pressure* drop as given Paragraph F1.7).

(c) Available *pressure* at the *appliance* inlet is 1.71 kPa (equal to 2.0 kPa less 0.29 kPa), which exceeds the minimum *pressure* required at the *appliance* inlet of 1.13 kPa (Table 5.1, *natural gas*). As the available *pressure* at the *appliance* inlet is greater than the minimum required, the design *pressure* drop of 0.29 kPa can be used.

F3.3.2 *Determine the required pipe size using the pipe sizing graphs*

The process to determine the required size for the pipe work is the same as in Paragraph F3.2, as follows:

(a) The longest run of piping is given as 19 m (see Paragraph F3.2.4).

(b) The allowable *pressure* drop is given as 0.29 kPa (see Paragraph F3.3.1(b)).

(c) Determine the allowable *pressure* drop per meter, that is, 0.29/19 = 0.0153 kPa/m.

(d) Select the correct pipe sizing graph (Figure F4, in this example reproduced as Figure F2.2 below). Once again, section AB has a total flow rate of 265 MJ/h. Find 265 on the *gas* flow axis, and draw a line up to the line 0.0153 kPa/m. These lines intersect between the curves for 20 mm and 25 mm pipe sizes. The required pipe size is 25 mm, the larger size (see Figure F2.2 below).

(e) Repeat the procedure in Step (d) for each of the other pipe sections as shown in Example 1, (Paragraph F3.2.6), entering the pipe sizes in the installation table, to give Table F3.2.

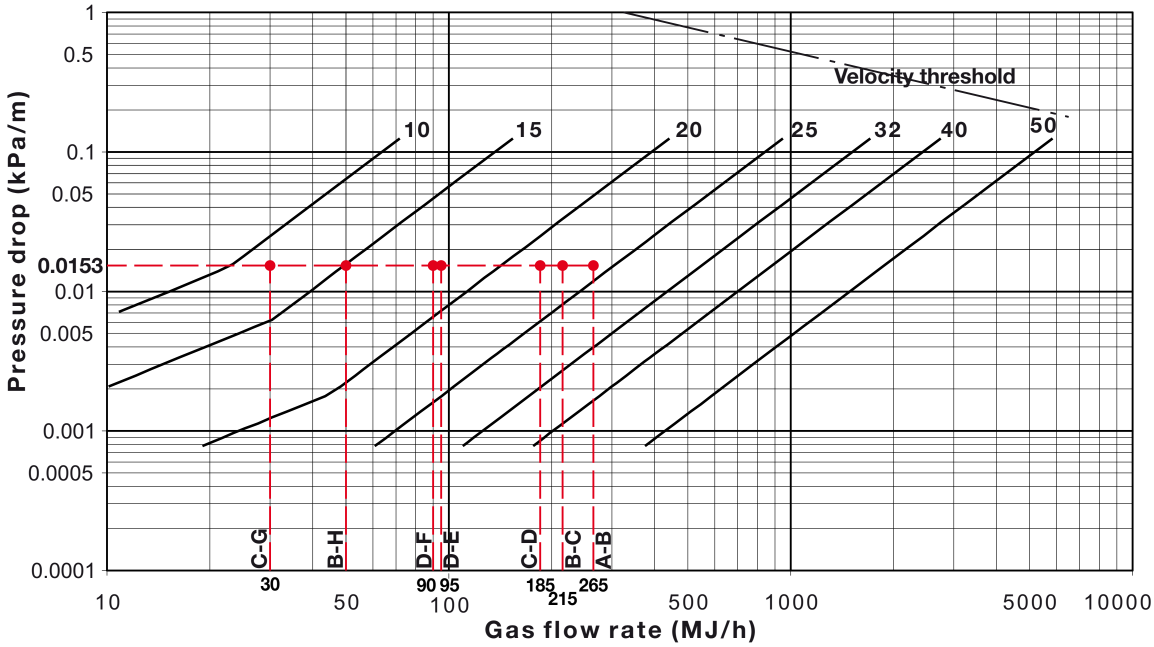


FIGURE F2.2 EXAMPLE 2—PIPE SIZING FOR NATURAL GAS IN COPPER PIPE TO NZS 3501

TABLE F3.2

INSTALLATION DETAILS—EXAMPLE 2

Pipe section	Length, m	Gas flow, MJ/h	Pipe size, mm
AB	9	50 + 30 + 90 + 95 = 265	25
BC	4	30 + 90 + 95 = 215	25
CD	2	90 + 95 = 185	25
DE	4	95	20
DF	1	90	20
CG	3	30	15
BH	3	50	15

NOTE: Pipe sizes for pipe sections AB and BH have reduced required *nominal diameter* due to the increased capacity allowance.

F4 PIPE SIZING GRAPHS

The pipe sizing charts indicate the flow of gas, in megajoules per hour, through pipes of various materials. The heating value quoted in the pipe sizing graph listing is a nominal figure typical of the gas that the graph represents. It is not intended to represent any particular gas supply in any particular area.

The pipe sizing graphics are listed as follows:

Figure	Type of gas	Hv (MJ/m^3)	Rd	Material
F3	Natural gas (NG)	38	0.6	Copper to AS 1432 Type B
F4	Natural gas (NG)	38	0.6	Copper to NZS 3501
F5	Natural gas (NG)	38	0.6	Steel to AS 1074 Medium Grade
F6	Natural gas (NG)	38	0.6	Polyamide to AS 2944.1 SDR 25
F7	Natural gas (NG)	38	0.6	Polyethylene to AS/NZS 4130 SDR 11
F8	Natural gas (NG)	38	0.6	PVC-HI to AS ISO 6993.1
F9	PROPANE (LP Gas)	96	1.5	Copper to AS 1432 Type B
F10	PROPANE (LP Gas)	96	1.5	Copper to NZS 3501
F11	PROPANE (LP Gas)	96	1.5	Steel to AS 1074 Medium Grade
F12	PROPANE (LP Gas)	96	1.5	Polyamide to AS 2944.1 SDR 25
F13	PROPANE (LP Gas)	96	1.5	Polyethylene to AS/NZS 4130 SDR 11
F14	PROPANE (LP Gas)	96	1.5	PVC-HI to AS ISO 6993.1

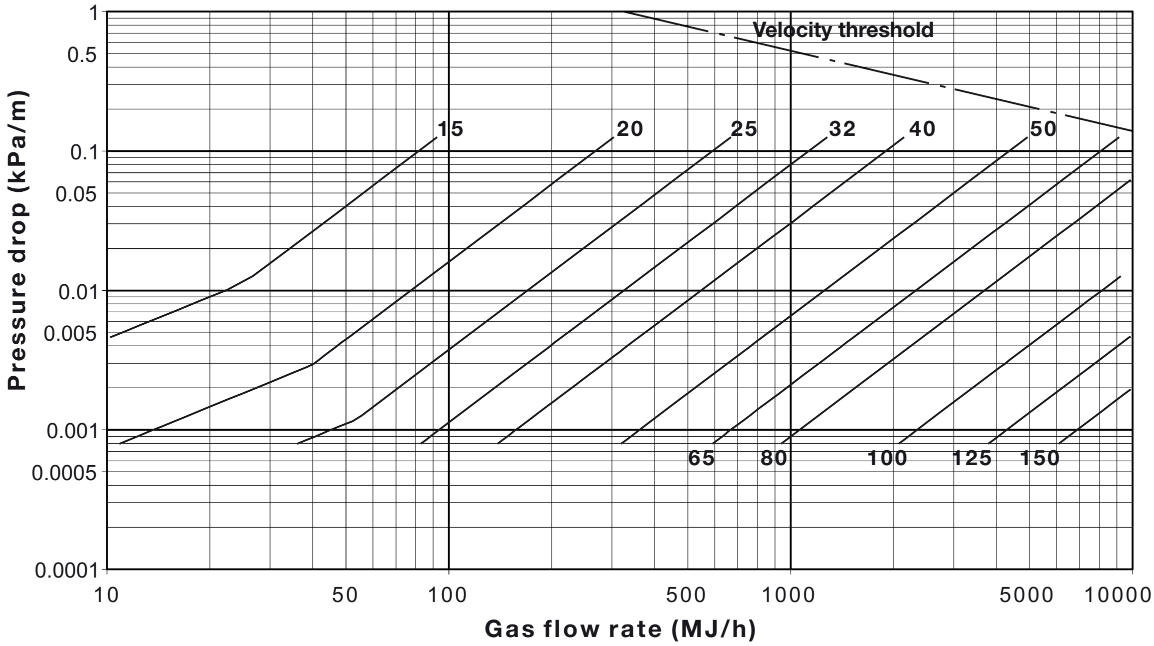


FIGURE F3 PIPE SIZING FOR NATURAL GAS THROUGH COPPER PIPE (AS 1432 TYPE B)

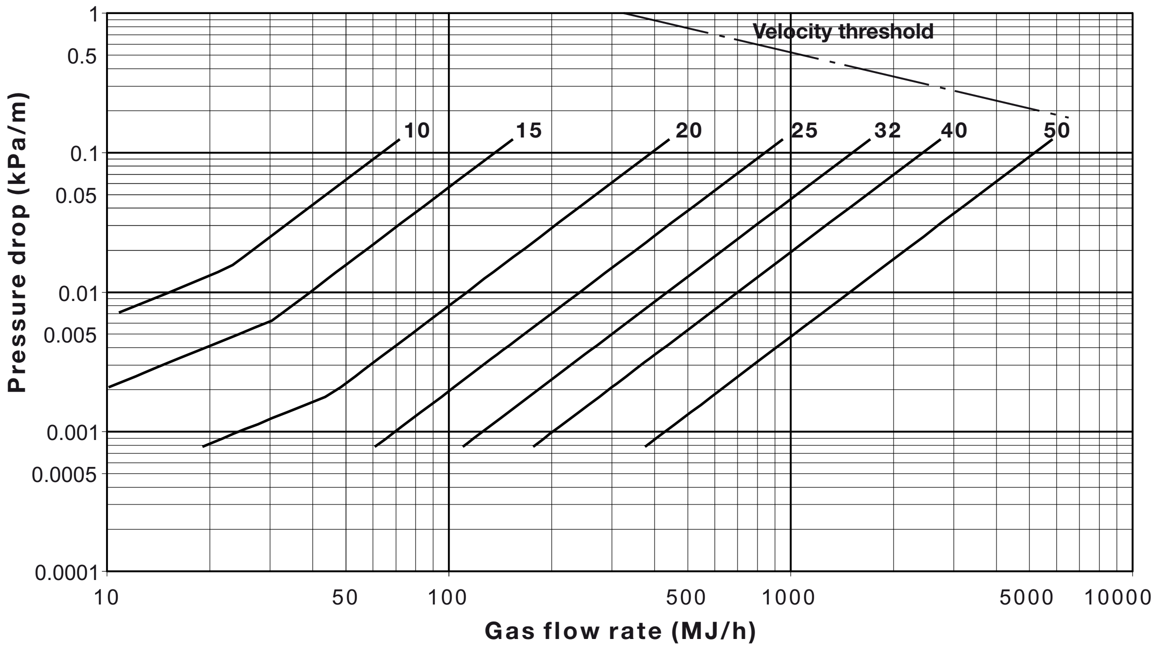


FIGURE F4 PIPE SIZING FOR NATURAL GAS THROUGH COPPER PIPE (NZS 3501)

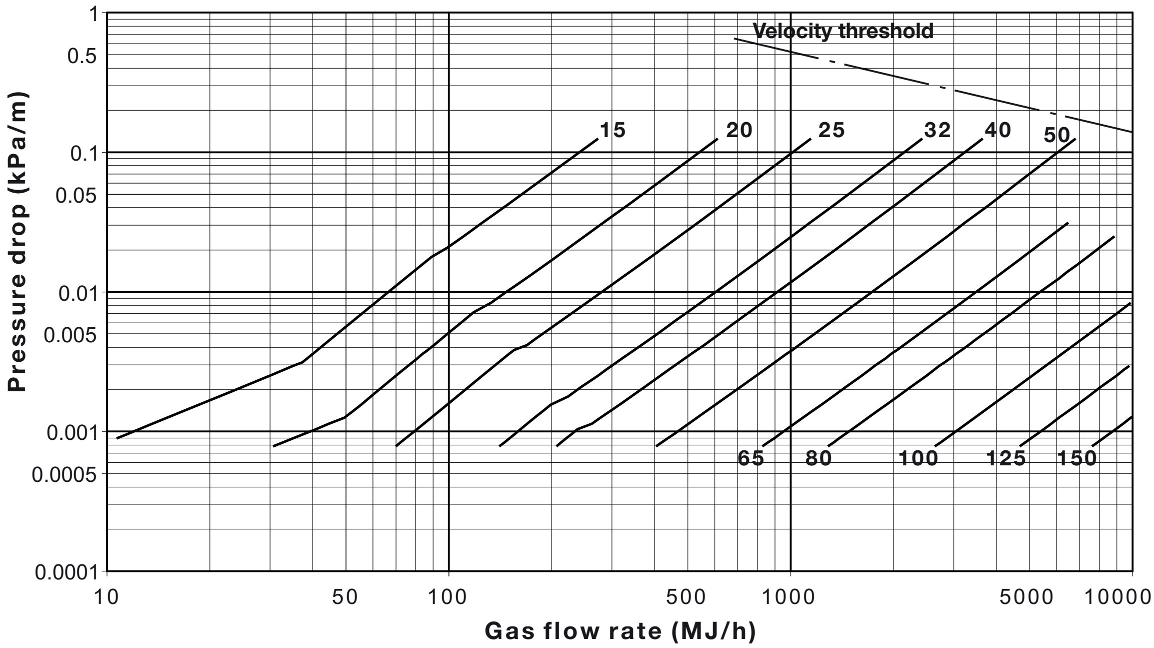


FIGURE F5 PIPE SIZING FOR NATURAL GAS THROUGH STEEL PIPE (AS 1074 MEDIUM GRADE)

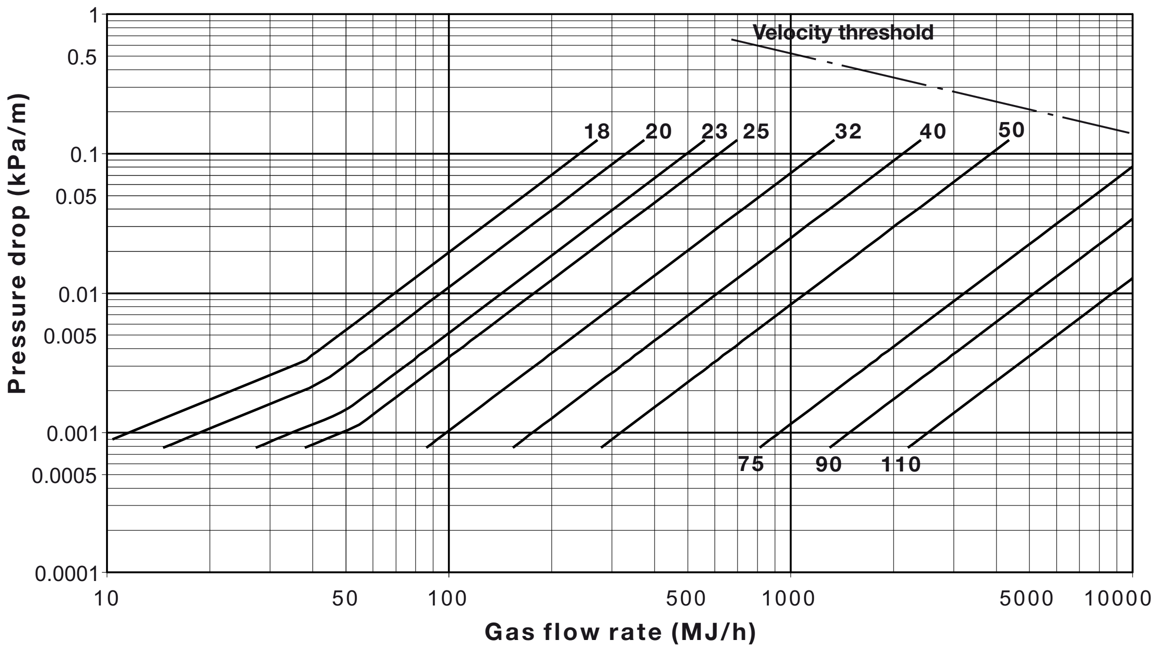


FIGURE F6 PIPE SIZING FOR NATURAL GAS THROUGH POLYAMIDE PIPE (AS 2944.1 SDR 25)

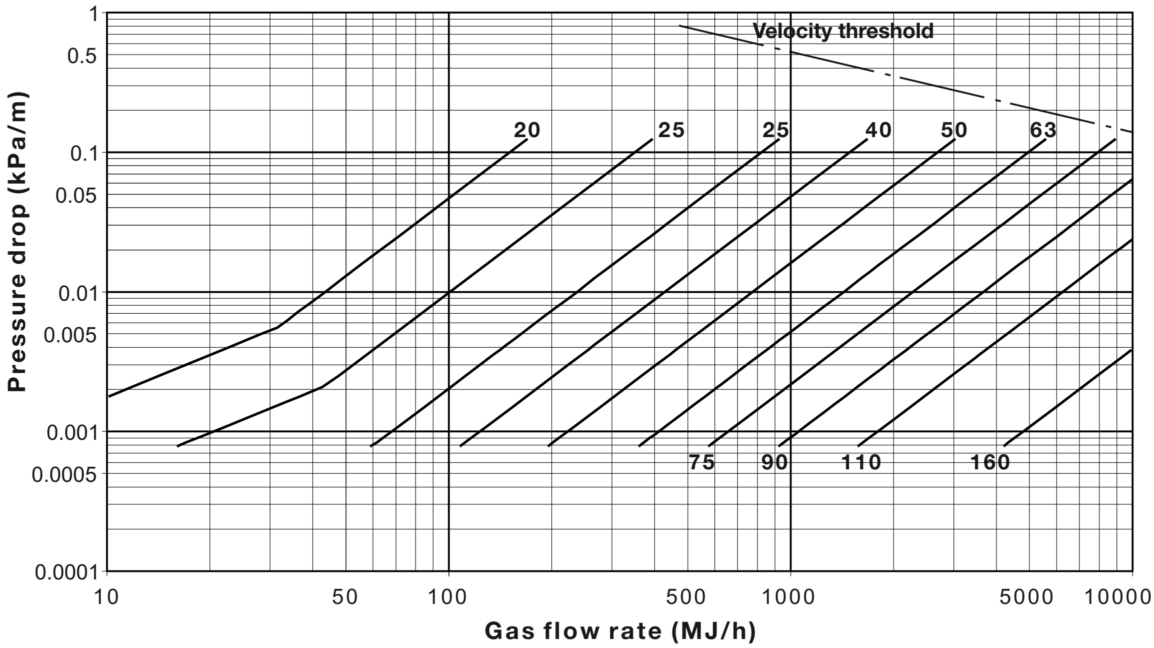


FIGURE F7 PIPE SIZING FOR NATURAL GAS THROUGH POYETHYLENE PIPE (AS/NZS 4130 SDR 11)

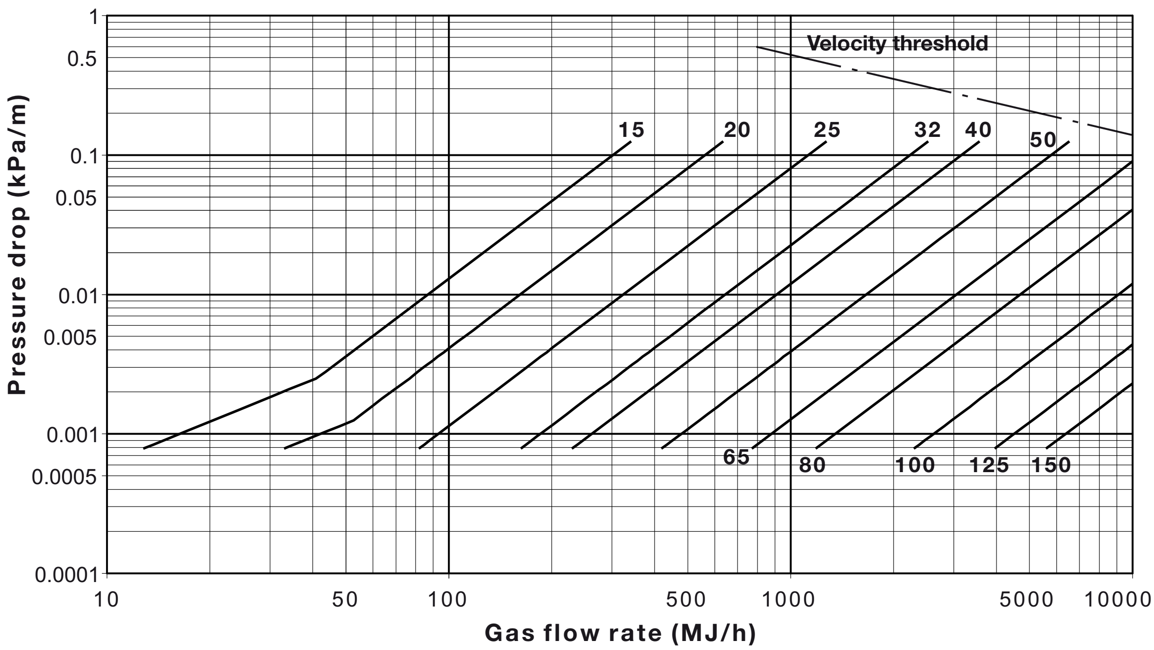


FIGURE F8 PIPE SIZING FOR NATURAL GAS THROUGH PVC-HI PIPE (AS ISO 6993.1)

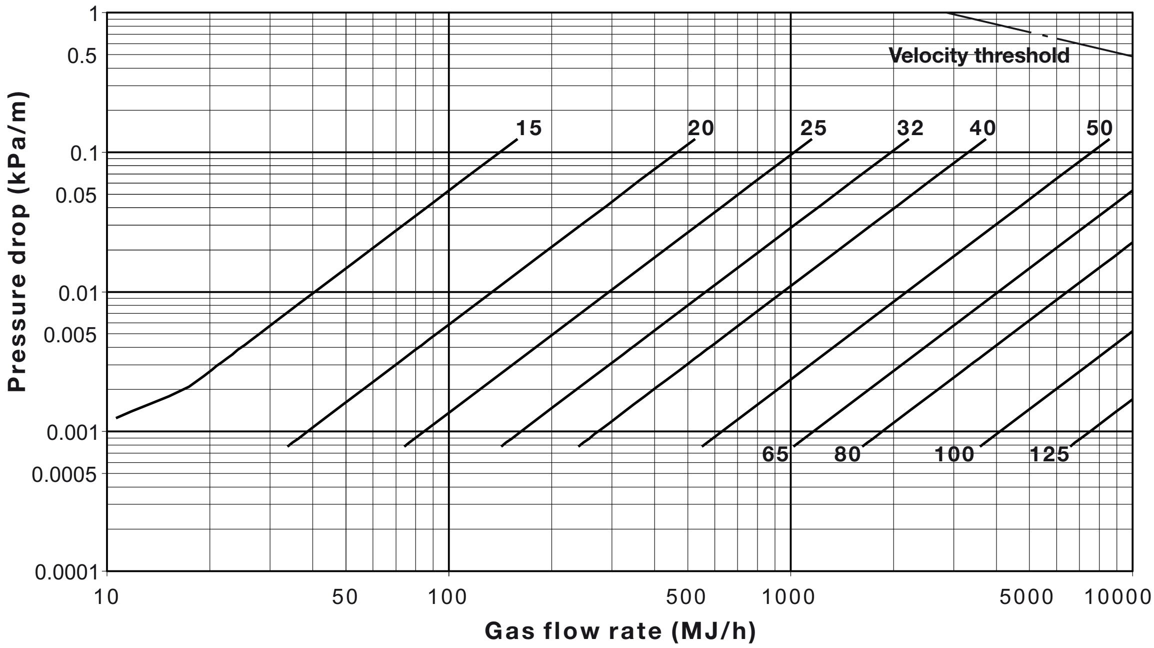


FIGURE F9 PIPE SIZING FOR PROPANE THROUGH COPPER PIPE (AS 1432 TYPE B)

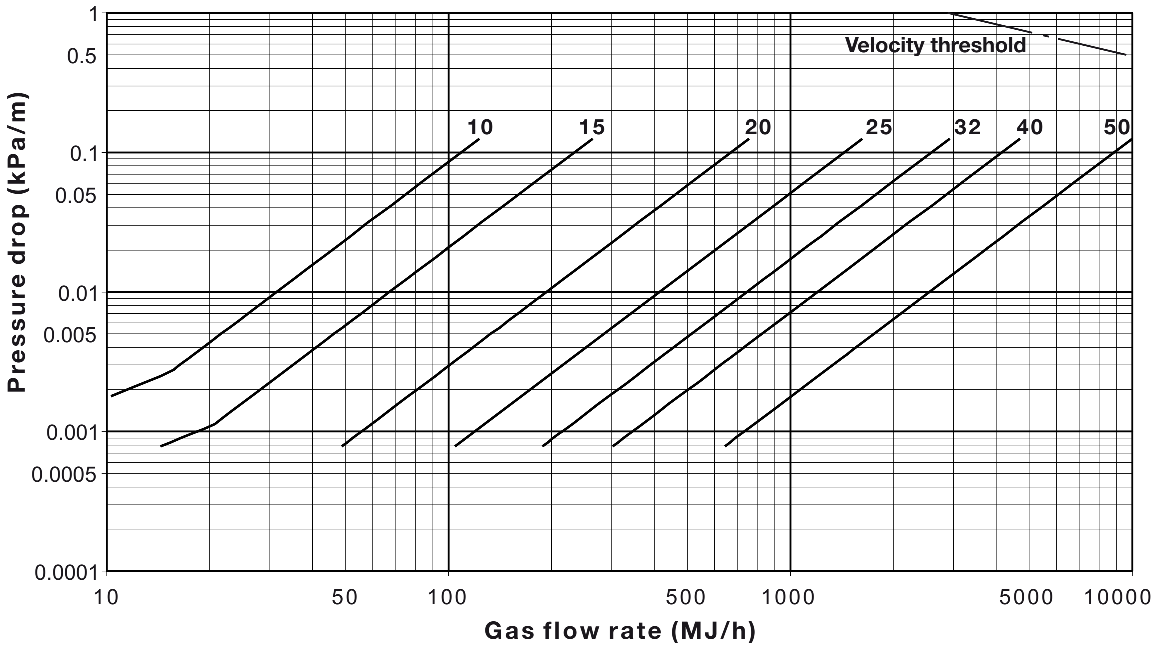


FIGURE F10 PIPE SIZING FOR PROPANE THROUGH COPPER PIPE (NZS 3501)

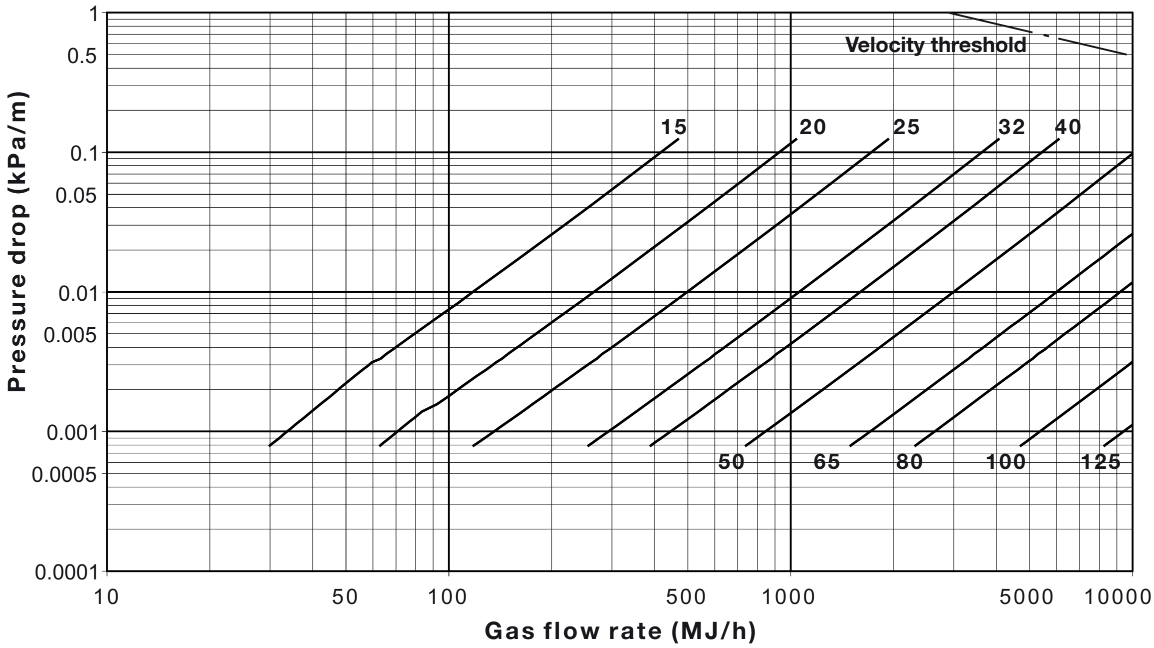


FIGURE F11 PIPE SIZING FOR PROPANE GAS THROUGH STEEL PIPE (AS 1074 MEDIUM GRADE)

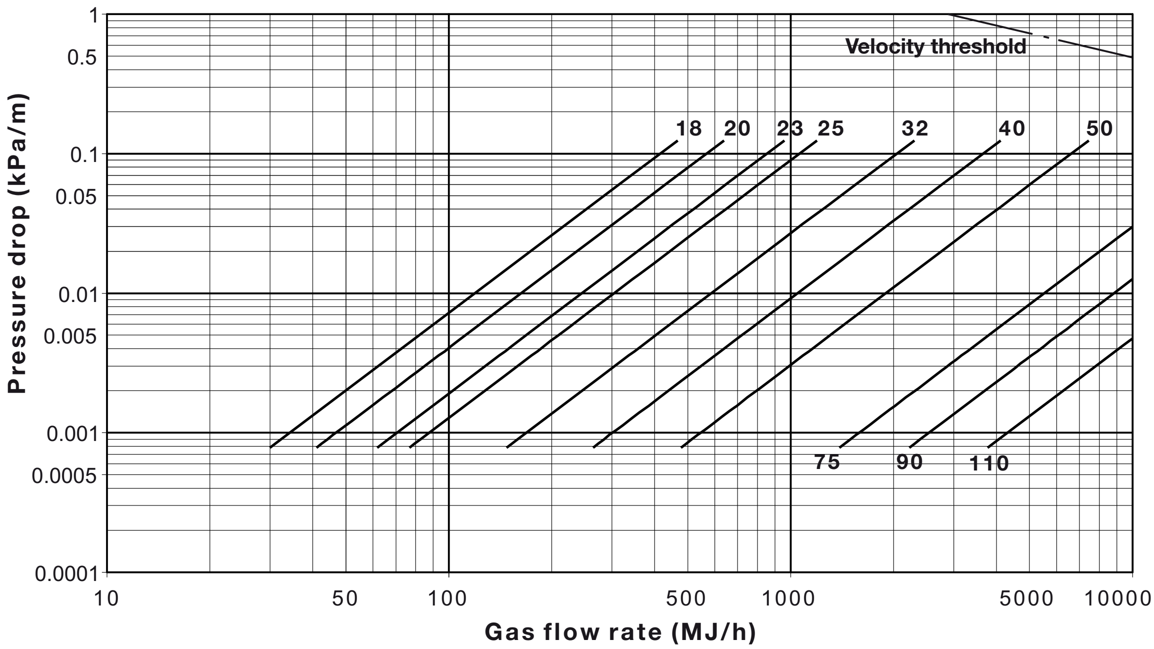


FIGURE F12 PIPE SIZING FOR PROPANE GAS THROUGH POLYAMIDE PIPE (AS 2944.1 SDR 11)

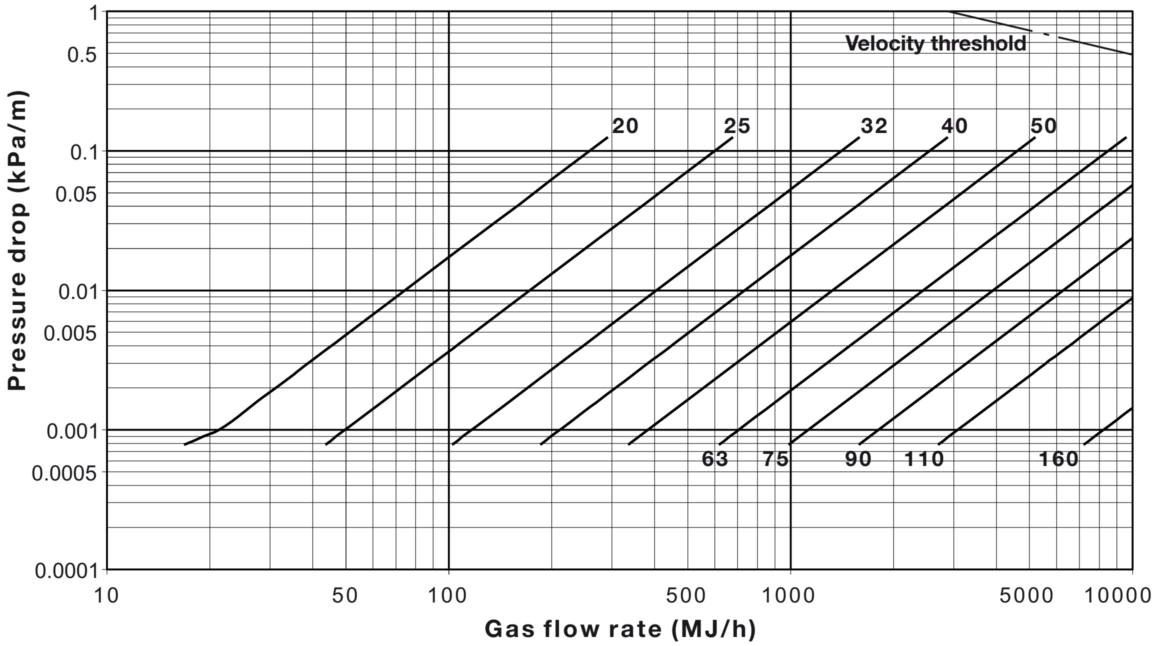


FIGURE F13 PIPE SIZING FOR PROPANE THROUGH POLYETHYLENE PIPE (AS/NZS 4130 SDR 11)

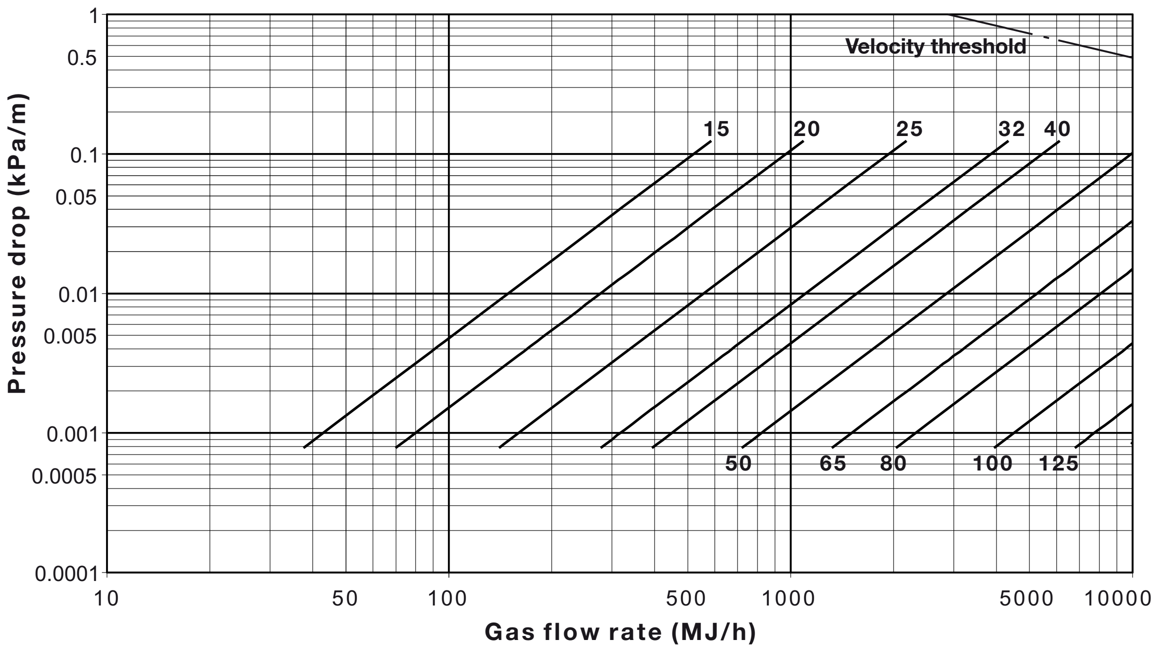


FIGURE F14 PIPE SIZING FOR PROPANE THROUGH PVC-HI PIPE (AS ISO 6993.1)

F5 DESIGN PROCEDURE USING PIPE SIZING TABLES

F5.1 Introduction

This method of sizing *consumer piping* is suitable where the allowable *pressure* drop, measured in kilopascals (kPa) is—

A2 (a) *Natural gas*.. 0.12, 0.25, 0.75, 1.5 or 10.

(b) *LP Gas* ....0.25, 10 or 20.

The sizing of *consumer piping* for materials or conditions other than those in the pipe sizing tables of this Appendix should be determined using recognized formulae or tables.

Included, at the top of each table, is an indicative supply *pressure*, or *pressure* range, for which the table is suitable.

NOTE: Other conditions include longer pipe runs, complex pipe runs, greater *gas* flows, higher *pressure*s, other *pressure* drops and special *appliance* requirements.

F5.2 Worked example 1

F5.2.1 *Introduction*

A2 A worked example is given to explain a method of pipe sizing for a typical *consumer piping* system that will be using *natural gas* at 2.75 kPa at the start of the *consumer piping* with copper pipe.

F5.2.2 *Sketch the piping layout*

Sketch the intended *consumer piping* layout (see Figure F1), 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 meter with the letter 'A'.

(c) Allocate a letter to each *appliance* position.

F5.2.3 *Determine the main run*

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

NOTE: The *main run* in Figure F1 is from the meter to the central heater, which is 19 m.

F5.2.4 *Select the piping material*

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

A2 NOTE: Copper piping in accordance with AS 1432 and NZS 3501 is used for the example for Australia and New Zealand respectively.

F5.2.5 *Select the pipe sizing table*

Select the appropriate pipe sizing table by taking into consideration the type of *gas* available, the allowable *pressure* drop and the chosen piping material.

A2 NOTE: For the example for Australia, use Table F8 and for New Zealand use Table F12 both of which have an allowable pressure drop of 0.75 kPa.

F5.2.6 *Tabulate the pipe runs*

Draw up a table with a row for each pipe run, as in Table F5.0, as follows:

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

(b) Indicate, in the column marked 'Gas flow', the amount of *gas*, in MJ/h, flowing through each section.

(c) The column indicating *nominal size* will be completed in Paragraph F5.2.7.

TABLE F5.0

INSTALLATION DETAILS

Pipe section	Main run, m	Gas flow, MJ/h	Nominal size DN
AB	19	50 + 30 + 90 + 95 = 265	
BC	19	30 + 90 + 95 = 215	
CD	19	90 + 95 = 185	
DE	19	95	
DF	19	90	
CG	19	30	
BH	19	50	

F5.2.7 *Selecting the pipe size*

A2 Refer to the appropriate pipe sizing table (Table F8 for Australia and Table F12 for New Zealand for the example), then as follows:

(a) Select the *main run* length shown under 'Length of straight pipe'. If the *main run* falls between two figures, use the greater length. Therefore, in the example, 20 m is used because the *main run* length is 19 m.

(b) Section AB has a total flow rate of 265 MJ/h. Follow the 20 m column down until the figure of 265 or the next larger figure is reached, in this case, 351 for Australia in Table F8 or 494 for New Zealand in Table F12.

(c) Read across to the indicated '*nominal size*', which is DN 25 for Australia in Table F8 or DN25 for New Zealand in Table F12 in the example.

(d) Insert the pipe size in the prepared installation table, Table F5.1a for Australia and Table F5.1b for New Zealand.

(e) Determine the pipe size of the remaining sections, continuing to use the *main run* length (20 m in the example), not the individual length of each section.

At Steps (b) and (e), if any values have fallen in grey shaded areas, this indicates that the required flow rate through that pipe size and over that length is not recommended owing to the factors explained more fully in Paragraph F1.6. When this occurs, it will be necessary to find a pipe size where the flow rate is possible even though that flow rate appears against a larger pipe size and longer length.

As an example, using Table F16 with the length of *main run* as 10 m and the load as 15 000 MJ/h, the 65 mm size over 10 m is in grey shade so it is not recommended. Go to the next size that is not grey shaded and will carry 15 000 MJ/h. 80 mm under the 18 m column is not shaded and will therefore carry the load at a lower velocity and *pressure* drop.

A2

TABLE F5.1a (Australia)

INSTALLATION DETAILS—EXAMPLE 1

Pipe section	Main run, m	Gas flow, MJ/h	Nominal size, DN
AB	19	50 + 30 + 90 + 95 = 265	25
BC	19	30 + 90 + 95 = 215	25
CD	19	90 + 95 = 185	25
DE	19	95	20
DF	19	90	20
CG	19	30	15
BH	19	50	20

TABLE F5.1b (New Zealand)

INSTALLATION DETAILS—EXAMPLE 1

Pipe section	Main run, m	Gas flow, MJ/h	Nominal size, DN
AB	19	50 + 30 + 90 + 95 = 265	25
BC	19	30 + 90 + 95 = 215	20
CD	19	90 + 95 = 185	20
DE	19	95	20
DF	19	90	20
CG	19	30	10
BH	19	50	15

NOTE: The results in this table differ from those in the worked example Table F5.1a as New Zealand copper piping is measured based upon the inner diameter whilst Australian copper piping is measured based upon the outer diameter.

F5.3 Worked example 2—With increased allowable pressure drop

F5.3.1 *Introduction*

The worked example given in Paragraph F5.2 uses an allowable *pressure* drop of 0.75 kPa. The example in this Paragraph (F5.3) satisfies the criteria given in Paragraph F1.7 to increase the pipe work capacity by 20% by increasing the design *pressure* drop. As follows:

(a) Available *pressure* at the meter outlet is 2.75 kPa (see Paragraph F5.2.1).

(b) Design allowable *pressure* drop becomes 1.09 kPa, that is, 1.45 × 0.75 kPa (45% increase in *pressure* drop as given in Paragraph F1.7).

(c) Available *pressure* at the *appliance* inlet is 1.66 kPa (equal to 2.75 kPa less 1.09 kPa), which exceeds the minimum *pressure* required at the *appliance* inlet of 1.13 kPa (Table 5.1, *natural gas*). As the available *pressure* at the *appliance* inlet is greater than the minimum required, the design *pressure* drop of 1.09 kPa can be used.

NOTE: A *pressure* drop of 0.75 kPa is 27% of a 2.75 kPa supply *pressure*. This is higher than the recommended range of 10% to 20% and may result in high levels of flow noise.

A2 **F5.3.2** *Determine the required pipe size using the pipe sizing tables*

The process to determine the required size for the pipe work is the same as in Paragraph F5.2, as follows:

(a) The *gas* type is *natural gas* (see Paragraph F5.2.1).

(b) The longest run of piping is 19 m (see Paragraph F5.2.3).

(c) Selected pipe material, copper (see Paragraph F5.2.4).

(d) Select allowable *pressure* drop, 0.75 kPa.

(e) Select pipe sizing chart, Table F8 Australia, F12 New Zealand (see Paragraph F5.2.5).

(f) Tabulate the pipe runs as in Paragraph F5.2.6.

(g) As the *main run* is 19 m, use the next greatest length from Table F8 or F12, that is, 20 m.

(h) As supply *pressure* of 2.75 kPa and minimum *appliance* inlet *pressure* of 1.13 kPa can accommodate the higher *pressure* drop of 1.09 kPa [see Paragraph F5.3.1(b)], the capacity values in Table F8 for Australia or F12 for New Zealand can be increased by 20% (see Table F8a Australia or F12a New Zealand).

TABLE F8a (Australia)

MODIFIED TABLE F8
(for length of straight pipe = 20 m)

Nominal diameter mm	Gas flow, MJ/h	
	Table F8	1.2 × value in Table F8
15	48	58
20	160	192
25	351	421
32	672	806

TABLE F12a (New Zealand)

MODIFIED TABLE F12
(for length of straight pipe = 20 m)

Nominal diameter mm	Gas flow, MJ/h	
	Table F12	1.2 × value in Table F12
10	37	44
15	80	96
20	231	277
25	494	593

(i) Read the correct pipe size from the modified table of Table F8 (Table F8a for Australia) or the modified table of Table F12 (Table F12a for New Zealand).

(j) Enter pipe sizes in the installation table (see Table F5.2a for Australia and F5.2b for New Zealand).

A2

TABLE F5.2a (Australia)

INSTALLATION DETAILS—EXAMPLE 2

Pipe section	Main run, m	Gas flow, MJ/h	Nominal size, DN
AB	19	50 + 30 + 90 + 95 = 265	25
BC	19	30 + 90 + 95 = 215	25
CD	19	90 + 95 = 185	20
DE	19	95	20
DF	19	90	20
CG	19	30	15
BH	19	50	15

NOTE: Some smaller nominal pipe diameters have resulted from the increased pipe capacities (refer Table F5.1a).

TABLE F5.2b (New Zealand)

INSTALLATION DETAILS—EXAMPLE 2

Pipe section	Main run, m	Gas flow, MJ/h	Nominal size, DN
AB	19	50 + 30 + 90 + 95 = 265	20
BC	19	30 + 90 + 95 = 215	20
CD	19	90 + 95 = 185	20
DE	19	95	15
DF	19	90	15
CG	19	30	10
BH	19	50	15

NOTE: Some smaller nominal pipe diameters have resulted from the increased pipe capacities (refer Table F5.1b).

F6 PIPE SIZING TABLES

The pipe sizing tables indicate the flow of *gas*, in megajoules per hour, through pipes of various materials. The heating value quoted in each pipe sizing table listing is a nominal figure typical of the gas that the table represents. It is not intended to represent any particular *gas* supply in any particular area.

The pipe sizing tables are listed as follows:

Table	Type of gas	Hv, MJ/m^3	Rd	Material	Pressure drop, kPa
F6	Natural gas (NG)	38	0.6	Copper to AS 1432 Type B	0.12
F7	Natural gas (NG)	38	0.6	Copper to AS 1432 Type B	0.25
F8	Natural gas (NG)	38	0.6	Copper to AS 1432 Type B	0.75
F9	Natural gas (NG)	38	0.6	Copper to AS 1432 Type B	1.50
F10	Natural gas (NG)	38	0.6	Copper to NZS 3501	0.12
F11	Natural gas (NG)	38	0.6	Copper to NZS 3501	0.25
F12	Natural gas (NG)	38	0.6	Copper to NZS 3501	0.75
F13	Natural gas (NG)	38	0.6	Copper to NZS 3501	1.50
A2 F13A	Natural gas (NG)	38	0.6	Steel to AS 1074 Medium Grade	0.12
F14	Natural gas (NG)	38	0.6	Steel to AS 1074 Medium Grade	0.25
F15	Natural gas (NG)	38	0.6	Steel to AS 1074 Medium Grade	0.75
F16	Natural gas (NG)	38	0.6	Steel to AS 1074 Medium Grade	1.50
F17	Natural gas (NG)	38	0.6	Polyamide to AS 2944.1 SDR 25	0.25
F18	Natural gas (NG)	38	0.6	Polyamide to AS 2944.1 SDR 25	0.75
F19	Natural gas (NG)	38	0.6	Polyamide to AS 2944.1 SDR 25	1.50
A2 F20	Natural gas (NG)	38	0.6	Polyethylene to AS/NZS 4130 SDR 11	0.25
F21	Natural gas (NG)	38	0.6	Polyethylene to AS/NZS 4130 SDR 11	0.75
F22	Natural gas (NG)	38	0.6	Polyethylene to AS/NZS 4130 SDR 11	1.50
F23	Natural gas (NG)	38	0.6	PVC-HI to AS ISO 6993.1	0.12
F24	Natural gas (NG)	38	0.6	PVC-HI to AS ISO 6993.1	0.25
F25	Natural gas (NG)	38	0.6	PVC-HI to AS ISO 6993.1	0.75
F26	Natural gas (NG)	38	0.6	PVC-HI to AS ISO 6993.1	1.50
F27	PROPANE (LP Gas)	96	1.5	Copper to AS 1432 Type B	0.25
F28	PROPANE (LP Gas)	96	1.5	Copper to NZS 3501	0.25
F29	PROPANE (LP Gas)	96	1.5	Steel to AS 1074 Medium Grade	0.25
F30	PROPANE (LP Gas)	96	1.5	Polyamide to AS 2944.1 SDR 25	0.25
F31	PROPANE (LP Gas)	96	1.5	Polyethylene to AS/NZS 4130 SDR 11	0.25
F32	PROPANE (LP Gas)	96	1.5	PVC-HI to AS ISO 6993.1	0.25
F33	Natural gas (NG)	38	0.6	Copper to AS 1432 Type B	10.0
F34	Natural gas (NG)	38	0.6	Copper to NZS 3501	10.0
F35	Natural gas (NG)	38	0.6	Steel to AS 1074 Medium Grade	10.0
F36	PROPANE (LP Gas)	96	1.5	Copper to AS 1432 Type B	10.0
F37	PROPANE (LP Gas)	96	1.5	Copper to NZS 3501	10.0
F38	PROPANE (LP Gas)	96	1.5	Copper to AS 1432 Type B	20.0
F39	PROPANE (LP Gas)	96	1.5	Copper to NZS 3501	20.0
F40	PROPANE (LP Gas)	96	1.5	Polyethylene to AS/NZS 4130 SDR 11	10.0
F41	PROPANE (LP Gas)	96	1.5	Steel to AS 1074 Medium Grade	10.0
F42	PROPANE (LP Gas)	96	1.5	Steel to AS 1074 Medium Grade	20.0

NOTES:

1 Use caution—tables include copper pipe to AS 1432 measured O.D. and copper pipe to NZS 3501 measured I.D.

2 In New Zealand, where longer pipe sizes are required, the corresponding table for copper to AS 1432 may be used. This will underestimate the capacity by about 10%.

3 In the pipe sizing tables, an em-dash (—) indicates the flow rate value being less than 10 MJ/h.

TABLE F6

NATURAL GAS—FLOW THROUGH—COPPER PIPE (AS 1432 TYPE B) (MJ/h) (Pressure drop of 0.12 kPa; suitable for supply pressures around 1.25 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	2	4	6	8	10	12	14	16	18
15	62	43	34	29	26	22	19	17	15
20	206	141	114	97	86	78	72	67	63
25	452	311	249	214	189	171	158	147	138
32	867	596	478	409	363	329	302	281	264
40	1459	1002	805	689	611	553	509	474	444
50	3356	2307	1852	1585	1405	1273	1171	1090	1022
65	6217	4273	3431	2937	2603	2358	2169	2018	1894
80	9884	6794	5455	4669	4138	3750	3450	3209	3011
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
20	59	52	48	44	41	37	33	30	28
25	130	115	104	96	89	84	79	75	72
32	249	221	200	184	171	161	152	144	138
40	420	372	337	310	288	271	256	243	232
50	966	856	776	713	664	623	588	559	533
65	1789	1585	1436	1321	1229	1154	1090	1035	987
80	2844	2521	2284	2101	1955	1834	1732	1645	1570
100	6286	5571	5048	4644	4320	4054	3829	3637	3469
125	11520	10210	9251	8511	7918	7429	7017	6665	6358
150	18531	16423	14881	13690	12736	11950	11288	10720	10227
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
25	69	66	64	61	59	58	54	46	39
32	132	127	122	118	114	111	104	95	87
40	222	213	205	198	192	186	176	159	146
50	510	490	472	456	441	428	404	366	337
65	945	908	875	845	818	793	749	679	624
80	1503	1444	1391	1344	1300	1261	1191	1079	993
100	3322	3192	3075	2969	2874	2786	2632	2384	2194
125	6089	5850	5635	5442	5266	5106	4823	4370	4020
150	9794	9409	9064	8753	8471	8213	7758	7029	6467
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
32	81	76	72	68	62	57	53	50	47
40	136	128	121	115	109	105	101	97	94
50	314	294	278	264	252	241	232	223	215
65	581	545	515	489	466	447	429	413	399
80	923	866	818	777	742	710	682	657	635
100	2041	1915	1809	1718	1639	1569	1508	1452	1403
125	3740	3509	3315	3148	3003	2876	2763	2662	2571
150	6016	5645	5332	5064	4831	4626	4445	4282	4135

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F7

NATURAL GAS—FLOW THROUGH—COPPER PIPE (AS 1432 TYPE B) (MJ/h)
(Pressure drop of 0.25 kPa; suitable for supply pressures within the range 1.5–2.5 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	2	4	6	8	10	12	14	16	18
15	93	64	51	44	39	35	32	30	28
20	306	210	169	145	128	116	107	99	93
25	672	462	371	318	281	255	235	218	205
32	1289	886	712	609	540	489	450	419	393
40	2170	1491	1197	1025	908	823	757	704	661
50	4993	3431	2755	2358	2090	1894	1742	1621	1521
65	9247	6355	5104	4368	3871	3508	3227	3002	2817
80	14703	10105	8115	6945	6155	5577	5131	4773	4479
	20	25	30	35	40	45	50	55	60
20	88	78	71	65	61	57	54	51	49
25	193	171	155	143	133	125	118	112	107
32	371	329	298	274	255	239	226	215	205
40	624	553	501	461	429	403	380	361	345
50	1437	1273	1154	1061	987	926	875	831	793
65	2661	2358	2137	1966	1829	1716	1621	1539	1469
80	4231	3750	3397	3125	2908	2728	2577	2448	2335
100	9350	8287	7509	6908	6426	6030	5696	5409	5161
125	17136	15187	13761	12660	11777	11050	10438	9914	9458
150	27564	24429	22135	20363	18944	17775	16790	15946	15213
	65	70	75	80	85	90	100	120	140
20	47	45	43	42	40	38	35	29	25
25	102	98	95	91	88	86	81	73	68
32	196	188	181	175	170	164	155	141	129
40	330	317	305	295	285	277	261	237	218
50	759	729	703	679	657	637	601	545	501
65	1406	1351	1302	1257	1216	1179	1114	1009	929
80	2236	2148	2069	1998	1934	1875	1771	1605	1476
100	4942	4748	4574	4417	4274	4144	3915	3547	3263
125	9057	8701	8382	8095	7833	7595	7174	6500	5980
150	14568	13996	13483	13020	12600	12217	11540	10456	9619
	160	180	200	220	240	260	280	300	320
25	63	59	56	52	48	44	41	38	36
32	120	113	107	101	97	93	89	86	83
40	203	190	180	171	163	156	150	144	139
50	466	438	413	393	375	359	345	332	321
65	864	811	766	727	694	664	638	615	594
80	1374	1289	1217	1156	1103	1056	1015	978	944
100	3036	2848	2690	2555	2438	2334	2243	2161	2086
125	5563	5220	4931	4683	4468	4278	4110	3960	3824
150	8949	8396	7931	7533	7186	6882	6611	6369	6150

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F8

NATURAL GAS—FLOW THROUGH—COPPER PIPE (AS 1432 TYPE B) (MJ/h) (Pressure drop of 0.75 kPa; suitable for supply pressures within the range 2.75–5 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
15	168	115	93	79	70	64	59	54	51
20	554	381	306	262	232	210	193	180	169
25	1218	837	672	575	510	462	425	396	371
32	2336	1606	1289	1104	978	886	815	758	712
40	3931	2702	2170	1857	1646	1491	1372	1276	1197
50	9046	6217	4993	4273	3787	3431	3157	2937	2755
65	16754	11515	9247	7914	7014	6355	5847	5439	5104
80	26639	18309	14703	12584	11153	10105	9297	8649	8115
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
15	48	43	39	36	33	31	29	28	27
20	160	141	128	118	110	103	97	92	88
25	351	311	281	259	241	226	214	203	193
32	672	596	540	497	462	433	409	389	371
40	1131	1002	908	836	777	729	689	654	624
50	2603	2307	2090	1923	1789	1678	1585	1506	1437
65	4821	4273	3871	3562	3313	3109	2937	2789	2661
80	7665	6794	6155	5663	5268	4943	4669	4435	4231
100	16941	15015	13604	12516	11644	10925	10320	9801	9350
125	31048	27517	24932	22938	21339	20022	18912	17962	17136
150	49941	44262	40104	36896	34324	32205	30421	28892	27564
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
20	84	81	78	75	73	71	67	61	56
25	185	178	171	166	160	155	147	133	122
32	355	341	329	318	307	298	281	255	235
40	598	574	553	534	517	501	474	429	395
50	1376	1322	1273	1229	1190	1154	1090	987	908
65	2548	2448	2358	2277	2204	2137	2018	1829	1682
80	4051	3892	3750	3621	3504	3397	3209	2908	2675
100	8954	8602	8287	8003	7744	7509	7093	6426	5912
125	16410	15765	15187	14666	14193	13761	12998	11777	10835
150	26395	25358	24429	23591	22830	22135	20908	18944	17429
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
25	114	107	101	96	91	88	84	81	78
32	218	205	193	184	175	168	161	155	150
40	367	345	325	309	295	282	271	261	252
50	845	793	749	711	679	650	624	601	581
65	1565	1469	1387	1317	1257	1204	1156	1114	1076
80	2489	2335	2206	2095	1998	1914	1839	1771	1710
100	5500	5161	4875	4630	4417	4230	4063	3915	3780
125	10080	9458	8934	8485	8095	7752	7447	7174	6928
150	16214	15213	14370	13648	13020	12469	11979	11540	11144

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F9

NATURAL GAS—FLOW THROUGH—COPPER PIPE (AS 1432 TYPE B) (MJ/h) (Pressure drop of 1.5 kPa; suitable for supply pressures within the range 5–10 kPa)

Nom. dia. DN	Length of straight pipe in metres								
	2	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
15	244	168	135	115	102	93	85	79	74
20	807	554	445	381	338	306	281	262	246
25	1772	1218	978	837	742	672	619	575	540
32	3399	2336	1876	1606	1423	1289	1186	1104	1035
40	5720	3931	3157	2702	2395	2170	1996	1857	1742
50	13161	9046	7264	6217	5510	4993	4593	4273	4009
65	24377	16754	13454	11515	10206	9247	8507	7914	7426
80	38760	26639	21392	18309	16227	14703	13526	12584	11807
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
20	232	206	186	171	160	150	141	134	128
25	510	452	410	377	351	329	311	295	281
32	978	867	785	723	672	631	596	566	540
40	1646	1459	1322	1216	1131	1061	1002	952	908
50	3787	3356	3041	2798	2603	2442	2307	2191	2090
65	7014	6217	5633	5182	4821	4523	4273	4058	3871
80	11153	9884	8956	8239	7665	7192	6794	6452	6155
100	24649	21846	19794	18210	16941	15895	15015	14260	13604
125	45174	40037	36276	33374	31048	29131	27517	26134	24932
150	72663	64400	58351	53682	49941	46858	44262	42037	40104
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
15	37	36	34	33	32	31	29	27	24
20	123	118	114	110	106	103	97	88	81
25	270	259	249	241	233	226	214	193	178
32	517	497	478	462	447	433	409	371	341
40	870	836	805	777	752	729	689	624	574
50	2002	1923	1852	1789	1731	1678	1585	1437	1322
65	3707	3562	3431	3313	3206	3109	2937	2661	2448
80	5895	5663	5455	5268	5098	4943	4669	4231	3892
100	13028	12516	12057	11644	11268	10925	10320	9350	8602
125	23876	22938	22097	21339	20650	20022	18912	17136	15765
150	38405	36896	35544	34324	33217	32205	30421	27564	25358
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
25	166	155	147	139	133	127	122	118	114
32	318	298	281	267	255	244	235	226	218
40	534	501	474	450	429	411	395	380	367
50	1229	1154	1090	1035	987	945	908	875	845
65	2277	2137	2018	1917	1829	1751	1682	1621	1565
80	3621	3397	3209	3048	2908	2784	2675	2577	2489
100	8003	7509	7093	6736	6426	6154	5912	5696	5500
125	14666	13761	12998	12345	11777	11278	10835	10438	10080
150	23591	22135	20908	19857	18944	18141	17429	16790	16214

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F10

NATURAL GAS—FLOW THROUGH—COPPER PIPE (NZS 3501) (MJ/h)
(Pressure drop of 0.12 kPa; suitable for supply pressures around 1.25 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
10	48	33	27	23	18	15	13	11	10
15	103	71	57	49	43	39	36	34	31
20	297	204	164	140	124	113	104	97	91
25	637	438	351	301	267	242	222	207	194
32	1148	789	634	542	481	435	401	373	350
40	1844	1268	1018	871	772	700	644	599	562
50	3922	2696	2165	1853	1642	1488	1369	1273	1195
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
10	—	—	—	—	—	—	—	—	—
15	29	23	19	17	15	13	12	11	—
20	86	76	69	63	59	55	52	49	47
25	183	162	147	135	126	118	112	106	101
32	330	293	265	244	227	213	201	191	182
40	531	470	426	392	365	342	323	307	293
50	1129	1000	906	834	776	728	687	653	623
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
10	—	—	—	—	—	—	—	—	—
15	—	—	—	—	—	—	—	—	—
20	45	42	39	36	34	32	29	24	21
25	97	93	90	87	84	81	77	69	64
32	175	168	162	156	151	146	138	125	115
40	280	269	260	251	243	235	222	201	185
50	597	573	552	533	516	500	473	428	394
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
10	—	—	—	—	—	—	—	—	—
15	—	—	—	—	—	—	—	—	—
20	18	16	15	13	12	11	10	—	—
25	58	52	47	42	39	36	33	31	29
32	107	101	95	90	86	82	79	76	72
40	172	162	153	145	138	132	127	123	118
50	366	344	325	308	294	282	271	261	252

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F11

NATURAL GAS—FLOW THROUGH—COPPER PIPE (NZS 3501) (MJ/h)
(Pressure drop of 0.25 kPa; suitable for supply pressures within the range 1.5–2.5 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
10	72	49	40	34	30	27	25	23	21
15	154	106	85	73	64	58	54	50	47
20	442	304	244	209	185	168	154	144	135
25	947	651	523	447	397	359	331	307	289
32	1708	1174	942	807	715	648	596	554	520
40	2743	1885	1514	1296	1149	1041	957	891	836
50	5834	4010	3220	2756	2443	2213	2036	1894	1777
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
10	19	15	13	11	—	—	—	—	—
15	44	39	36	33	30	27	24	22	20
20	127	113	102	94	87	82	78	74	70
25	273	242	219	201	187	176	166	158	150
32	491	435	395	363	338	317	299	284	271
40	789	700	634	583	543	509	481	457	436
50	1679	1488	1348	1240	1154	1083	1023	971	927
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
10	—	—	—	—	—	—	—	—	—
15	19	17	16	15	14	13	12	10	—
20	67	65	62	60	58	56	53	48	43
25	144	138	133	129	125	121	114	103	95
32	260	249	240	232	225	218	206	186	171
40	417	401	386	373	361	350	330	299	275
50	887	852	821	793	767	744	703	637	586
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
10	—	—	—	—	—	—	—	—	—
15	—	—	—	—	—	—	—	—	—
20	38	34	30	28	25	23	22	20	19
25	88	83	78	74	71	68	65	63	61
32	160	150	141	134	128	123	118	114	110
40	256	240	227	216	206	197	189	182	176
50	545	511	483	459	438	419	403	388	375

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F12

NATURAL GAS—FLOW THROUGH—COPPER PIPE (NZS 3501) (MJ/h)
(Pressure drop of 0.75 kPa; suitable for supply pressures within the range 2.75–5 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	2	4	6	8	10	12	14	16	18
10	130	89	72	61	54	49	45	42	40
15	279	191	154	132	117	106	97	90	85
20	801	551	442	379	335	304	280	260	244
25	1716	1179	947	811	718	651	599	557	523
32	3094	2126	1708	1461	1295	1174	1080	1004	942
40	4971	3416	2743	2348	2081	1885	1735	1614	1514
50	10571	7265	5834	4993	4426	4010	3689	3432	3220
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
10	37	33	30	28	26	24	23	21	19
15	80	71	64	59	55	52	49	46	44
20	231	204	185	170	158	149	140	133	127
25	494	438	397	365	339	318	301	286	273
32	890	789	715	658	612	574	542	515	491
40	1430	1268	1149	1057	983	922	871	827	789
50	3042	2696	2443	2247	2091	1961	1853	1760	1679
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
10	18	16	15	14	13	13	11	—	—
15	42	41	39	38	37	36	34	30	26
20	122	117	113	109	105	102	97	87	80
25	261	251	242	233	226	219	207	187	172
32	471	452	435	421	407	395	373	338	311
40	756	726	700	676	654	634	599	543	499
50	1608	1544	1488	1437	1390	1348	1273	1154	1061
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
10	—	—	—	—	—	—	—	—	—
15	23	20	18	17	15	14	13	12	11
20	75	70	66	63	60	58	55	53	51
25	160	150	142	135	129	123	118	114	110
32	289	271	256	243	232	222	214	206	199
40	464	436	412	391	373	357	343	330	319
50	988	927	875	831	793	759	730	703	679

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F13

NATURAL GAS—FLOW THROUGH—COPPER PIPE (NZS 3501) (MJ/h)
(Pressure drop of 1.5 kPa; suitable for supply pressures within the range 5–10 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
10	189	130	104	89	79	72	66	61	58
15	405	279	224	191	170	154	141	132	123
20	1166	801	643	551	488	442	407	379	355
25	2497	1716	1378	1179	1045	947	871	811	761
32	4502	3094	2484	2126	1885	1708	1571	1461	1371
40	7232	4971	3992	3416	3028	2743	2524	2348	2203
50	15381	10571	8489	7265	6439	5834	5368	4993	4685
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
10	54	48	44	40	37	35	33	32	30
15	117	103	94	86	80	75	71	67	64
20	335	297	269	248	231	216	204	194	185
25	718	637	577	531	494	463	438	416	397
32	1295	1148	1040	957	890	835	789	749	715
40	2081	1844	1671	1537	1430	1342	1268	1204	1149
50	4426	3922	3554	3270	3042	2854	2696	2560	2443
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
10	29	28	27	26	25	24	23	19	16
15	62	59	57	55	53	52	49	44	41
20	177	170	164	158	153	149	140	127	117
25	380	365	351	339	328	318	301	273	251
32	685	658	634	612	592	574	542	491	452
40	1100	1057	1018	983	951	922	871	789	726
50	2339	2247	2165	2091	2023	1961	1853	1679	1544
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
10	14	13	11	10	—	—	—	—	—
15	38	36	34	32	30	28	26	24	23
20	109	102	97	92	87	84	80	78	75
25	233	219	207	196	187	179	172	166	160
32	421	395	373	354	338	323	311	299	289
40	676	634	599	569	543	520	499	481	464
50	1437	1348	1273	1209	1154	1105	1061	1023	988

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

A2

TABLE F13A

NATURAL GAS—FLOW THROUGH-STEEL PIPE (AS 1074 MEDIUM GRADE) (MJ/h) (Pressure drop of 0.12 kPa; suitable for supply pressures around 1.25 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	2	4	6	8	10	12	14	16	18
15	181	122	97	82	73	67	62	58	54
20	408	277	220	187	164	148	135	121	114
25	767	522	416	354	311	280	257	238	222
32	1631	1115	890	758	669	603	553	512	479
40	2460	1685	1347	1148	1014	915	839	778	728
50	4611	3168	2538	2166	1914	1730	1587	1473	1379
65	9220	6355	5099	4358	3856	3487	3202	2974	2786
80	14141	9763	7844	6708	5939	5374	4938	4587	4298
100	28475	19715	15865	13585	12039	10903	10024	9319	8736
125	49632	34437	27747	23781	21089	19110	17579	16349	15334
150	79802	55470	44739	38374	34049	30870	28408	26429	24796
	20	25	30	35	40	45	50	55	60
20	108	97	89	82	77	72	69	65	63
25	209	184	165	147	137	129	123	117	112
32	451	397	357	327	302	282	266	251	239
40	686	604	544	498	461	431	405	384	365
50	1300	1146	1034	947	878	821	773	732	696
65	2627	2320	2094	1921	1781	1667	1570	1488	1416
80	4055	3583	3237	2970	2756	2579	2431	2304	2194
100	8246	7293	6594	6055	5622	5266	4966	4708	4485
125	14478	12815	11595	10652	9896	9273	8747	8297	7906
150	23418	20741	18777	17258	16039	15034	14186	13460	12829
	65	70	75	80	85	90	100	120	140
25	108	104	100	97	94	91	87	79	73
32	228	219	201	195	189	184	174	159	147
40	348	333	320	308	298	288	271	233	216
50	665	637	612	590	569	551	518	466	426
65	1353	1297	1247	1202	1161	1124	1058	953	872
80	2097	2011	1933	1864	1801	1743	1642	1480	1355
100	4288	4114	3958	3817	3689	3572	3366	3037	2783
125	7562	7256	6983	6736	6512	6307	5946	5368	4922
150	12273	11780	11338	10940	10578	10247	9664	8730	8009
	160	180	200	220	240	260	280	300	320
32	138	130	123	118	113	108	104	101	97
40	202	190	181	172	165	158	153	147	143
50	394	368	346	327	296	285	274	265	257
65	807	754	709	671	638	609	583	560	539
80	1255	1173	1104	1044	993	948	908	873	841
100	2580	2413	2272	2152	2047	1956	1874	1801	1736
125	4566	4272	4025	3813	3630	3468	3325	3197	3082
150	7432	6956	6556	6214	5917	5655	5423	5216	5029

NOTE: Use of the values printed in the shaded areas is not recommended and requires professional advice. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of tables in general.

TABLE F14

NATURAL GAS—FLOW THROUGH—STEEL PIPE (AS 1074 MED. GRADE) (MJ/h)
(Pressure drop of 0.25 kPa; suitable for supply pressures within the range 1.5–2.5 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
15	273	186	148	125	110	99	89	83	79
20	612	418	333	284	250	225	206	191	179
25	1146	785	628	535	472	426	390	362	339
32	2426	1668	1337	1141	1008	911	836	776	726
40	3651	2516	2018	1724	1525	1379	1266	1175	1100
50	6825	4715	3789	3241	2869	2596	2385	2216	2076
65	13603	9426	7588	6498	5759	5216	4796	4458	4179
80	20824	14455	11648	9983	8853	8022	7378	6862	6435
100	41808	29104	23490	20156	17890	16223	14931	13893	13036
125	72696	50722	40989	35203	31266	28369	26123	24317	22825
150	116636	81544	65968	56698	50385	45737	42133	39234	36838
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
20	168	148	133	118	111	104	99	94	90
25	319	281	253	231	214	200	188	178	169
32	684	603	544	498	462	432	406	385	366
40	1037	915	826	757	702	657	618	586	557
50	1959	1730	1563	1434	1330	1245	1173	1112	1058
65	3945	3488	3154	2896	2689	2518	2374	2251	2144
80	6075	5376	4863	4467	4149	3887	3666	3477	3312
100	12313	10907	9874	9076	8435	7907	7461	7079	6747
125	21566	19117	17318	15926	14809	13887	13109	12442	11862
150	34815	30880	27988	25750	23951	22467	21215	20141	19207
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
25	155	150	145	140	136	132	125	114	106
32	349	335	322	310	299	289	272	245	224
40	532	510	490	472	456	441	415	374	342
50	1011	970	932	899	868	840	791	713	652
65	2049	1966	1891	1824	1762	1706	1608	1450	1328
80	3168	3039	2924	2820	2726	2640	2488	2246	2058
100	6455	6196	5963	5753	5563	5389	5082	4590	4211
125	11352	10898	10492	10125	9792	9488	8950	8090	7426
150	18385	17654	16999	16408	15871	15380	14514	13126	12054
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
32	199	188	178	170	162	156	150	145	141
40	316	295	277	262	238	229	220	213	206
50	604	564	531	502	477	456	436	419	404
65	1231	1151	1083	1026	976	932	893	858	827
80	1908	1785	1681	1592	1515	1447	1387	1333	1285
100	3907	3657	3446	3266	3109	2971	2849	2740	2641
125	6893	6455	6085	5769	5494	5253	5039	4847	4674
150	11194	10486	9889	9378	8934	8543	8197	7886	7607

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F15

NATURAL GAS—FLOW THROUGH—STEEL PIPE (AS 1074 MED. GRADE) (MJ/h)
(Pressure drop of 0.75 kPa; suitable for supply pressures within the range 2.75–5 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	2	4	6	8	10	12	14	16	18
15	499	342	274	233	206	186	170	158	148
20	1109	764	613	524	463	419	384	357	334
25	2066	1428	1148	982	869	786	722	671	628
32	4347	3016	2429	2081	1844	1670	1536	1428	1338
40	6524	4535	3656	3135	2780	2519	2317	2155	2021
50	12140	8462	6834	5865	5206	4721	4346	4044	3794
65	24079	16838	13621	11705	10400	9438	8693	8093	7598
80	36746	25750	20852	17931	15941	14474	13336	12421	11664
100	73366	51603	41862	36043	32071	29142	26867	25036	23521
125	126950	89591	72791	62734	55861	50788	46846	43671	41043
150	202736	143539	116788	100741	89762	81650	75344	70262	66054

Nom. dia. DN	20	25	30	35	40	45	50	55	60
15	139	123	110	101	94	86	82	78	75
20	315	277	250	229	212	199	187	177	168
25	593	523	473	433	402	376	354	335	319
32	1263	1117	1010	927	860	805	759	720	685
40	1908	1688	1527	1402	1302	1220	1150	1091	1039
50	3583	3174	2873	2640	2454	2300	2170	2058	1961
65	7179	6365	5767	5304	4932	4624	4365	4143	3950
80	11024	9780	8865	8156	7587	7116	6720	6379	6083
100	22241	19748	17913	16492	15349	14405	13608	12924	12329
125	38822	34494	31307	28837	26850	25207	23821	22631	21595
150	62496	55561	50452	46488	43300	40664	38438	36526	34861

Nom. dia. DN	65	70	75	80	85	90	100	120	140
20	161	154	148	143	138	133	121	111	103
25	305	292	281	271	262	253	238	214	196
32	655	628	604	583	563	545	513	463	423
40	993	953	917	884	854	827	779	703	644
50	1876	1800	1733	1671	1616	1565	1475	1332	1221
65	3780	3629	3493	3371	3260	3158	2979	2692	2471
80	5823	5591	5383	5196	5026	4870	4595	4155	3815
100	11805	11339	10921	10544	10201	9888	9334	8447	7761
125	20682	19870	19143	18485	17888	17342	16377	14829	13632
150	33395	32091	30921	29865	28904	28026	26474	23984	22057

Nom. dia. DN	160	180	200	220	240	260	280	300	320
25	181	169	153	146	140	135	130	125	121
32	392	366	345	326	310	296	284	273	262
40	597	558	525	497	473	452	433	416	401
50	1133	1060	998	946	900	860	824	792	764
65	2293	2147	2023	1918	1826	1745	1674	1610	1552
80	3542	3317	3128	2965	2824	2700	2590	2492	2403
100	7210	6757	6374	6046	5761	5511	5288	5089	4909
125	12671	11878	11210	10637	10139	9701	9311	8963	8648
150	20509	19233	18156	17233	16430	15724	15096	14534	14026

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F16

NATURAL GAS—FLOW THROUGH—STEEL PIPE (AS 1074 MED. GRADE) (MJ/h)
(Pressure drop of 1.5 kPa; suitable for supply pressures within the range 5–10 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
15	724	500	401	343	303	274	252	234	219
20	1602	1111	894	766	679	614	565	525	492
25	2975	2070	1669	1431	1269	1150	1058	984	922
32	6240	4356	3520	3022	2683	2434	2240	2085	1956
40	9346	6537	5288	4544	4037	3663	3374	3141	2948
50	17332	12164	9856	8479	7540	6847	6309	5877	5519
65	34238	24126	19587	16871	15016	13647	12584	11728	11019
80	52101	36818	29928	25800	22977	20892	19272	17967	16886
100	103470	73509	59892	51703	46093	41944	38716	36113	33957
125	178135	127199	103853	89765	80094	72932	67356	62856	59126
150	283038	203137	166192	143818	128428	117015	108120	100936	94980
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
20	464	410	370	340	315	295	278	263	251
25	871	770	697	640	594	556	524	497	474
32	1848	1637	1482	1362	1266	1186	1119	1062	1012
40	2786	2469	2236	2056	1912	1792	1692	1605	1530
50	5217	4628	4195	3860	3591	3368	3180	3019	2879
65	10420	9254	8395	7729	7194	6751	6378	6057	5778
80	15972	14192	12881	11864	11046	10370	9799	9309	8882
100	32134	28578	25956	23922	22284	20930	19787	18804	17949
125	55970	49811	45267	41739	38898	36548	34562	32856	31369
150	89937	80088	72817	67169	62619	58853	55670	52934	50551
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
25	453	434	418	403	389	377	355	320	293
32	968	929	894	862	833	807	761	687	630
40	1464	1405	1352	1305	1262	1222	1153	1041	955
50	2755	2646	2547	2459	2378	2304	2174	1965	1804
65	5533	5314	5118	4941	4781	4634	4374	3958	3636
80	8506	8172	7873	7602	7356	7131	6733	6096	5602
100	17195	16525	15923	15380	14885	14434	13635	12354	11362
125	30059	28894	27848	26903	26043	25257	23868	21638	19910
150	48450	46580	44902	43385	42006	40744	38514	34931	32155
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
25	271	254	239	226	215	205	196	189	182
32	584	546	514	487	463	443	424	408	393
40	886	829	781	740	704	673	645	620	598
50	1675	1568	1479	1402	1335	1276	1224	1177	1135
65	3378	3165	2985	2831	2698	2580	2476	2382	2298
80	5206	4880	4605	4369	4163	3983	3822	3679	3549
100	10565	9908	9353	8878	8464	8100	7777	7487	7225
125	18522	17376	16410	15580	14859	14224	13659	13153	12696
150	29924	28081	26527	25193	24032	23009	22101	21286	20551

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F17

NATURAL GAS—FLOW THROUGH—POLYAMIDE PIPE (AS 2944.1 SDR 25) (MJ/h) (Pressure drop of 0.25 kPa; suitable for supply pressures within the range 1.5–2.5 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
18	273	187	150	129	114	103	95	89	83
20	373	256	206	176	156	141	130	121	114
23	561	385	310	265	235	213	196	182	171
25	697	479	385	329	292	264	243	226	212
32	1341	922	740	633	561	509	468	435	408
40	2399	1649	1324	1133	1004	910	837	779	731
50	4345	2986	2398	2052	1819	1648	1516	1411	1324
75	12634	8683	6973	5968	5289	4792	4409	4102	3848
90	20224	13900	11162	9553	8467	7672	7058	6566	6161
110	34295	23571	18928	16200	14358	13009	11968	11134	10447
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
20	107	95	86	79	74	69	65	62	59
23	161	143	130	119	111	104	98	93	89
25	201	178	161	148	138	129	122	116	111
32	386	342	310	285	265	249	235	223	213
40	690	612	554	510	474	445	420	399	381
50	1250	1108	1004	924	859	806	762	723	690
75	3635	3222	2919	2686	2498	2344	2214	2103	2006
90	5819	5158	4673	4299	4000	3753	3545	3367	3212
110	9868	8746	7924	7290	6782	6364	6011	5709	5446
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
23	85	82	79	76	74	72	68	61	56
25	106	102	98	95	92	89	84	76	70
32	204	196	189	182	176	171	162	146	135
40	365	350	338	326	316	306	289	262	241
50	661	635	612	591	571	554	523	474	436
75	1921	1846	1778	1717	1662	1611	1522	1379	1269
90	3076	2955	2847	2749	2660	2579	2436	2207	2031
110	5216	5011	4827	4661	4511	4374	4131	3743	3444
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
25	65	61	58	55	51	47	43	41	38
32	125	118	111	105	101	96	93	89	86
40	224	210	199	189	180	172	166	159	154
50	406	381	360	342	326	312	300	289	279
75	1180	1107	1046	993	948	908	872	840	811
90	1889	1773	1674	1590	1517	1453	1396	1345	1299
110	3204	3006	2839	2697	2573	2464	2367	2280	2202

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F18

NATURAL GAS—FLOW THROUGH—POLYAMIDE PIPE (AS 2944.1 SDR 25) (MJ/h) (Pressure drop of 0.75 kPa; suitable for supply pressures within the range 2.75–5 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
18	494	340	273	233	207	187	172	160	150
20	675	464	373	319	283	256	236	219	206
23	1016	698	561	480	425	385	355	330	310
25	1263	868	697	597	529	479	441	410	385
32	2429	1670	1341	1148	1017	922	848	789	740
40	4346	2987	2399	2053	1820	1649	1517	1411	1324
50	7872	5410	4345	3719	3296	2986	2747	2556	2398
75	22890	15732	12634	10813	9583	8683	7988	7432	6973
90	36644	25185	20224	17310	15341	13900	12788	11897	11162
110	62138	42707	34295	29352	26014	23571	21685	20174	18928
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
20	194	172	156	144	134	125	118	112	107
23	292	259	235	216	201	189	178	169	161
25	363	322	292	269	250	234	221	210	201
32	699	620	561	516	480	451	426	404	386
40	1251	1108	1004	924	860	806	762	724	690
50	2265	2008	1819	1673	1557	1461	1380	1310	1250
75	6586	5837	5289	4866	4527	4247	4012	3810	3635
90	10544	9345	8467	7790	7247	6799	6423	6100	5819
110	17880	15846	14358	13209	12288	11530	10891	10344	9868
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
23	155	148	143	138	134	130	122	111	102
25	192	185	178	172	166	161	152	138	127
32	369	355	342	330	320	310	293	265	244
40	661	635	612	591	572	554	524	474	436
50	1197	1150	1108	1070	1035	1004	948	859	790
75	3481	3344	3222	3111	3011	2919	2757	2498	2299
90	5573	5354	5158	4981	4820	4673	4414	4000	3680
110	9450	9079	8746	8446	8173	7924	7485	6782	6240
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
25	118	111	105	99	95	91	87	84	81
32	227	213	201	191	182	175	168	162	156
40	406	381	360	342	326	312	300	289	279
50	735	690	652	619	591	566	543	523	505
75	2138	2006	1895	1800	1717	1644	1580	1522	1470
90	3423	3212	3034	2881	2749	2632	2529	2436	2353
110	5805	5446	5145	4886	4661	4464	4288	4131	3990

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F19

NATURAL GAS—FLOW THROUGH—POLYAMIDE PIPE (AS 2944.1 SDR 25) (MJ/h) (Pressure drop of 1.5 kPa; suitable for supply pressures within the range 5–10 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	2	4	6	8	10	12	14	16	18
18	719	494	397	340	301	273	251	233	219
20	983	675	542	464	411	373	343	319	299
23	1478	1016	816	698	619	561	516	480	450
25	1838	1263	1014	868	769	697	641	597	560
32	3535	2429	1951	1670	1480	1341	1234	1148	1077
40	6324	4346	3490	2987	2648	2399	2207	2053	1926
50	11454	7872	6322	5410	4795	4345	3997	3719	3489
75	33305	22890	18382	15732	13943	12634	11623	10813	10145
90	53316	36644	29426	25185	22321	20224	18606	17310	16241
	20	25	30	35	40	45	50	55	60
18	207	183	166	153	142	133	126	120	114
20	283	251	227	209	194	182	172	164	156
23	425	377	342	314	292	274	259	246	235
25	529	469	425	391	363	341	322	306	292
32	1017	901	817	751	699	656	620	588	561
40	1820	1613	1461	1344	1251	1173	1108	1053	1004
50	3296	2921	2647	2435	2265	2125	2008	1907	1819
75	9583	8493	7696	7080	6586	6180	5837	5544	5289
90	15341	13597	12319	11334	10544	9893	9345	8875	8467
	65	70	75	80	85	90	100	120	140
18	109	105	101	98	95	92	87	78	72
20	149	144	138	134	129	125	118	107	99
23	225	216	208	201	194	189	178	161	148
25	280	269	259	250	242	234	221	201	185
32	538	516	498	480	465	451	426	386	355
40	962	924	890	860	832	806	762	690	635
50	1742	1673	1612	1557	1507	1461	1380	1250	1150
75	5065	4866	4688	4527	4381	4247	4012	3635	3344
90	8108	7790	7504	7247	7013	6799	6423	5819	5354
	160	180	200	220	240	260	280	300	320
23	138	130	122	116	111	106	102	98	95
25	172	161	152	145	138	132	127	122	118
32	330	310	293	278	265	254	244	235	227
40	591	554	524	497	474	454	436	420	406
50	1070	1004	948	901	859	823	790	762	735
75	3111	2919	2757	2619	2498	2393	2299	2214	2138
90	4981	4673	4414	4192	4000	3830	3680	3545	3423
110	8446	7924	7485	7109	6782	6495	6240	6011	5805

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F20

NATURAL GAS—FLOW THROUGH— POLYETHYLENE PIPE (AS/NZS 4130 SDR 11) (MJ/h)
(Pressure drop of 0.25 kPa; suitable for supply pressures within the range 1.5–2.5 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
20	170	117	94	80	71	65	59	55	52
25	395	272	218	187	165	150	138	128	120
32	928	638	512	438	388	352	324	301	283
40	1680	1154	927	793	703	637	586	545	512
50	3036	2086	1676	1434	1271	1152	1059	986	925
63	5596	3846	3089	2644	2343	2123	1953	1817	1705
75	8950	6151	4939	4228	3747	3395	3123	2906	2726
90	14353	9865	7922	6780	6009	5445	5009	4660	4372
110	24508	16844	13526	11577	10260	9297	8553	7957	7465
160	65337	44906	36061	30864	27354	24784	22801	21212	19903
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
25	114	101	91	84	78	73	69	66	63
32	267	237	214	197	183	172	163	154	147
40	483	428	388	357	332	312	294	280	267
50	874	774	701	645	600	563	532	505	482
63	1610	1427	1293	1190	1107	1038	981	932	889
75	2575	2282	2068	1902	1770	1661	1569	1490	1421
90	4130	3660	3317	3051	2839	2663	2516	2389	2279
110	7052	6250	5663	5210	4847	4547	4296	4080	3892
160	18800	16662	15097	13889	12921	12124	11452	10876	10376
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
32	141	136	131	126	122	118	112	101	93
40	255	245	236	228	221	214	202	183	169
50	462	444	427	413	399	387	366	331	305
63	851	818	788	761	736	714	674	611	562
75	1361	1308	1260	1216	1177	1141	1078	977	899
90	2183	2097	2020	1951	1888	1830	1729	1567	1441
110	3727	3581	3449	3331	3224	3125	2952	2675	2461
160	9936	9546	9196	8881	8594	8332	7871	7131	6561
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
40	157	147	139	132	126	121	116	112	108
50	284	266	251	239	228	218	210	202	195
63	523	491	463	440	420	402	386	372	359
75	836	784	741	704	671	643	618	595	575
90	1341	1258	1188	1129	1077	1031	991	954	922
110	2289	2148	2029	1927	1838	1761	1691	1629	1574
160	6104	5727	5410	5138	4901	4694	4509	4344	4195

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F21

NATURAL GAS—FLOW THROUGH— POLYETHYLENE PIPE (AS/NZS 4130 SDR 11) (MJ/h) (Pressure drop of 0.75 kPa; suitable for supply pressures within the range 2.75–5 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	2	4	6	8	10	12	14	16	18
20	308	212	170	146	129	117	108	100	94
25	716	492	395	338	300	272	250	232	218
32	1681	1155	928	794	704	638	587	546	512
40	3043	2092	1680	1437	1274	1154	1062	988	927
50	5500	3780	3036	2598	2303	2086	1920	1786	1676
63	10140	6969	5596	4790	4245	3846	3539	3292	3089
75	16215	11145	8950	7660	6789	6151	5659	5264	4939
90	26006	17874	14353	12285	10888	9865	9076	8443	7922
110	44404	30519	24508	20975	18590	16844	15496	14416	13526
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
20	89	79	71	66	61	57	54	51	49
25	206	183	165	152	142	133	125	119	114
32	484	429	388	357	332	312	295	280	267
40	876	776	703	647	602	565	533	507	483
50	1583	1403	1271	1169	1088	1021	964	916	874
63	2918	2586	2343	2156	2005	1881	1777	1688	1610
75	4666	4135	3747	3447	3207	3009	2842	2699	2575
90	7483	6632	6009	5528	5143	4826	4558	4329	4130
110	12777	11324	10260	9439	8781	8239	7783	7392	7052
160	34063	30189	27354	25165	23411	21966	20749	19706	18800
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
25	109	105	101	97	94	91	86	78	72
32	256	246	237	228	221	214	202	183	169
40	463	445	428	414	400	388	367	332	306
50	836	804	774	748	723	701	663	600	552
63	1542	1481	1427	1378	1334	1293	1221	1107	1018
75	2466	2369	2282	2204	2133	2068	1953	1770	1628
90	3955	3800	3660	3535	3421	3317	3133	2839	2611
110	6753	6488	6250	6035	5841	5663	5349	4847	4459
160	18003	17296	16662	16090	15571	15097	14261	12921	11887
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
32	157	147	139	132	126	121	116	112	108
40	284	267	252	239	228	219	210	202	195
50	514	482	455	433	413	395	380	366	353
63	947	889	840	797	761	728	700	674	651
75	1515	1421	1343	1275	1216	1165	1119	1078	1041
90	2429	2279	2153	2045	1951	1868	1795	1729	1670
110	4148	3892	3676	3492	3331	3190	3065	2952	2851
160	11059	10376	9801	9309	8881	8504	8170	7871	7601

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F22

NATURAL GAS—FLOW THROUGH— POLYETHYLENE PIPE (AS/NZS 4130 SDR 11) (MJ/h)
(Pressure drop of 1.5 kPa; suitable for supply pressures within the range 5–10 kPa)

Nom. dia. DN	Length of straight pipe in metres								
	2	4	6	8	10	12	14	16	18
20	448	308	248	212	188	170	157	146	137
25	1042	716	575	492	436	395	363	338	317
32	2445	1681	1350	1155	1024	928	853	794	745
40	4428	3043	2444	2092	1854	1680	1545	1437	1349
50	8003	5500	4417	3780	3350	3036	2793	2598	2438
63	14753	10140	8143	6969	6177	5596	5149	4790	4494
75	23593	16215	13021	11145	9877	8950	8233	7660	7187
90	37838	26006	20884	17874	15841	14353	13205	12285	11526
110	64607	44404	35658	30519	27048	24508	22547	20975	19680
	20	25	30	35	40	45	50	55	60
20	129	114	104	95	89	83	79	75	71
25	300	266	241	221	206	193	183	173	165
32	704	624	565	520	484	454	429	407	388
40	1274	1129	1023	941	876	822	776	737	703
50	2303	2041	1849	1701	1583	1485	1403	1332	1271
63	4245	3762	3409	3136	2918	2738	2586	2456	2343
75	6789	6017	5451	5015	4666	4378	4135	3927	3747
90	10888	9649	8743	8044	7483	7021	6632	6299	6009
110	18590	16476	14928	13734	12777	11988	11324	10755	10260
160	49561	43925	39799	36615	34063	31960	30189	28672	27354
	65	70	75	80	85	90	100	120	140
25	158	152	147	142	137	133	125	114	105
32	372	357	344	332	322	312	295	267	246
40	673	647	623	602	582	565	533	483	445
50	1217	1169	1126	1088	1053	1021	964	874	804
63	2244	2156	2077	2005	1941	1881	1777	1610	1481
75	3588	3447	3321	3207	3103	3009	2842	2575	2369
90	5754	5528	5326	5143	4977	4826	4558	4130	3800
110	9825	9439	9093	8781	8498	8239	7783	7052	6488
160	26195	25165	24243	23411	22656	21966	20749	18800	17296
	160	180	200	220	240	260	280	300	320
32	228	214	202	192	183	176	169	163	157
40	414	388	367	348	332	318	306	294	284
50	748	701	663	629	600	575	552	532	514
63	1378	1293	1221	1160	1107	1060	1018	981	947
75	2204	2068	1953	1855	1770	1695	1628	1569	1515
90	3535	3317	3133	2975	2839	2718	2611	2516	2429
110	6035	5663	5349	5080	4847	4641	4459	4296	4148
160	16090	15097	14261	13544	12921	12374	11887	11452	11059

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F23

NATURAL GAS—FLOW THROUGH—PVC-HI PIPE (AS ISO 6993.1) (MJ/h)
(Pressure drop of 0.12 kPa; suitable for supply pressures around 1.25 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	2	4	6	8	10	12	14	16	18
20	426	293	235	201	179	162	149	138	130
25	853	586	471	403	357	324	298	277	260
32	1696	1166	936	801	710	643	592	551	517
40	2396	1647	1323	1132	1003	909	836	778	730
50	4384	3013	2419	2071	1835	1663	1530	1423	1335
65	8044	5528	4439	3800	3368	3051	2807	2611	2450
80	12365	8499	6825	5841	5177	4691	4315	4015	3767
100	23976	16479	13233	11326	10038	9095	8367	7784	7304
125	41268	28363	22776	19494	17277	15654	14402	13398	12571
150	58361	40111	32211	27568	24433	22138	20367	18947	17778

Nom. dia. DN	20	25	30	35	40	45	50	55	60
25	246	218	197	181	169	158	150	142	136
32	488	432	392	360	335	315	297	282	269
40	690	611	554	509	474	445	420	399	381
50	1261	1118	1013	932	867	813	768	730	696
65	2314	2051	1859	1710	1591	1493	1410	1339	1277
80	3558	3153	2857	2629	2445	2294	2167	2058	1964
100	6899	6114	5540	5097	4742	4449	4202	3991	3808
125	11874	10524	9536	8773	8161	7657	7233	6870	6554
150	16793	14883	13485	12406	11542	10829	10229	9715	9268

Nom. dia. DN	65	70	75	80	85	90	100	120	140
25	130	125	120	116	112	109	103	93	86
32	258	248	239	230	223	216	204	185	170
40	364	350	337	326	315	306	289	262	241
50	667	640	617	596	577	559	528	478	440
65	1223	1175	1132	1093	1058	1026	969	878	808
80	1881	1807	1740	1681	1626	1577	1490	1350	1242
100	3646	3503	3375	3259	3154	3058	2888	2617	2408
125	6276	6029	5808	5609	5428	5263	4971	4504	4144
150	8875	8527	8214	7932	7676	7443	7030	6370	5860

Nom. dia. DN	160	180	200	220	240	260	280	300	320
32	158	149	140	133	127	122	117	113	109
40	224	210	198	188	180	172	165	159	154
50	410	384	363	345	329	315	303	291	281
65	751	705	666	632	603	578	555	535	516
80	1155	1084	1024	972	928	888	853	822	794
100	2240	2102	1985	1885	1799	1722	1655	1594	1539
125	3855	3617	3417	3245	3096	2965	2848	2744	2650
150	5452	5115	4832	4589	4378	4193	4028	3880	3747

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F24

NATURAL GAS—FLOW THROUGH—PVC-HI PIPE (AS ISO 6993.1) (MJ/h)
(Pressure drop of 0.25 kPa; suitable for supply pressures within the range 1.5–2.5 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
20	634	436	350	300	266	241	221	206	193
25	1269	872	701	600	531	481	443	412	387
32	2522	1734	1392	1192	1056	957	880	819	768
40	3565	2450	1967	1684	1492	1352	1244	1157	1086
50	6521	4482	3599	3080	2730	2473	2276	2117	1986
65	11965	8223	6604	5652	5009	4539	4175	3884	3645
80	18393	12641	10152	8688	7700	6977	6419	5972	5603
100	35664	24512	19684	16847	14931	13528	12446	11579	10864
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
25	365	324	293	270	251	236	222	211	202
32	726	643	583	536	499	468	442	420	401
40	1026	909	824	758	705	661	625	593	566
50	1876	1663	1507	1386	1290	1210	1143	1085	1036
65	3443	3051	2765	2543	2366	2220	2097	1992	1900
80	5292	4691	4250	3910	3637	3413	3224	3062	2921
100	10262	9095	8241	7581	7053	6618	6251	5937	5664
125	17663	15654	14184	13049	12139	11390	10759	10218	9748
150	24979	22138	20059	18454	17168	16108	15215	14451	13786
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
32	384	369	355	343	332	322	304	275	253
40	542	521	502	484	469	455	429	389	358
50	992	953	918	886	858	832	786	712	655
65	1820	1748	1684	1626	1574	1526	1441	1306	1201
80	2797	2687	2589	2500	2419	2346	2216	2008	1847
100	5424	5211	5020	4847	4691	4548	4296	3893	3581
125	9335	8968	8640	8343	8074	7828	7395	6700	6164
150	13202	12683	12219	11799	11419	11071	10457	9475	8717
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
40	333	312	295	280	267	256	246	237	229
50	609	572	540	513	489	468	450	434	419
65	1118	1049	991	941	898	860	826	795	768
80	1718	1612	1523	1446	1380	1321	1269	1223	1181
100	3332	3126	2953	2804	2675	2562	2461	2371	2290
125	5734	5380	5082	4827	4605	4410	4236	4081	3941
150	8110	7609	7187	6826	6512	6236	5991	5772	5574

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F25

NATURAL GAS—FLOW THROUGH—PVC-HI PIPE (AS ISO 6993.1) (MJ/h)
(Pressure drop of 0.75 kPa; suitable for supply pressures within the range 2.75–5 kPa)

Nom. dia. DN	Length of straight pipe in metres								
	2	4	6	8	10	12	14	16	18
15	617	424	341	292	258	234	215	200	188
20	1149	790	634	543	481	436	401	373	350
25	2300	1581	1269	1086	963	872	803	747	701
32	4570	3141	2522	2159	1913	1734	1595	1484	1392
40	6458	4439	3565	3051	2704	2450	2254	2097	1967
50	11814	8120	6521	5581	4946	4482	4123	3836	3599
65	21678	14899	11965	10240	9076	8223	7565	7038	6604
80	33326	22904	18393	15742	13952	12641	11630	10819	10152
100	64617	44411	35664	30524	27052	24512	22550	20979	19684
	20	25	30	35	40	45	50	55	60
15	178	157	143	131	122	115	108	103	98
20	331	293	266	244	227	213	201	191	183
25	662	586	531	489	455	427	403	383	365
32	1315	1166	1056	972	904	848	801	761	726
40	1858	1647	1492	1373	1277	1198	1132	1075	1026
50	3399	3013	2730	2511	2336	2192	2071	1967	1876
65	6238	5528	5009	4608	4287	4022	3800	3609	3443
80	9589	8499	7700	7084	6591	6184	5841	5548	5292
100	18593	16479	14931	13736	12779	11990	11326	10756	10262
125	32002	28363	25699	23643	21995	20637	19494	18514	17663
	65	70	75	80	85	90	100	120	140
20	175	168	162	156	151	147	138	125	115
25	350	336	324	313	303	293	277	251	231
32	695	668	643	621	601	583	551	499	459
40	982	944	909	878	850	824	778	705	649
50	1797	1726	1663	1606	1554	1507	1423	1290	1186
65	3297	3167	3051	2947	2851	2765	2611	2366	2177
80	5068	4869	4691	4530	4383	4250	4015	3637	3346
100	9827	9441	9095	8783	8499	8241	7784	7053	6489
125	16914	16249	15654	15117	14629	14184	13398	12139	11168
150	23920	22980	22138	21379	20689	20059	18947	17168	15794
	160	180	200	220	240	260	280	300	320
25	215	202	190	181	173	165	159	153	148
32	427	401	378	359	343	328	315	304	293
40	603	566	535	508	484	464	446	429	415
50	1104	1036	978	929	886	849	815	786	759
65	2025	1900	1795	1705	1626	1557	1496	1441	1392
80	3113	2921	2759	2621	2500	2394	2300	2216	2140
100	6036	5664	5350	5081	4847	4642	4460	4296	4149
125	10390	9748	9208	8746	8343	7990	7676	7395	7141
150	14693	13786	13022	12368	11799	11299	10855	10457	10099

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F26

NATURAL GAS—FLOW THROUGH—PVC-HI PIPE (AS ISO 6993.1) (MJ/h)
(Pressure drop of 1.5 kPa; suitable for supply pressures within the range 5–10 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	2	4	6	8	10	12	14	16	18
15	898	617	496	424	376	341	313	292	274
20	1672	1149	923	790	700	634	584	543	509
25	3346	2300	1847	1581	1401	1269	1168	1086	1019
32	6650	4570	3670	3141	2784	2522	2321	2159	2026
40	9397	6458	5186	4439	3934	3565	3279	3051	2862
50	17190	11814	9487	8120	7197	6521	5999	5581	5236
65	31541	21678	17408	14899	13205	11965	11007	10240	9608
80	48488	33326	26762	22904	20300	18393	16921	15742	14770
100	94017	64617	51890	44411	39361	35664	32810	30524	28639
125	161822	111219	89313	76440	67748	61384	56473	52537	49294
150	228849	157287	126307	108102	95809	86810	79864	74298	69711
	20	25	30	35	40	45	50	55	60
15	258	229	208	191	178	167	157	149	143
20	481	426	386	355	331	310	293	278	266
25	963	853	773	711	662	621	586	557	531
32	1913	1696	1537	1414	1315	1234	1166	1107	1056
40	2704	2396	2171	1998	1858	1744	1647	1564	1492
50	4946	4384	3972	3654	3399	3190	3013	2861	2730
65	9076	8044	7288	6705	6238	5853	5528	5251	5009
80	13952	12365	11204	10307	9589	8997	8499	8072	7700
100	27052	23976	21724	19986	18593	17445	16479	15650	14931
125	46563	41268	37391	34400	32002	30027	28363	26938	25699
150	65849	58361	52879	48648	45258	42464	40111	38095	36343
	65	70	75	80	85	90	100	120	140
20	254	244	235	227	220	213	201	183	168
25	509	489	471	455	440	427	403	365	336
32	1011	972	936	904	875	848	801	726	668
40	1429	1373	1323	1277	1236	1198	1132	1026	944
50	2614	2511	2419	2336	2261	2192	2071	1876	1726
65	4797	4608	4439	4287	4149	4022	3800	3443	3167
80	7374	7084	6825	6591	6378	6184	5841	5292	4869
100	14298	13736	13233	12779	12367	11990	11326	10262	9441
125	24610	23643	22776	21995	21285	20637	19494	17663	16249
150	34803	33436	32211	31105	30102	29185	27568	24979	22980
	160	180	200	220	240	260	280	300	320
25	313	293	277	263	251	240	231	222	215
32	621	583	551	523	499	478	459	442	427
40	878	824	778	739	705	675	649	625	603
50	1606	1507	1423	1352	1290	1235	1186	1143	1104
65	2947	2765	2611	2480	2366	2266	2177	2097	2025
80	4530	4250	4015	3813	3637	3483	3346	3224	3113
100	8783	8241	7784	7393	7053	6754	6489	6251	6036
125	15117	14184	13398	12725	12139	11625	11168	10759	10390
150	21379	20059	18947	17995	17168	16440	15794	15215	14693

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F27

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. dia.	Length of straight pipe in metres								
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
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
25	175	169	162	157	152	147	139	126	116
32	336	323	311	301	291	282	266	241	222
40	566	544	524	506	490	475	448	406	374
50	1302	1251	1205	1164	1126	1092	1032	935	860
65	2412	2317	2233	2156	2086	2023	1911	1731	1593
80	3836	3685	3550	3428	3317	3216	3038	2753	2533
100	8477	8144	7846	7576	7332	7109	6715	6084	5597
125	15536	14925	14378	13885	13437	13028	12306	11150	10258
150	24989	24007	23128	22334	21614	20955	19794	17935	16500
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
32	207	194	183	174	166	159	153	147	142
40	348	326	308	293	279	267	257	247	239
50	800	751	709	673	642	615	591	569	550
65	1482	1390	1313	1247	1190	1139	1095	1055	1018
80	2356	2211	2088	1983	1892	1812	1741	1677	1619
100	5207	4886	4615	4383	4182	4004	3847	3706	3579
125	9543	8954	8458	8033	7663	7339	7050	6792	6559
150	15350	14403	13605	12921	12327	11804	11340	10925	10550

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F28

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

Nom. dia.	Length of straight pipe in metres								
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
	65	70	75	80	85	90	100	120	140
10	19	18	17	17	16	16	14	12	10
15	40	39	37	36	35	34	32	29	26
20	115	111	107	103	100	97	91	83	76
25	247	237	229	221	214	207	196	177	163
32	445	428	412	398	385	374	353	320	294
40	716	688	662	640	619	600	567	514	473
50	1522	1462	1409	1360	1316	1276	1206	1092	1005
	160	180	200	220	240	260	280	300	320
10	—	—	—	—	—	—	—	—	—
15	25	23	22	21	19	18	16	15	14
20	71	66	63	60	57	54	52	50	49
25	152	142	135	128	122	117	112	108	104
32	274	257	243	230	220	210	202	195	188
40	440	412	390	370	353	338	325	313	302
50	935	877	829	787	751	719	691	665	643

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F29

PROPANE—FLOW THROUGH—STEEL PIPE (AS 1074 MEDIUM GRADE) (MJ/h) (Pressure drop of 0.25 kPa; suitable for supply pressures around 3 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	2	4	6	8	10	12	14	16	18
15	471	324	260	222	197	178	163	152	142
20	1043	722	581	497	440	398	366	340	319
25	1940	1346	1084	929	824	746	686	638	598
32	4078	2836	2288	1963	1743	1580	1454	1353	1269
40	6117	4260	3441	2954	2623	2379	2191	2039	1913
50	11376	7939	6420	5517	4902	4450	4099	3817	3584
65	22567	15781	12778	10991	9774	8878	8182	7623	7160
80	34454	24124	19547	16823	14967	13600	12539	11685	10978
100	68891	48338	39214	33778	30072	27340	25219	23511	22099
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
20	301	266	240	220	204	191	180	171	162
25	565	499	451	414	385	360	340	322	307
32	1199	1062	961	883	820	769	725	688	655
40	1808	1602	1450	1333	1239	1162	1096	1040	991
50	3387	3004	2722	2504	2329	2184	2062	1957	1866
65	6770	6009	5450	5016	4668	4380	4138	3929	3748
80	10382	9220	8365	7703	7170	6730	6359	6040	5763
100	20905	18580	16868	15541	14474	13592	12847	12207	11650
125	36445	32409	29438	27133	25278	23745	22451	21339	20370
150	58615	52149	47385	43689	40715	38256	36179	34394	32840
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
20	155	149	143	138	133	129	121	109	100
25	293	281	270	261	252	244	230	207	190
32	627	601	579	558	540	523	493	445	408
40	949	910	876	845	817	792	747	674	618
50	1786	1715	1651	1593	1541	1493	1409	1273	1169
65	3588	3446	3319	3204	3100	3004	2836	2565	2356
80	5518	5301	5106	4930	4770	4624	4366	3952	3631
100	11160	10724	10332	9979	9658	9364	8845	8012	7368
125	19517	18758	18077	17462	16903	16392	15488	14038	12915
150	31470	30252	29159	28171	27273	26451	25000	22669	20863
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
25	176	164	154	146	139	133	127	122	118
32	378	353	333	315	300	286	275	264	254
40	574	537	506	479	456	436	418	402	387
50	1085	1016	957	908	864	826	792	762	735
65	2189	2050	1934	1834	1747	1671	1603	1543	1488
80	3374	3162	2984	2831	2697	2580	2476	2383	2299
100	6850	6423	6063	5754	5486	5250	5040	4852	4682
125	12013	11268	10641	10102	9633	9221	8854	8526	8229
150	19413	18216	17205	16338	15584	14920	14330	13801	13324

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F30

PROPANE—FLOW THROUGH—POLYAMIDE PIPE (AS 2944.1 SDR 25) (MJ/h) (Pressure drop of 0.25 kPa; suitable for supply pressures within the range 3 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	2	4	6	8	10	12	14	16	18
18	468	321	258	221	196	177	163	152	142
20	639	439	353	302	268	243	223	208	195
23	962	661	531	454	403	365	336	312	293
25	1196	822	660	565	501	454	417	388	364
32	2300	1581	1269	1086	963	872	803	747	701
40	4115	2828	2271	1944	1723	1561	1436	1336	1253
50	7453	5122	4113	3521	3120	2827	2601	2420	2270
75	21671	14894	11961	10237	9073	8221	7563	7036	6601
90	34692	23843	19147	16387	14524	13160	12107	11263	10568
110	58828	40432	32468	27789	24629	22315	20530	19099	17920
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
20	184	163	148	136	126	119	112	106	102
23	277	245	222	204	190	178	169	160	153
25	344	305	276	254	237	222	210	199	190
32	662	587	531	489	455	427	403	383	365
40	1184	1049	951	875	814	764	721	685	653
50	2144	1901	1722	1584	1474	1383	1306	1241	1184
75	6236	5527	5007	4607	4286	4021	3798	3607	3442
90	9982	8847	8016	7375	6861	6437	6081	5775	5509
110	16927	15002	13593	12505	11634	10916	10311	9793	9342
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
23	146	141	135	131	127	123	116	105	97
25	182	175	168	163	157	153	144	131	120
32	350	336	324	313	303	293	277	251	231
40	626	601	579	559	541	525	496	449	413
50	1133	1089	1049	1013	980	950	898	813	748
75	3296	3166	3050	2946	2850	2764	2611	2365	2176
90	5276	5069	4883	4715	4563	4424	4179	3787	3484
110	8947	8595	8280	7996	7738	7502	7087	6421	5907
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
25	112	105	99	94	90	86	83	80	77
32	215	202	190	181	173	165	159	153	148
40	384	361	341	324	309	296	284	274	264
50	696	653	617	586	559	535	514	496	479
75	2024	1899	1794	1704	1626	1557	1496	1441	1391
90	3241	3041	2872	2728	2602	2492	2394	2307	2227
110	5496	5156	4871	4626	4413	4226	4060	3911	3777

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F31

PROPANE—FLOW THROUGH— POLYETHYLENE PIPE (AS/NZS 4130 SDR 11) (MJ/h)
(Pressure drop of 0.25 kPa; suitable for supply pressures within the range 3 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	2	4	6	8	10	12	14	16	18
20	292	201	161	138	122	111	102	95	89
25	678	466	374	320	284	257	237	220	206
32	1591	1094	878	752	666	604	555	517	485
40	2881	1980	1590	1361	1206	1093	1005	935	878
50	5207	3579	2874	2460	2180	1975	1817	1691	1586
63	9600	6598	5298	4535	4019	3642	3350	3117	2924
75	15351	10551	8473	7252	6427	5823	5357	4984	4676
90	24621	16922	13589	11630	10308	9339	8592	7993	7500
110	42039	28893	23202	19858	17600	15947	14671	13648	12806
160	112075	77029	61857	52941	46921	42514	39112	36386	34140
	20	25	30	35	40	45	50	55	60
20	84	74	67	62	58	54	51	49	46
25	195	173	157	144	134	126	119	113	108
32	458	406	368	338	315	295	279	265	253
40	829	735	666	612	570	535	505	480	458
50	1498	1328	1203	1107	1030	966	913	867	827
63	2762	2448	2218	2041	1898	1781	1683	1598	1525
75	4417	3915	3547	3263	3036	2849	2691	2555	2438
90	7084	6279	5689	5234	4869	4568	4315	4098	3910
110	12096	10721	9714	8936	8314	7800	7368	6998	6676
160	32248	28581	25897	23825	22164	20796	19644	18657	17799
	65	70	75	80	85	90	100	120	140
40	438	421	406	392	379	367	347	314	289
50	792	761	733	708	685	664	627	568	523
63	1460	1403	1351	1305	1263	1224	1156	1048	964
75	2335	2243	2161	2087	2019	1958	1849	1676	1542
90	3744	3597	3465	3346	3238	3140	2966	2687	2472
110	6393	6142	5917	5714	5530	5361	5064	4588	4221
160	17044	16375	15775	15233	14742	14293	13501	12233	11254
	160	180	200	220	240	260	280	300	320
40	269	253	239	227	216	207	199	192	185
50	486	456	431	409	391	374	359	346	334
63	897	841	795	755	720	690	663	638	616
75	1434	1346	1271	1207	1152	1103	1059	1021	986
90	2300	2158	2038	1936	1847	1769	1699	1637	1581
110	3927	3685	3481	3306	3154	3020	2901	2795	2699
160	10470	9823	9279	8813	8408	8051	7735	7452	7196

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F32

PROPANE—FLOW THROUGH—PVC-HI PIPE (AS ISO 6993.1) (MJ/h)
(Pressure drop of 0.25 kPa; suitable for supply pressures around 3 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
15	584	402	323	276	245	222	204	190	178
20	1088	748	600	514	456	413	380	353	331
25	2177	1496	1202	1028	912	826	760	707	663
32	4327	2974	2388	2044	1811	1641	1510	1405	1318
40	6114	4202	3375	2888	2560	2319	2134	1985	1863
50	11185	7687	6173	5284	4683	4243	3903	3631	3407
65	20524	14106	11327	9695	8592	7785	7162	6663	6252
80	31550	21684	17413	14904	13209	11968	11010	10243	9611
100	61175	42045	33764	28898	25611	23206	21349	19861	18635
125	105295	72368	58114	49738	44082	39942	36746	34185	32075
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
15	168	149	135	124	116	108	102	97	93
20	313	277	251	231	215	202	191	181	173
25	626	555	503	463	431	404	382	362	346
32	1245	1103	1000	920	856	803	758	720	687
40	1759	1559	1413	1300	1209	1135	1072	1018	971
50	3218	2852	2584	2378	2212	2075	1960	1862	1776
65	5905	5234	4742	4363	4059	3808	3597	3416	3259
80	9078	8046	7290	6707	6239	5854	5530	5252	5011
100	17603	15601	14135	13004	12098	11351	10722	10184	9715
125	30297	26852	24330	22383	20823	19538	18455	17528	16722
150	42847	37974	34408	31654	29448	27630	26100	24788	23648
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
20	165	159	153	148	143	139	131	119	109
25	331	318	306	296	286	278	262	238	219
32	658	632	609	588	569	552	521	472	434
40	930	893	861	831	804	780	737	667	614
50	1701	1634	1574	1520	1471	1426	1347	1221	1123
65	3121	2999	2889	2790	2700	2617	2472	2240	2061
80	4798	4610	4441	4288	4150	4024	3801	3444	3168
100	9304	8938	8610	8315	8047	7802	7369	6677	6143
125	16013	15384	14820	14312	13850	13428	12684	11493	10573
150	22646	21756	20959	20240	19587	18990	17938	16253	14953
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
32	404	379	358	340	325	311	299	288	278
40	571	536	506	481	459	439	422	407	393
50	1045	980	926	880	839	804	772	744	718
65	1917	1799	1699	1614	1540	1474	1416	1365	1318
80	2947	2765	2612	2481	2367	2267	2177	2098	2026
100	5715	5362	5065	4810	4589	4395	4222	4067	3928
125	9836	9229	8718	8280	7899	7564	7267	7001	6760
150	13911	13052	12329	11709	11171	10697	10277	9900	9561

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F33

NATURAL GAS—FLOW THROUGH—COPPER PIPE AS 1432 TYPE B) (MJ/h)
(Pressure drop of 10.0 kPa; suitable for supply pressures around 70 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	2	4	6	8	10	12	14	16	18
15	890	612	491	420	372	338	311	289	271
20	2938	2019	1622	1388	1230	1115	1025	954	895
25	6457	4438	3564	3050	2703	2449	2253	2096	1967
32	12382	8510	6834	5849	5184	4697	4321	4020	3772
40	20836	14320	11500	9842	8723	7904	7271	6765	6347
50	47945	32953	26462	22648	20073	18187	16732	15566	14605
65	88803	61034	49012	41948	37178	33686	30991	28831	27051
80	141199	97045	77931	66699	59114	53561	49276	45842	43012
100	312069	214483	172238	147413	130650	118378	108906	101316	95062
	20	25	30	35	40	45	50	55	60
15	256	227	206	189	176	165	156	148	141
20	845	749	679	625	581	545	515	489	467
25	1858	1647	1492	1373	1277	1198	1132	1075	1025
32	3563	3158	2861	2632	2449	2298	2170	2061	1966
40	5995	5314	4814	4429	4121	3866	3652	3468	3309
50	13796	12227	11079	10192	9482	8896	8404	7981	7614
65	25552	22646	20519	18877	17562	16478	15565	14782	14103
80	40628	36008	32626	30016	27924	26200	24748	23505	22424
100	89795	79583	72108	66339	61715	57906	54697	51948	49560
125	164564	145850	132151	121577	113104	106122	100242	95204	90827
150	264706	234604	212568	195560	181931	170700	161242	153139	146097
	65	70	75	80	85	90	100	120	140
20	447	429	414	399	386	375	354	321	295
25	982	943	909	878	849	823	778	705	648
32	1883	1809	1743	1683	1629	1579	1492	1351	1243
40	3169	3044	2933	2832	2741	2657	2510	2274	2092
50	7292	7005	6748	6517	6307	6114	5776	5233	4814
65	13505	12974	12499	12070	11681	11325	10698	9693	8917
80	21473	20630	19874	19192	18573	18007	17009	15412	14179
100	47459	45594	43924	42417	41048	39798	37593	34062	31337
125	86978	83559	80498	77736	75228	72937	68896	62425	57430
150	139905	134407	129483	125040	121006	117321	110821	100412	92377
	160	180	200	220	240	260	280	300	320
25	603	566	535	508	484	464	446	429	415
32	1157	1085	1025	974	929	890	855	823	795
40	1946	1826	1725	1638	1563	1497	1438	1385	1338
50	4479	4202	3970	3770	3597	3444	3309	3188	3078
65	8296	7784	7352	6983	6662	6379	6129	5904	5702
80	13190	12376	11690	11103	10592	10143	9745	9388	9066
100	29153	27353	25838	24539	23411	22419	21538	20748	20036
125	53427	50129	47352	44972	42904	41086	39471	38025	36720
150	85939	80634	76166	72339	69012	66088	63490	61164	59066

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F34

NATURAL GAS—FLOW THROUGH—COPPER PIPE (NZS 3501) (MJ/h)
(Pressure drop of 10.0 kPa; suitable for supply pressures around 70 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	2	4	6	8	10	12	14	16	18
10	689	474	381	326	289	262	241	224	210
15	1476	1015	815	697	618	560	515	479	450
20	4247	2919	2344	2006	1778	1611	1482	1379	1294
25	9095	6251	5020	4296	3808	3450	3174	2953	2771
32	16399	11271	9051	7746	6865	6221	5723	5324	4995
40	26346	18107	14541	12445	11030	9994	9194	8553	8025
50	56030	38509	30924	26467	23457	21254	19553	18191	17068
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
10	198	176	159	147	136	128	121	115	109
15	425	377	341	314	292	274	259	246	234
20	1222	1083	981	903	840	788	744	707	675
25	2617	2319	2102	1933	1799	1688	1594	1514	1444
32	4719	4182	3789	3486	3243	3043	2874	2730	2604
40	7581	6719	6088	5600	5210	4889	4618	4386	4184
50	16122	14289	12947	11911	11081	10397	9821	9327	8898
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
10	105	101	97	94	91	88	83	75	69
15	225	216	208	201	194	188	178	161	148
20	646	621	598	577	559	542	512	464	426
25	1383	1329	1280	1236	1196	1160	1096	993	913
32	2494	2396	2308	2229	2157	2091	1975	1790	1647
40	4007	3849	3708	3581	3465	3360	3174	2876	2646
50	8521	8186	7886	7616	7370	7146	6750	6116	5626
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
10	64	60	57	54	52	50	48	46	44
15	138	129	122	116	111	106	102	98	95
20	397	372	352	334	319	305	293	282	273
25	850	797	753	715	682	653	628	605	584
32	1532	1437	1358	1289	1230	1178	1132	1090	1053
40	2461	2309	2181	2072	1976	1893	1818	1752	1692

NOTES:

1 Use of values printed in shaded areas is not recommended and require professional advice.

2 Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements.

3 Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

4 For larger diameter pipes, tables for copper to AS 1432 may be used.

TABLE F35

NATURAL GAS—FLOW THROUGH— STEEL PIPE (AS 1074 MEDIUM GRADE) (MJ/h) (Pressure drop of 10.0 kPa; suitable for supply pressures around 70 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
20	5452	3852	3133	2703	2409	2191	2022	1886	1773
25	10027	7114	5797	5006	4464	4064	3753	3502	3293
32	20765	14817	12103	10467	9345	8514	7866	7344	6911
40	30866	22109	18086	15656	13985	12747	11783	11004	10358
50	56499	40748	33424	28977	25912	23637	21862	20427	19236
65	109710	79876	65760	57127	51154	46708	43232	40419	38082
80	164899	120901	99807	86834	77830	71115	65858	61599	58058
100	319773	237690	197281	172146	154591	141442	131121	122740	115760
125	538241	405352	338220	295985	266295	243964	226382	212075	200140
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
20	1678	1492	1355	1248	1163	1092	1032	981	936
25	3117	2774	2521	2324	2166	2035	1924	1829	1746
32	6545	5829	5301	4891	4560	4286	4055	3856	3683
40	9811	8743	7954	7340	6846	6437	6091	5794	5534
50	18227	16254	14797	13663	12748	11991	11351	10800	10319
65	36101	32223	29353	27119	25316	23823	22559	21471	20522
80	55054	49169	44810	41414	38673	36401	34477	32822	31377
100	109831	98197	89562	82828	77387	72872	69048	65755	62880
125	189986	170030	155191	143603	134231	126448	119851	114168	109205
150	303395	271792	248247	229834	214926	202537	192029	182972	175059
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
25	1673	1608	1550	1497	1449	1405	1328	1203	1107
32	3530	3394	3272	3162	3061	2970	2807	2546	2344
40	5306	5102	4920	4754	4604	4467	4224	3833	3530
50	9896	9519	9180	8874	8595	8340	7889	7163	6600
65	19685	18940	18270	17665	17114	16609	15717	14281	13166
80	30103	28967	27947	27025	26185	25416	24056	21867	20167
100	60343	58082	56051	54212	52538	51006	48293	43925	40532
125	104823	100916	97405	94227	91333	88683	83990	76430	70554
150	168069	161836	156232	151158	146537	142304	134807	122724	113328
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
25	1029	965	911	865	825	789	758	729	704
32	2181	2047	1934	1836	1751	1677	1610	1551	1497
40	3286	3084	2914	2768	2641	2529	2429	2340	2259
50	6148	5773	5457	5186	4949	4741	4555	4389	4239
65	12269	11527	10900	10362	9892	9479	9111	8781	8483
80	18798	17666	16709	15887	15170	14539	13977	13473	13017
100	37798	35536	33623	31979	30547	29284	28160	27151	26239
125	65819	61898	58583	55733	53248	51058	49107	47357	45774
150	105753	99479	94173	89610	85632	82123	78999	76194	73658

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F36

PROPANE—FLOW THROUGH—COPPER PIPE (AS 1432 TYPE B) (MJ/h)
(Pressure drop of 10.0 kPa; suitable for supply pressures around 70 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
15	1520	1045	839	718	636	577	530	493	463
20	5020	3450	2770	2371	2101	1904	1752	1630	1529
25	11031	7581	6088	5211	4618	4184	3850	3581	3360
32	21153	14538	11675	9992	8856	8024	7382	6867	6443
40	35594	24464	19645	16814	14902	13502	12422	11556	10843
50	81906	56294	45206	38690	34291	31070	28584	26592	24950
65	151704	104265	83729	71661	63512	57546	52942	49252	46212
80	241213	165785	133131	113943	100985	91500	84179	78312	73478
100	533115	366407	294238	251830	223192	202228	186047	173081	162396
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
15	437	388	351	323	301	282	266	253	241
20	1444	1280	1160	1067	993	931	880	836	797
25	3174	2813	2549	2345	2181	2047	1933	1836	1752
32	6086	5394	4888	4497	4183	3925	3707	3521	3359
40	10242	9077	8225	7567	7039	6605	6239	5925	5653
50	23568	20888	18926	17411	16198	15198	14356	13635	13008
65	43651	38687	35054	32249	30001	28149	26590	25253	24092
80	69407	61514	55736	51276	47703	44758	42278	40153	38307
100	153399	135954	123184	113328	105430	98921	93441	88745	84664
125	281129	249160	225757	207693	193219	181291	171246	162640	155161
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
15	231	222	214	207	200	194	183	166	153
20	763	733	706	682	660	640	605	548	504
25	1678	1612	1553	1499	1451	1407	1329	1204	1108
32	3217	3090	2977	2875	2782	2698	2548	2309	2124
40	5413	5200	5010	4838	4682	4539	4288	3885	3574
50	12456	11967	11528	11133	10774	10446	9867	8940	8225
65	23071	22164	21352	20620	19954	19347	18275	16558	15233
80	36684	35242	33951	32786	31728	30762	29058	26328	24222
100	81076	77890	75036	72461	70123	67988	64221	58189	53533
125	148586	142747	137517	132798	128513	124600	117696	106642	98109
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
20	469	440	416	395	377	361	346	334	322
25	1030	967	913	867	827	792	761	733	708
32	1976	1854	1751	1663	1587	1520	1460	1406	1358
40	3325	3120	2947	2799	2670	2557	2457	2367	2285
50	7651	7179	6781	6441	6144	5884	5653	5446	5259
65	14172	13297	12560	11929	11380	10898	10470	10086	9740
80	22534	21142	19971	18967	18095	17328	16647	16037	15487
100	49802	46728	44139	41921	39993	38298	36793	35445	34229
125	91271	85637	80892	76827	73294	70188	67430	64959	62730

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F37

PROPANE—FLOW THROUGH—COPPER PIPE (NZS 3501) (MJ/h) (Pressure drop of 10.0 kPa; suitable for supply pressures around 70 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
10	1178	810	650	556	493	447	411	382	359
15	2522	1734	1392	1191	1056	957	880	819	768
20	7256	4987	4005	3427	3038	2752	2532	2356	2210
25	15538	10679	8576	7340	6505	5894	5422	5045	4733
32	28014	19254	15462	13233	11728	10627	9776	9095	8534
40	45007	30933	24840	21260	18842	17073	15707	14612	13710
50	95718	65786	52829	45215	40073	36309	33404	31076	29157
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
10	339	300	272	250	233	219	206	196	187
15	726	643	583	536	499	468	442	420	401
20	2088	1850	1677	1542	1435	1346	1272	1208	1152
25	4471	3962	3590	3303	3073	2883	2723	2586	2468
32	8061	7144	6473	5955	5540	5198	4910	4663	4449
40	12950	11478	10400	9567	8901	8351	7888	7492	7148
50	27542	24410	22117	20347	18929	17761	16777	15934	15201
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
10	179	172	166	160	155	150	142	129	118
15	384	369	355	343	332	322	304	275	253
20	1103	1060	1021	986	954	925	874	792	729
25	2363	2270	2187	2112	2044	1982	1872	1696	1560
32	4260	4093	3943	3808	3685	3573	3375	3058	2813
40	6845	6576	6335	6117	5920	5740	5422	4912	4519
50	14557	13985	13472	13010	12590	12207	11531	10448	9612
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
10	110	103	98	93	88	85	81	78	76
15	236	221	209	198	189	181	174	168	162
20	678	636	601	571	544	521	501	482	466
25	1452	1362	1286	1222	1166	1116	1072	1033	998
32	2617	2455	2319	2203	2102	2012	1933	1863	1799
40	4204	3945	3726	3539	3376	3233	3106	2992	2890
50	8942	8390	7925	7527	7181	6876	6606	6364	6146

NOTES:

1 Use of values printed in shaded areas is not recommended and require professional advice.

2 Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements.

3 Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

4 For larger diameter pipes, tables for copper to AS 1432 may be used.

TABLE F38

PROPANE—FLOW THROUGH—COPPER PIPE (AS 1432 TYPE B) (MJ/h)
(Pressure drop of 20.0 kPa; suitable for supply pressures around 140 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
15	2644	1817	1459	1249	1107	1003	923	858	805
20	8730	6000	4818	4124	3655	3312	3047	2834	2659
25	19185	13186	10589	9063	8032	7278	6695	6229	5844
32	36790	25285	20305	17379	15402	13956	12839	11944	11207
40	61908	42549	34168	29244	25918	23484	21605	20099	18858
50	142456	97909	78625	67293	59640	54038	49715	46250	43395
65	263852	181344	145626	124637	110463	100088	92079	85662	80374
80	419532	288342	231549	198176	175639	159142	146409	136205	127797
100	927224	637276	511755	437996	388188	351726	323584	301032	282449
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
15	761	674	611	562	523	491	463	440	420
20	2512	2226	2017	1856	1727	1620	1530	1453	1386
25	5520	4893	4433	4078	3794	3560	3363	3194	3047
32	10586	9382	8501	7821	7276	6826	6448	6124	5843
40	17813	15788	14305	13160	12243	11487	10851	10305	9832
50	40990	36329	32917	30283	28172	26433	24969	23714	22623
65	75921	67287	60967	56089	52180	48959	46246	43922	41902
80	120716	106988	96939	89183	82967	77846	73532	69837	66626
100	266799	236459	214249	197107	183370	172050	162517	154350	147252
125	488956	433353	392649	361232	336057	315311	297841	282873	269865
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
15	402	386	372	359	348	337	318	289	265
20	1328	1276	1229	1187	1148	1113	1052	953	877
25	2918	2803	2700	2608	2524	2447	2311	2094	1927
32	5595	5375	5178	5001	4839	4692	4432	4016	3694
40	9415	9045	8714	8415	8143	7895	7458	6757	6217
50	21665	20813	20051	19363	18738	18167	17161	15549	14305
65	40127	38550	37137	35863	34706	33649	31785	28799	26495
80	63802	61295	59049	57023	55183	53503	50538	45792	42128
100	141012	135470	130507	126029	121963	118249	111697	101206	93108
125	258429	248273	239177	230970	223517	216712	204704	185477	170636
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
20	816	765	723	686	655	627	603	580	561
25	1792	1682	1588	1509	1439	1378	1324	1276	1232
32	3437	3225	3046	2893	2760	2643	2539	2446	2362
40	5783	5426	5126	4868	4644	4447	4273	4116	3975
50	13308	12486	11795	11202	10687	10234	9832	9471	9146
65	24648	23127	21845	20748	19794	18955	18210	17543	16941
80	39192	36772	34735	32989	31472	30138	28954	27893	26936
100	86619	81272	76769	72911	69558	66610	63993	61648	59533
125	158744	148945	140692	133622	127477	122075	117277	112981	109104

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F39

PROPANE—FLOW THROUGH—COPPER PIPE (NZS 3501) (MJ/h)
(Pressure drop of 20.0 kPa; suitable for supply pressures around 140 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	2	4	6	8	10	12	14	16	18
10	2049	1408	1131	968	858	777	715	665	624
15	4387	3015	2421	2072	1837	1664	1531	1424	1336
20	12620	8673	6965	5961	5283	4787	4404	4097	3844
25	27024	18574	14915	12766	11314	10251	9431	8774	8232
32	48724	33488	26892	23016	20399	18483	17004	15819	14842
40	78278	53800	43204	36977	32772	29694	27318	25414	23845
50	166478	114419	91883	78640	69697	63150	58098	54049	50712
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
10	589	522	473	435	405	380	359	341	325
15	1262	1119	1014	933	868	814	769	730	697
20	3631	3218	2916	2683	2496	2342	2212	2101	2004
25	7776	6892	6244	5745	5344	5014	4737	4499	4292
32	14020	12425	11258	10358	9636	9041	8540	8111	7738
40	22524	19962	18087	16640	15480	14525	13720	13031	12431
50	47902	42455	38467	35389	32923	30891	29179	27713	26438
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
10	312	299	288	278	269	261	247	224	206
15	667	641	617	596	577	559	528	479	441
20	1919	1844	1776	1715	1660	1609	1520	1377	1267
25	4110	3948	3804	3673	3555	3446	3255	2950	2714
32	7410	7119	6858	6623	6409	6214	5869	5318	4893
40	11905	11437	11018	10640	10296	9983	9430	8544	7860
50	25318	24323	23432	22628	21898	21231	20055	18171	16717
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
10	191	180	170	161	154	147	141	136	132
15	410	385	363	345	329	315	303	292	282
20	1179	1106	1045	992	947	907	871	839	810
25	2525	2369	2237	2125	2027	1941	1865	1797	1735
32	4552	4271	4034	3831	3655	3500	3363	3239	3128
40	7313	6861	6481	6155	5872	5623	5402	5204	5026
50	15552	14592	13783	13091	12489	11959	11489	11069	10689

NOTES:

1 Use of values printed in shaded areas is not recommended and require professional advice.

2 Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements.

3 Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

4 For larger diameter pipes, tables for copper to AS 1432 may be used.

TABLE F40

PROPANE—FLOW THROUGH— POLYETHYLENE PIPE (AS/NZS 4130 SDR 11) (MJ/h) (Pressure drop of 10.0 kPa; suitable for supply pressures around 70 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	2	4	6	8	10	12	14	16	18
20	2791	1918	1540	1318	1169	1059	974	906	850
25	6482	4455	3577	3062	2714	2459	2262	2104	1974
32	15219	10460	8400	7189	6372	5773	5311	4941	4636
40	27554	18938	15208	13016	11536	10452	9616	8946	8394
50	49804	34230	27488	23526	20851	18892	17381	16169	15171
63	91814	63103	50674	43371	38439	34828	32041	29808	27968
75	146825	100912	81036	69356	61469	55695	51239	47668	44725
90	235477	161842	129965	111233	98584	89324	82177	76450	71730
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
20	803	712	645	593	552	518	489	465	443
25	1865	1653	1498	1378	1282	1203	1136	1079	1029
32	4379	3881	3517	3235	3010	2824	2667	2533	2417
40	7929	7027	6367	5857	5449	5113	4830	4587	4376
50	14331	12701	11508	10587	9849	9241	8729	8291	7909
63	26419	23414	21215	19518	18157	17036	16093	15284	14581
75	42247	37443	33926	31212	29036	27244	25734	24441	23317
90	67756	60051	54411	50057	46568	43694	41273	39199	37396
110	115691	102534	92904	85470	79513	74605	70471	66930	63852
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
20	424	408	393	379	367	356	336	305	280
25	986	947	912	881	853	827	781	707	651
32	2314	2224	2142	2069	2002	1941	1833	1661	1528
40	4190	4026	3878	3745	3624	3514	3319	3008	2767
50	7574	7277	7010	6769	6551	6352	6000	5436	5001
63	13963	13414	12923	12479	12077	11709	11060	10021	9220
75	22329	21452	20666	19957	19313	18725	17687	16026	14744
90	35811	34404	33143	32006	30974	30030	28367	25702	23646
110	61146	58743	56591	54649	52886	51276	48435	43885	40374
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
25	605	568	537	510	486	466	447	431	416
32	1422	1334	1260	1197	1142	1093	1050	1012	977
40	2574	2415	2281	2167	2067	1979	1902	1832	1769
50	4653	4365	4124	3916	3736	3578	3437	3311	3198
63	8577	8048	7602	7220	6888	6596	6337	6104	5895
75	13716	12869	12156	11545	11014	10548	10133	9762	9427
90	21998	20640	19496	18516	17665	16916	16251	15656	15119
110	37560	35241	33289	31616	30162	28884	27749	26732	25815

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F41

PROPANE—FLOW THROUGH—STEEL PIPE (AS 1074 MEDIUM GRADE) (MJ/h)
(Pressure drop of 10.0 kPa; suitable for supply pressures around 70 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
15	4049	2864	2334	2017	1800	1640	1515	1415	1331
20	8835	6273	5120	4428	3955	3605	3332	3113	2931
25	16220	11557	9445	8176	7306	6662	6161	5757	5422
32	33525	24012	19665	17042	15241	13907	12867	12027	11331
40	49788	35786	29346	25451	22773	20786	19238	17986	16948
50	91019	65847	54130	47009	42098	38450	35603	33300	31388
65	176522	128870	106301	92487	82924	75802	70232	65723	61975
80	265137	194887	161172	140423	126015	115262	106843	100019	94343
100	513633	382647	318100	277923	249848	228811	212291	198873	187695
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
15	1261	1124	1022	944	880	828	783	745	712
20	2776	2476	2254	2081	1942	1827	1730	1646	1573
25	5138	4584	4175	3857	3601	3388	3209	3054	2920
32	10741	9589	8737	8075	7541	7099	6725	6403	6122
40	16069	14350	13079	12091	11294	10633	10074	9593	9174
50	29768	26598	24254	22428	20956	19735	18702	17813	17038
65	58796	52571	47961	44370	41471	39067	37032	35279	33750
80	89525	80086	73088	67634	63229	59575	56481	53816	51490
100	178195	159549	145703	134898	126164	118913	112769	107476	102854
125	307747	275784	252005	233426	218393	205904	195316	186189	178218
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
15	683	656	633	612	593	575	544	494	455
20	1509	1452	1400	1354	1311	1273	1204	1094	1008
25	2801	2695	2600	2514	2436	2364	2238	2034	1876
32	5874	5654	5456	5276	5113	4964	4700	4275	3944
40	8804	8474	8178	7910	7666	7443	7048	6412	5919
50	16353	15743	15196	14700	14249	13836	13105	11928	11014
65	32401	31198	30118	29140	28250	27435	25992	23668	21862
80	49437	47607	45963	44475	43120	41880	39683	36145	33395
100	98773	95135	91865	88905	86209	83740	79368	72322	66843
125	171176	164897	159252	154141	149485	145220	137666	125487	116013
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
20	940	883	835	793	757	726	697	672	649
25	1749	1643	1554	1478	1411	1353	1300	1253	1211
32	3678	3458	3272	3113	2973	2850	2741	2643	2554
40	5521	5192	4913	4674	4466	4282	4118	3971	3839
50	10277	9667	9152	8708	8322	7981	7678	7405	7159
65	20407	19202	18183	17306	16542	15869	15269	14730	14243
80	31178	29342	27789	26454	25289	24262	23348	22527	21784
100	62425	58766	55670	53007	50685	48636	46811	45172	43690
125	108373	102042	96685	92076	88056	84509	81349	78512	75945

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

TABLE F42

PROPANE—FLOW THROUGH—STEEL PIPE (AS 1074 MEDIUM GRADE) (MJ/h)
(Pressure drop of 20.0 kPa; suitable for supply pressures around 140 kPa)

Nom. dia.	Length of straight pipe in metres								
DN	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**
15	6755	4801	3921	3393	3032	2765	2557	2389	2250
20	14693	10488	8581	7433	6647	6064	5611	5245	4941
25	26893	19282	15802	13702	12259	11190	10357	9684	9126
32	55334	39947	32821	28499	25522	23311	21587	20192	19035
40	81933	59424	48907	42506	38088	34804	32239	30165	28441
50	148983	108983	89983	78339	70273	64262	59560	55752	52586
65	286847	212337	176112	153693	138078	126400	117243	109814	103629
80	428579	320051	266356	232876	209456	191895	178098	166888	157546
100	821969	624329	523136	459072	413868	379782	352896	330986	312687
	20	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
15	2133	1903	1734	1602	1496	1408	1333	1269	1213
20	4684	4182	3812	3523	3291	3098	2935	2795	2673
25	8654	7730	7047	6516	6088	5733	5432	5174	4949
32	18054	16136	14718	13613	12723	11984	11359	10821	10352
40	26981	24123	22008	20361	19032	17930	16997	16194	15493
50	49901	44641	40744	37708	35256	33223	31501	30019	28725
65	98376	88074	80430	74469	69651	65653	62266	59348	56801
80	149606	134014	122432	113391	106081	100012	94868	90436	86565
100	297104	266437	243600	225744	211288	199274	189084	180299	172623
125	512031	459688	420611	390003	365190	344548	327027	311911	298697
	65	**70**	**75**	**80**	**85**	**90**	**100**	**120**	**140**
15	1164	1120	1081	1045	1013	983	931	846	781
20	2565	2469	2383	2305	2234	2169	2054	1868	1725
25	4750	4573	4414	4270	4139	4019	3806	3465	3199
32	9938	9569	9238	8938	8665	8415	7972	7260	6706
40	14875	14324	13829	13381	12974	12600	11940	10875	10048
50	27583	26565	25650	24823	24069	23379	22157	20189	18658
65	54552	52547	50746	49115	47629	46269	43861	39979	36960
80	83147	80100	77361	74881	72622	70554	66890	60984	56390
100	165841	159793	154354	149429	144942	140831	133549	121804	112665
125	287017	276595	267220	258729	250991	243901	231336	211061	195276
	160	**180**	**200**	**220**	**240**	**260**	**280**	**300**	**320**
20	1609	1513	1432	1362	1301	1248	1200	1157	1119
25	2985	2808	2659	2530	2418	2319	2231	2151	2080
32	6260	5891	5578	5310	5076	4869	4685	4520	4371
40	9381	8829	8362	7961	7611	7302	7027	6780	6556
50	17425	16404	15539	14796	14148	13576	13067	12610	12196
65	34527	32510	30805	29337	28057	26928	25922	25019	24202
80	52686	49616	47019	44785	42835	41116	39584	38208	36963
100	105292	99181	94009	89558	85676	82249	79197	76455	73974
125	182537	171976	163036	155340	148625	142699	137419	132675	128383

NOTE: Use of values printed in shaded areas is not recommended and require professional advice. Deliverable energy flow may be increased by 20% provided supply *pressure* and 1.5 times *pressure* drop can meet device minimum inlet *pressure* requirements. Refer to Paragraph F1 where further, detailed explanation is provided on these values and the use of the tables in general.

APPENDIX G

DETERMINATION OF MAXIMUM BREATHER VENT ORIFICE SIZE FOR DEVICES NOT VENTED TO OUTSIDE ATMOSPHERE

(Normative)

G1 INTRODUCTION

Tables G1 to G4 list the minimum effective volume of a room or *enclosure* where a release of *gas* from a device is not expected to represent a hazard. The effective volume takes into account the relative density of the *gas* and is defined as—

(a) for 2nd family *gases*, the proportion of the volume of the room or *enclosure* above the device; or

(b) for 3rd family *gases*, the proportion of the volume of the room or *enclosure* below the device.

Tables G1 to G4 are designed for use with *natural gas* or *LP Gas* (Propane) for *gas pressures* ranging from 1.25 kPa to 200 kPa and device *breather vent* diameters from 0.1 to 10 mm. For installations outside these criteria, see to Clause 5.11.5.7.

Tables G1 to G4 assume the following:

(i) A uniform airflow through the effective volume of one air change per hour.

(ii) In the case of an escape, uniform dispersal of *gas* throughout the effective volume.

(iii) A *breather vent* discharge coefficient of 0.60.

NOTE: These assumptions may be invalid and result in the formation of a localized unacceptable air-*gas* concentration in the vicinity of the device. In such instances, consideration should be given to venting the device to the atmosphere.

G2 USING THE TABLES

To use Tables G1 to G4—

(a) select the applicable table for *gas* type, *gas pressure* (P), room or *enclosure* effective volume (V) and vent diameter (d); and

(b) from values of V, d or P, if any two are known, the remaining unknown value can be determined by identifying the two known values in the table and reading the unknown value.

NOTE: If the exact known value is not in the Table, use the closest larger value of P, and/or the closest smaller value of d and/or V.

G3 EXAMPLE USING A TABLE (SEE TABLE G1)

Using *natural gas*, an inlet *pressure* of 2.75 kPa, an *enclosure* with a floor area of 6 m^2 and a height of 2.4 m, and the device mounted at 600 mm above the floor, the following procedure determines the *breather vent* orifice size:

(a) Select Table G1.

(b) Calculate the effective *enclosure* volume as—

$$V = (2.4 - 0.6) \times 6.0 = 10.8\ (m^3)$$

(c) Find value 2.75 in the Column for P, and read across the Row until a value of 10.8 m^3 or the closest smaller value (9.4 m^3) is found.

(d) Find the value for d of 0.8 mm, i.e., a maximum value.

TABLE G1

MINIMUM EFFECTIVE VOLUME (V)—NATURE GAS— DEVICE SUPPLY PRESSURE (P) BETWEEN 1.25 kPa AND 7 kPa

Device inlet pressure (P), kPa	Minimum effective volume (V), m^3																		
	Breather vent orifice diameter (d), mm																		
	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.5	2	3	4	5	6	7	8	9	10
1.25	0.39	0.89	1.6	2.5	3.6	4.8	6.3	8.0	9.9	22.2	39	89	158	247	355	484	632	800	987
1.50	0.43	0.97	1.7	2.7	3.9	5.3	6.9	8.8	10.8	24.3	43	97	173	270	389	530	692	876	1081
1.75	0.47	1.1	1.9	2.9	4.2	5.7	7.5	9.5	11.7	26.3	47	105	187	292	421	572	748	946	
2.00	0.50	1.1	2.0	3.1	4.5	6.1	8.0	10.1	12.5	28.1	50	112	200	312	450	612	799	1011	
2.25	0.53	1.2	2.1	3.3	4.8	6.5	8.5	10.7	13.2	30	53	119	212	331	477	649	848		
2.50	0.56	1.3	2.2	3.5	5.0	6.8	8.9	11.3	14.0	31	56	126	223	349	503	684	894		
2.75	0.59	1.3	2.3	3.7	5.3	7.2	9.4	11.9	14.6	33	59	132	234	366	527	718	937		
3.00	0.61	1.4	2.4	3.8	5.5	7.5	9.8	12.4	15.3	34	61	138	245	382	551	749	979		
3.25	0.64	1.4	2.5	4.0	5.7	7.8	10.2	12.9	15.9	36	64	143	255	398	573	780	1019		
3.50	0.66	1.5	2.6	4.1	5.9	8.1	10.6	13.4	16.5	37	66	149	264	413	595	809			
3.75	0.68	1.5	2.7	4.3	6.2	8.4	10.9	13.9	17.1	38	68	154	274	427	616	838			
4.00	0.71	1.6	2.8	4.4	6.4	8.7	11.3	14.3	17.7	40	71	159	283	442	636	865			
4.25	0.73	1.6	2.9	4.6	6.6	8.9	11.7	14.7	18.2	41	73	164	291	455	655	892			
4.50	0.75	1.7	3.0	4.7	6.7	9.2	12.0	15.2	18.7	42	75	169	300	468	674	918			
4.75	0.77	1.7	3.1	4.8	6.9	9.4	12.3	15.6	19.2	43	77	173	308	481	693	943			
5.00	0.79	1.8	3.2	4.9	7.1	9.7	12.6	16.0	19.7	44	79	178	316	494	711	967			
5.25	0.81	1.8	3.2	5.1	7.3	9.9	12.9	16.4	20.2	46	81	182	324	506	728	991			
5.50	0.83	1.9	3.3	5.2	7.5	10.1	13.3	16.8	20.7	47	83	186	331	518	745	1015			
5.75	0.85	1.9	3.4	5.3	7.6	10.4	13.6	17.2	21.2	48	85	191	339	529	762				
6.00	0.87	1.9	3.5	5.4	7.8	10.6	13.8	17.5	21.6	49	87	195	346	541	779				
6.25	0.88	2.0	3.5	5.5	7.9	10.8	14.1	17.9	22.1	50	88	199	353	552	795				
6.50	0.90	2.0	3.6	5.6	8.1	11.0	14.4	18.2	22.5	51	90	203	360	563	810				
6.75	0.92	2.1	3.7	5.7	8.3	11.2	14.7	18.6	22.9	52	92	206	367	574	826				
7.00	0.93	2.1	3.7	5.8	8.4	11.4	15.0	18.9	23.4	53	93	210	374	584	841				

NOTES:

1 This Table is based on $V = 8.83\, d^2 \sqrt{P}$.

2 V = (Room height − device height above floor) × floor area.

TABLE G2

MINIMUM EFFECTIVE VOLUME (*V*)—NATURE GAS— DEVICE SUPPLY PRESSURE (*P*) BETWEEN 7 kPa AND 200 kPa

Device inlet pressure (*P*), kPa	Minimum effective volume (*V*), m^3																		
	Breather vent orifice diameter (*d*), mm																		
	0.1	**0.15**	**0.2**	**0.25**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**1**	**1.5**	**2**	**2.5**	**3**	**4**	**5**	**6**
7	0.23	0.53	0.93	1.5	2.1	3.7	5.8	8.4	11.4	15.0	18.9	23.4	53	93	146	210	374	584	841
8	0.25	0.56	1.0	1.6	2.2	4.0	6.2	9.0	12.2	16.0	20.2	25.0	56	100	156	225	400	624	899
9	0.26	0.60	1.1	1.7	2.4	4.2	6.6	9.5	13.0	17.0	21.5	26.5	60	106	166	238	424	662	954
10	0.28	0.63	1.1	1.7	2.5	4.5	7.0	10.1	13.7	17.9	22.6	27.9	63	112	175	251	447	698	1005
12.5	0.31	0.70	1.2	2.0	2.8	5.0	7.8	11.2	15.3	20.0	25.3	31	70	125	195	281	500	780	
15	0.34	0.77	1.4	2.1	3.1	5.5	8.5	12.3	16.8	21.9	27.7	34	77	137	214	308	547	855	
17.5	0.37	0.83	1.5	2.3	3.3	5.9	9.2	13.3	18.1	23.6	30	37	83	148	231	332	591	923	
20	0.39	0.89	1.6	2.5	3.6	6.3	9.9	14.2	19.3	25.3	32	39	89	158	247	355	632	987	
25	0.44	1.0	1.8	2.8	4.0	7.1	11.0	15.9	21.6	28.3	36	44	99	177	276	397	706	1104	
30	0.48	1.1	1.9	3.0	4.4	7.7	12.1	17.4	23.7	31	39	48	109	193	302	435	774		
35	0.52	1.2	2.1	3.3	4.7	8.4	13.1	18.8	25.6	33	42	52	118	209	326	470	836		
40	0.56	1.3	2.2	3.5	5.0	8.9	14.0	20.1	27.4	36	45	56	126	223	349	503	894		
45	0.59	1.3	2.4	3.7	5.3	9.5	14.8	21.3	29.0	38	48	59	133	237	370	533	948		
50	0.62	1.4	2.5	3.9	5.6	10.0	15.6	22.5	31	40	51	62	140	250	390	562	999		
60	0.68	1.5	2.7	4.3	6.2	10.9	17.1	24.6	34	44	55	68	154	274	427	616	1094		
70	0.74	1.7	3.0	4.6	6.6	11.8	18.5	26.6	36	47	60	74	166	296	462	665			
80	0.79	1.8	3.2	4.9	7.1	12.6	19.7	28.4	39	51	64	79	178	316	494	711			
90	0.84	1.9	3.4	5.2	7.5	13.4	20.9	30	41	54	68	84	188	335	524	754			
100	0.88	2.0	3.5	5.5	7.9	14.1	22.1	32	43	57	72	88	199	353	552	795			
125	0.99	2.2	3.9	6.2	8.9	15.8	24.7	36	48	63	80	99	222	395	617	889			
150	1.1	2.4	4.3	6.8	9.7	17.3	27.0	39	53	69	88	108	243	433	676	973			
175	1.2	2.6	4.7	7.3	10.5	18.7	29.2	42	57	75	95	117	263	467	730	1051			
200	1.2	2.8	5.0	7.8	11.2	20.0	31	45	61.2	80	101	125	281	500	780				

NOTES:

1 This Table is based on $V = 8.83\ d^2 \sqrt{P}$.

2 V = (Room height − device height above floor) × floor area.

TABLE G3

MINIMUM EFFECTIVE VOLUME (V)—LP GAS— DEVICE SUPPLY PRESSURE (P) BETWEEN 1.25 kPa AND 7 kPa

Device inlet pressure (P), kPa	Minimum effective volume (V), m^3																		
	Breather vent orifice diameter (d), mm																		
	0.2	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**1**	**1.5**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1.25	0.63	1.41	2.5	3.9	5.6	7.7	10.0	12.7	15.7	35.2	63	141	250	391	563	767	1002	1268	1565
1.50	0.69	1.54	2.7	4.3	6.2	8.4	11.0	13.9	17.1	38.6	69	154	274	429	617	840	1097	1389	1715
1.75	0.74	1.7	3.0	4.6	6.7	9.1	11.9	15.0	18.5	41.7	74	167	296	463	667	907	1185	1500	
2.00	0.79	1.8	3.2	4.9	7.1	9.7	12.7	16.0	19.8	44.5	79	178	317	495	713	970	1267	1604	
2.25	0.84	1.9	3.4	5.3	7.6	10.3	13.4	17.0	21.0	47	84	189	336	525	756	1029	1344		
2.50	0.89	2.0	3.5	5.5	8.0	10.8	14.2	17.9	22.1	50	89	199	354	553	797	1085	1417		
2.75	0.93	2.1	3.7	5.8	8.4	11.4	14.9	18.8	23.2	52	93	209	371	580	836	1138	1486		
3.00	0.97	2.2	3.9	6.1	8.7	11.9	15.5	19.6	24.2	55	97	218	388	606	873	1188	1552		
3.25	1.01	2.3	4.0	6.3	9.1	12.4	16.2	20.4	25.2	57	101	227	404	631	909	1237	1615		
3.50	1.05	2.4	4.2	6.5	9.4	12.8	16.8	21.2	26.2	59	105	236	419	655	943	1283			
3.75	1.08	2.4	4.3	6.8	9.8	13.3	17.4	22.0	27.1	61	108	244	434	678	976	1328			
4.00	1.12	2.5	4.5	7.0	10.1	13.7	17.9	22.7	28.0	63	112	252	448	700	1008	1372			
4.25	1.15	2.6	4.6	7.2	10.4	14.1	18.5	23.4	28.9	65	115	260	462	722	1039	1414			
4.50	1.19	2.7	4.8	7.4	10.7	14.6	19.0	24.1	29.7	67	119	267	475	742	1069	1455			
4.75	1.22	2.7	4.9	7.6	11.0	15.0	19.5	24.7	30.5	69	122	275	488	763	1098	1495			
5.00	1.25	2.8	5.0	7.8	11.3	15.3	20.0	25.4	31.3	70	125	282	501	783	1127	1534			
5.25	1.28	2.9	5.1	8.0	11.5	15.7	20.5	26.0	32.1	72	128	289	513	802	1155	1572			
5.50	1.31	3.0	5.3	8.2	11.8	16.1	21.0	26.6	32.8	74	131	295	525	821	1182	1609			
5.75	1.34	3.0	5.4	8.4	12.1	16.4	21.5	27.2	33.6	76	134	302	537	839	1209				
6.00	1.37	3.1	5.5	8.6	12.3	16.8	21.9	27.8	34.3	77	137	309	549	857	1235				
6.25	1.40	3.2	5.6	8.8	12.6	17.2	22.4	28.4	35.0	79	140	315	560	875	1260				
6.50	1.43	3.2	5.7	8.9	12.8	17.5	22.8	28.9	35.7	80	143	321	571	892	1285				
6.75	1.45	3.3	5.8	9.1	13.1	17.8	23.3	29.5	36.4	82	145	327	582	909	1309				
7.00	1.48	3.3	5.9	9.3	13.3	18.1	23.7	30.0	37.0	83	148	333	593	926	1333				

NOTES:

1 This Table is based on $V = 14\, d^2 \sqrt{P}$.

2 V = (Room height − device height above floor) × floor area.

TABLE G4

MINIMUM EFFECTIVE VOLUME (*V*)—LP GAS— DEVICE SUPPLY PRESSURE (*P*) BETWEEN 7 kPa AND 200 kPa

Device inlet pressure (P), kPa	Minimum effective volume (*V*), m^3																	
	Breather vent orifice diameter (*d*), mm																	
	0.1	**0.15**	**0.2**	**0.25**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**1**	**1.5**	**2**	**2.5**	**3**	**4**	**5**
7	0.37	0.83	1.5	2.3	3.3	5.9	9.3	13.3	18.1	23.7	30	37	83	148	232	333	593	926
8	0.40	0.89	1.6	2.5	3.6	6.3	9.9	14.3	19.4	25.3	32	40	89	158	247	356	634	990
9	0.42	0.95	1.7	2.6	3.8	6.7	10.5	15.1	20.6	26.9	34	42	95	168	263	378	672	1050
10	0.44	1.0	1.8	2.8	4.0	7.1	11.1	15.9	21.7	28.3	36	44	100	177	277	398	708	
12.5	0.49	1.1	2.0	3.1	4.5	7.9	12.4	17.8	24.3	32	40	49	111	198	309	445	792	
15	0.54	1.2	2.2	3.4	4.9	8.7	13.6	19.5	26.6	35	44	54	122	217	339	488	868	
17.5	0.59	1.3	2.3	3.7	5.3	9.4	14.6	21.1	28.7	37	47	59	132	234	366	527	937	
20	0.63	1.4	2.5	3.9	5.6	10.0	15.7	22.5	31	40	51	63	141	250	391	563	1002	
25	0.70	1.6	2.8	4.4	6.3	11.2	17.5	25.2	34	45	57	70	158	280	438	630		
30	0.77	1.7	3.1	4.8	6.9	12.3	19.2	27.6	38	49	62	77	173	307	479	690		
35	0.83	1.9	3.3	5.2	7.5	13.3	20.7	29.8	41	53	67	83	186	331	518	745		
40	0.89	2.0	3.5	5.5	8.0	14.2	22.1	32	43	57	72	89	199	354	553	797		
45	0.94	2.1	3.8	5.9	8.5	15.0	23.5	34	46	60	76	94	211	376	587	845		
50	0.99	2.2	4.0	6.2	8.9	15.8	24.7	36	49	63	80	99	223	396	619	891		
60	1.1	2.4	4.3	6.8	9.8	17.4	27.1	39	53	69	88	108	244	434	678	976		
70	1.2	2.6	4.7	7.3	10.5	18.7	29.3	42	57	75	95	117	264	469	732	1054		
80	1.3	2.8	5.0	7.8	11.3	20.0	31	45	61	80	101	125	282	501	783			
90	1.3	3.0	5.3	8.3	12.0	21.3	33	48	65	85	108	133	299	531	830			
100	1.4	3.2	5.6	8.8	12.6	22.4	35	50	69	90	113	140	315	560	875			
125	1.6	3.5	6.3	9.8	14.1	25.0	39	56	77	100	127	157	352	626	978			
150	1.7	3.9	6.9	10.7	15.4	27.4	43	62	84	110	139	171	386	686	1072			
175	1.9	4.2	7.4	11.6	16.7	29.6	46	67	91	119	150	185	417	741				
200	2.0	4.5	7.9	12.4	17.8	32	49	71	97.0	127	160	198	445	792				

NOTES:

1 This Table is based on $V = 14\, d^2 \sqrt{P}$.

2 V = (Room height − device height above floor) × floor area.

APPENDIX H

FLUE DESIGN

(Normative)

H1 FLUE DESIGN FOR APPLIANCES WITH ATMOSPHERIC BURNERS

NOTE: For *appliances* with *power flues*, see Paragraph H2.

H1.1 Introduction

The tables and procedures relating to Paragraph H1 have been based on information from the American Gas Association. The tables have been calculated to allow for approximately 50% *burner excess air* and approximately 100% *draught diverter* dilution air.

Flues required to convey *flue gases* with greater quantities of *excess air*, dilution air, or other *combustion products* shall be designed for the total quantity of *flue gas* discharge, using sound engineering practice.

Tables H1 to H7 show the extent and limitations of *natural draught flues*, relative to the thermal input, height, total length, diameter and other important factors to suit a wide variation in *flue* configuration.

Table H8 shows equivalent sizes for round and rectangular *flues*.

Table H9 shows the relationship between percentage carbon dioxide (% CO_2), volume of *flue gases* and amount of *excess air*.

H1.2 Factors influencing flue design

H1.2.1 *Heat loss*

In determining the correct size and configuration for a *flue*, the heat losses that will occur due to the materials used and the environment in which the *flue* will be located shall be considered. Since the motive force in a *flue* is due to the heat of the *flue gases*, the ideal conditions are those in which heat losses from the *flue* are very low.

Materials which are insulated against heat loss (e.g., *certified* twin-wall *flue*) or materials of low thermal conductivity are particularly suitable when the *flue* is located *outdoors* or is very long.

Non-insulated *flue* materials when located *indoors* and not exposed to draught may be classified as 'low heat loss' in applying the *flue* tables contained in this Standard. The same materials when located *outdoors* shall be classified as 'high heat loss'.

H1.2.2 *Resistance to flow of flue gases*

Resistance to the flow of *flue gases* shall be considered in the design of the *flue*. The capacities shown in the tables for *flues* with laterals make an allowance for two 90° changes of direction.

Where more than two 90° changes of direction are required, the *flue* shall be sized using one of the following methods:

(a) A 10% capacity reduction shall be made to the table for each additional bend or change of direction (e.g., one additional change, 90% of table capacity or two additional changes, 80% of table capacity).

(b) The *flue* diameter shall be increased from the *draught diverter* outlet size to one size larger.

For calculation purposes, the *flue* capacity shall be increased by approximately 60% of the difference in capacity of the actual *appliance* or *draught diverter flue* size, and the capacity of a similar *flue* one size larger. Any further increase in size is not recommended because it will not have a similar corresponding effect.

When using the tables to determine the *flue* size of wall furnaces and room heaters (but not forced air central heaters), *appliance gas consumption* shall be regarded as 40% greater than the nominal figure on the data plate, e.g., a wall furnace having a *gas consumption* of 40 MJ/h would need to be sized for 40 × 1.4, that is, 56 MJ/h.

H1.3 Designing individual appliance flues

H1.3.1 *Design procedure*

The procedures for using the tables for individual *flues*, whether for low heat loss or high heat loss, are identical.

Table H2 or H3 shall be used, as appropriate, based on the type of material selected and the location of the *flue* in regard to heat loss.

STEP 1 Determine the total *flue* height (*H*) of the system and the length of any lateral. (See Figure H1.)

STEP 2 Refer to Table H2 for low heat loss situations or Table H3 for high heat loss situations.

Read down the 'Total height of *flue*' column at the left of the appropriate table until a height equal to the height of the *flue* or the next lower *flue* height figure is listed.

STEP 3 Select the horizontal row for the appropriate 'Length of lateral' (*L*). (Zero for straight vertical systems).

STEP 4 Read across to the first column that shows a capacity equal to or greater than the *appliance gas consumption* (after any factor indicated by Paragraph H1.2.2 has been applied).

STEP 5 If the *flue* diameter shown at the top of the column listing the *appliance gas consumption* (or corrected *gas consumption*) is equal to or larger than the *appliance flue* outlet, use the diameter indicated in the table.

If the diameter indicated is less than the *appliance flue* outlet size, the smaller diameter may be used only where—

(a) the *flue* height is greater than 3 m;

(b) *flues* exceeding 300 mm in diameter are not reduced by more than two sizes (600 mm to 500 mm is a two size reduction); or

(c) *flues* 300 mm in diameter or less are not reduced by more than one size (200 mm to 175 mm is a one size reduction).

However, under no circumstances shall a 75 mm *flue* be connected to an *appliance* having a 100 mm *flue* outlet.

H1.3.2 *Example of flue design for individual appliance flue*

A *water heater* is to be installed with a *flue* configuration as in Figure H1.

Total height is 2.5 m and length of lateral is 600 m.

Appliance gas consumption is 120 MJ/h.

Appliance flue connection (*draught diverter*) is 125 mm diameter.

The *flue* will be located in a duct within the building except for 600 mm through the roof.

STEP 1 Because the *flue* will be inside the building, the appropriate table will be Table H2.

STEP 2 Under the column headed 'Total height of *flue*' locate 2.5 m.

STEP 3 Locate the line in the next column corresponding to a lateral of 0.6 m.

STEP 4 Reading across the line to the right, note that the figures in the first two columns (i.e., 42 and 79) are less than the *appliance gas consumption* (120 MJ/h). The figure in the third column is greater than the *appliance gas consumption* and so the diameter (125 mm) at the top of this column would be suitable. Therefore a 125 mm diameter *flue* would be used.

If it is essential to locate the 2.5 m of vertical *flue* on an external wall using non-insulated materials, then Table H3 would need to be used. Adopting the former procedure, Table H3 indicates that a 150 mm diameter *flue* would be required.

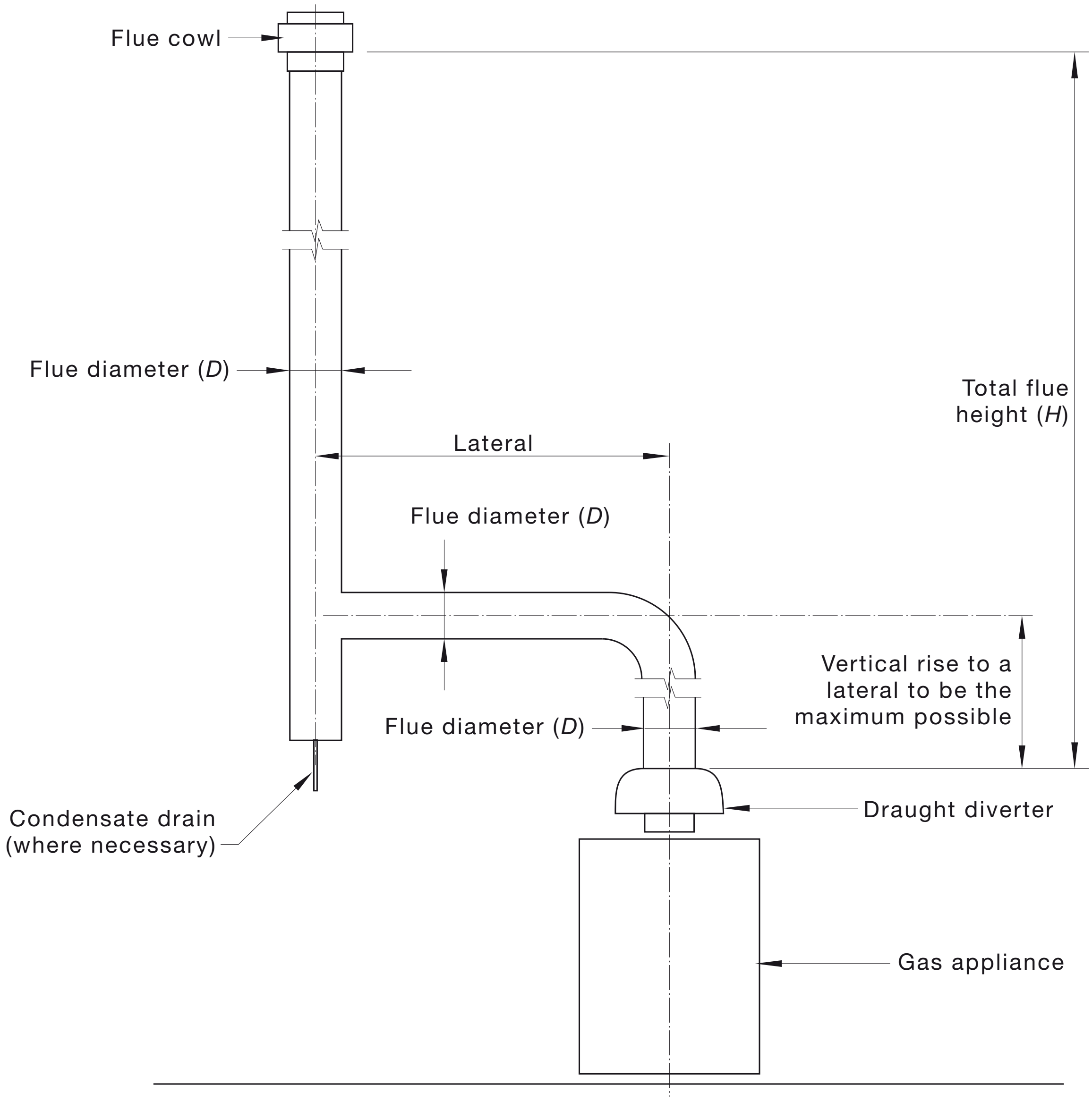


FIGURE H1 INDIVIDUAL APPLIANCE FLUE

H1.4 Common flues (combined and multiple *flues*)

NOTE: See Clauses 6.7.4, 6.7.6, 6.10.16.2 and 6.10.17 for *common flueing* limitations.

H1.4.1 *Design principles*

A *common flue* shall be designed on the same basic principles for heat loss and flow as with an individual *appliance flue*. There are, however, a number of important additional matters that need to be applied when designing a *common flue*. The most critical operating condition is when only one *appliance* is in use, particularly if the *gas consumption* is low compared with other *appliances* connected to the same *common flue*.

The *common flue* tables, Tables H4 to H7, shall apply when the individual *draught diverter* outlets from *appliances* connected to the *common flue* are within range of Table H1. Use Tables H4 to H7 as appropriate for low heat loss or high heat loss situations.

If the largest *draught diverter* outlet exceeds the range in Table H1, then the *flue* connector rise shall be increased by 300 mm in excess of that shown in Tables H4 and H6, (see Figure H5).

TABLE H1

COMMON FLUE—MAXIMUM DRAUGHT DIVERTER SIZE

Smaller draught diverter diameter, mm	Maximum diameter of larger diverter, mm
75	200
100	250
125	300
150	400
175	450
200	500
250	600

H1.4.2 *Performance of common flue*

Satisfactory performance of a *common flue* system depends on careful design of the *flue* connector, i.e., the part of the system connecting the individual *appliances* from the *draught diverter* outlet to the *common flue* (see Figures H2 and H4).

The *flue* connector configuration in diameter, lateral, rise and total length is of major importance not only to prevent spillage at the *appliance draught diverter* but also to contribute to the correct performance of the *common flue*. In all cases the *flue* connector diameter shall be equal to or larger than the *draught diverter* outlet size.

H1.4.3 *Flue connector—Change of direction*

The *flue* connector tables, Tables H4 and H6, allow for two 90° changes of direction. If a further change of direction is necessary, then—

(a) provide the next size larger *flue* connector;

(b) increase the *flue* connector rise by 300 mm; or

(c) deduct 10% for each additional change of direction from the listed capacity in the table.

H1.4.4 *Resistance to flow of flue gases—Manifolds and laterals*

Where a *common flue* has a manifold or lateral at the base (see Figure H4) the design shall allow for additional resistance to flow due to the change of direction. The (L) lines in Table H5 include an allowance for this increased resistance.

The length of a manifold or lateral shall be as short as possible, and designed in accordance with Tables H2 and H3. Where these Tables do not cover the particular installation, the lateral *flue* shall not exceed 50% of the total *flue* height.

Where two or more *appliances* are installed to operate simultaneously, and not independently of each other, the manifold and vertical *flue* may be designed as an individual *appliance flue* using Tables H2 or H3. The manifold shall then be designed as a lateral length.

H1.4.5 *Design of common flue—Appliances at different levels*

H1.4.5.1 *Design factors*

The *flue* from the first or lowest *appliance* connector to the *common flue* may be designed as an individual *flue* to the first interconnection or tee.

The other *appliance flues* joining the *common flue* shall be designed using the *common flue* tables (Tables H5 and H7).

In applying the tables to several *appliances* installed at different levels, the 'total height of *flue*' shall be the rise in the *flue* connector plus the vertical height between the connection to the *common flue* and the next connection above (see Figure H2). For the top floor *appliance*, the total *flue* height shall be the rise in the *flue* connector plus the vertical height from the connection with the *common flue* to the *flue terminal*.

NOTE: Consideration should be given to providing a separate *flue* for the top *appliance* if its total height will be insufficient.

Where the diameter of the *common flue* is more than seven times the diameter of the *flue* connector, the rise of the *flue* connector shall be increased by 300 mm more than that shown in the tables (see Figure H5).

H1.4.5.2 *Example of flue design for appliances at different levels*

Water heaters are to be installed on each of four levels in a building. (See Figure H2.)

The height between floors is 3 m and each *appliance* has a 100 mm *flue* outlet and a *gas consumption* of 50 MJ/h. The length of each lateral is 600 mm.

STEP 1 The lowest *appliance flue* is designed using Table H2 'Individual *appliance flues*'. For 0.6 m lateral and 3 m total height, a 100 mm *flue* diameter has a capacity for a *gas consumption* up to 85 MJ/h which is above that required (i.e., 50 MJ/h).

STEP 2 The tee connection to receive the second *appliance flue* and the next section of *common flue* should have capacity to serve the two *appliances*, i.e., 100 MJ/h, but first the *flue* connector size is determined.

From Table H4, under 'Least total height' locate 3 m. Reading across, note that with 0.3 m *flue* connector rise, a 100 mm *flue* has capacity for 53 MJ/h, which is adequate.

STEP 3 The common *flue* size to carry 100 MJ/h is determined next. From Table H5, under 'Least total height', locate 3 m. As the common *flue* is vertical, without change of direction and the *appliance*s are individually attached, Type V (for vertical) applies.

Read across to the right to find that a 125 mm common *flue* is satisfactory up to 131 MJ/h.

STEP 4 The third *appliance* is now considered for addition to the *common flue*, which then requires capacity for 150 MJ/h. Two alternatives may be considered:

(a) Design the third section of *common flue* using the same total height between connections as previously, i.e., 3 m on the assumption that the top floor *appliance* will be connected to the *common flue*.

(b) Design on the basis that the top floor *appliance* will not be joined to the *common flue* but *flued* separately. This then provides an increase in the total *flue* height above the third *appliance*. Assume that this is now 6 m.

STEP 4 (cont'd) Reading Table H5, for alternative (a): Under 'Least total height' 3 m, reading across the table, a 150 mm *common flue* would be suitable, having capacity up to 188 MJ/h; *OR*

Reading Table H5, for alternative (b): Under 'Least total height' 6 m, reading across the table, a 125 mm *common flue* would be suitable, having a capacity up to 169 MJ/h.

This illustrates the increase in capacity through additional total height. The choice between the two alternatives may be decided on the grounds of economy and availability of space.

H1.4.5.3 *Alternative method using oversize common flue*

An alternative method of designing *flues* for *high-rise buildings* is to provide an oversize *common flue* of constant diameter over its total length, and then design the connectors as individual *flues* (see Figure H3). They are then classified as self-venting. The *common flue* acts as a duct for the conveyance of *flue gases* but not necessarily contributing to satisfactory draught in the *flue* connectors.

H1.4.6 *Design of common flue—Appliances at same level*

H1.4.6.1 *Total flue height*

In applying the tables to several *appliances* installed at the same level, the 'total *flue* height' shall be the rise in the *flue* connector to the manifold plus the vertical height between the *flue* connector and the top of the *common flue* (see Figure H4).

H1.4.6.2 *Example of flue design for appliances at same level*

Four *water heaters* are to be installed on the ground floor of a four-*storey* building and connected through a manifold to a *common flue* (see Figure H4).

Each *appliance* has a 100 mm *flue* outlet, a *gas consumption* of 50 MJ/h and will operate independently.

The space available limits the *flue* connector rise to 600 mm. The spacing between the connectors is 750 mm.

STEP 1 The *flue* connector size is determined from Table H4. The total height from the *appliance draught diverter* to the *flue terminal* is 18 m. In order to have a rise in the manifold it is assumed that the connector rise of the *appliance* farthest from the *common flue* is 300 mm.

From Table H4, with a total height of 18 m and a rise of 0.3 m, a 100 mm diameter *flue* connector has a capacity of 70 MJ/h, which is adequate.

STEP 2 The manifold should be sized as a *common flue* since all *appliances* do not operate simultaneously. Using Table H5, the Type L line is used. For a total height of 18 m, on the Type L line, a 150 mm diameter *flue* has a capacity of 273 MJ/h that is greater than the total *appliance gas consumption* of 200 MJ/h.

A 125 mm diameter *flue* cannot be used as it has a capacity of only 188 MJ/h.

STEP 3 Ensure the manifold length 'A' (see Figure H4) does not exceed 50% of total *flue* height.

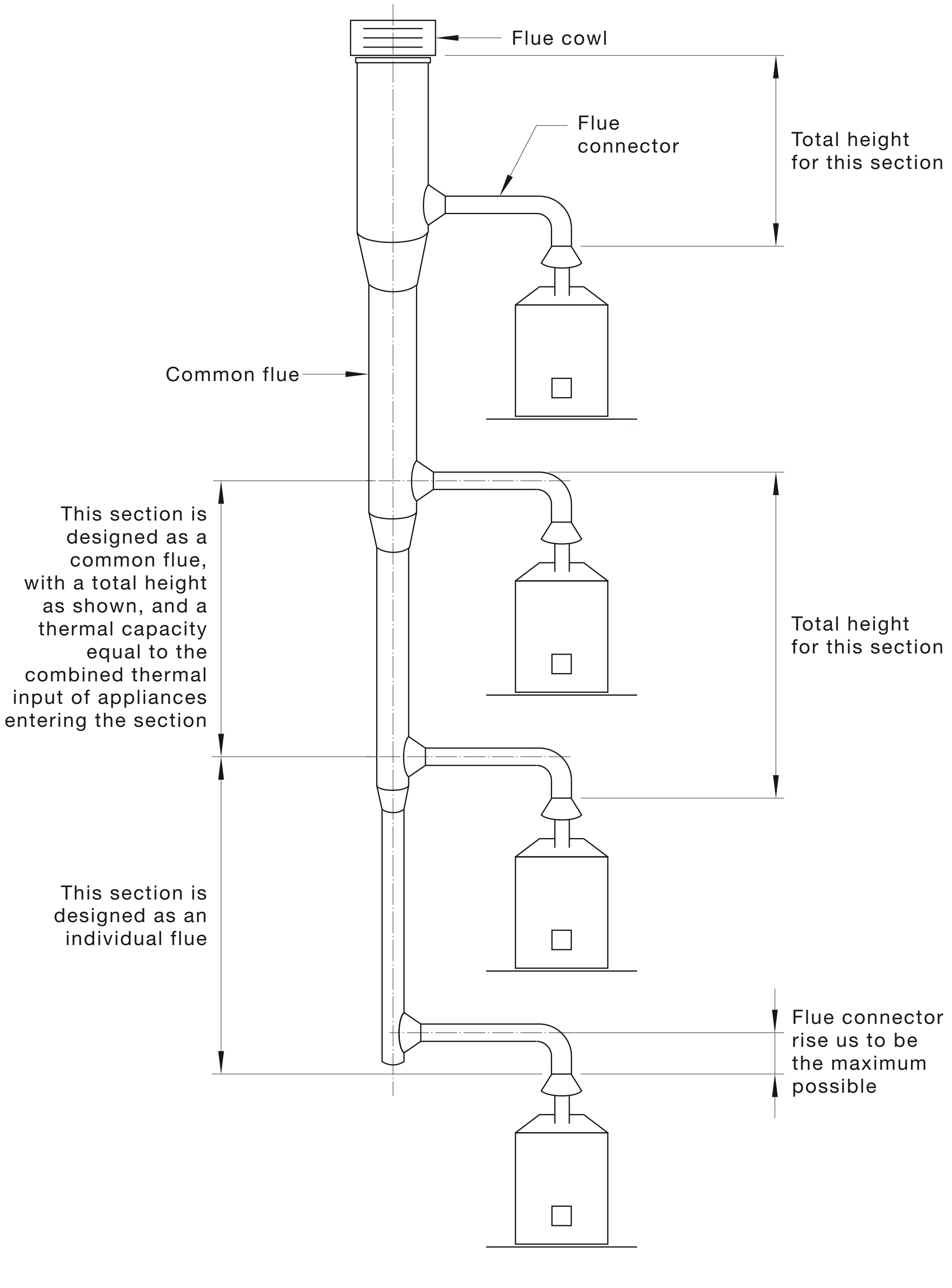
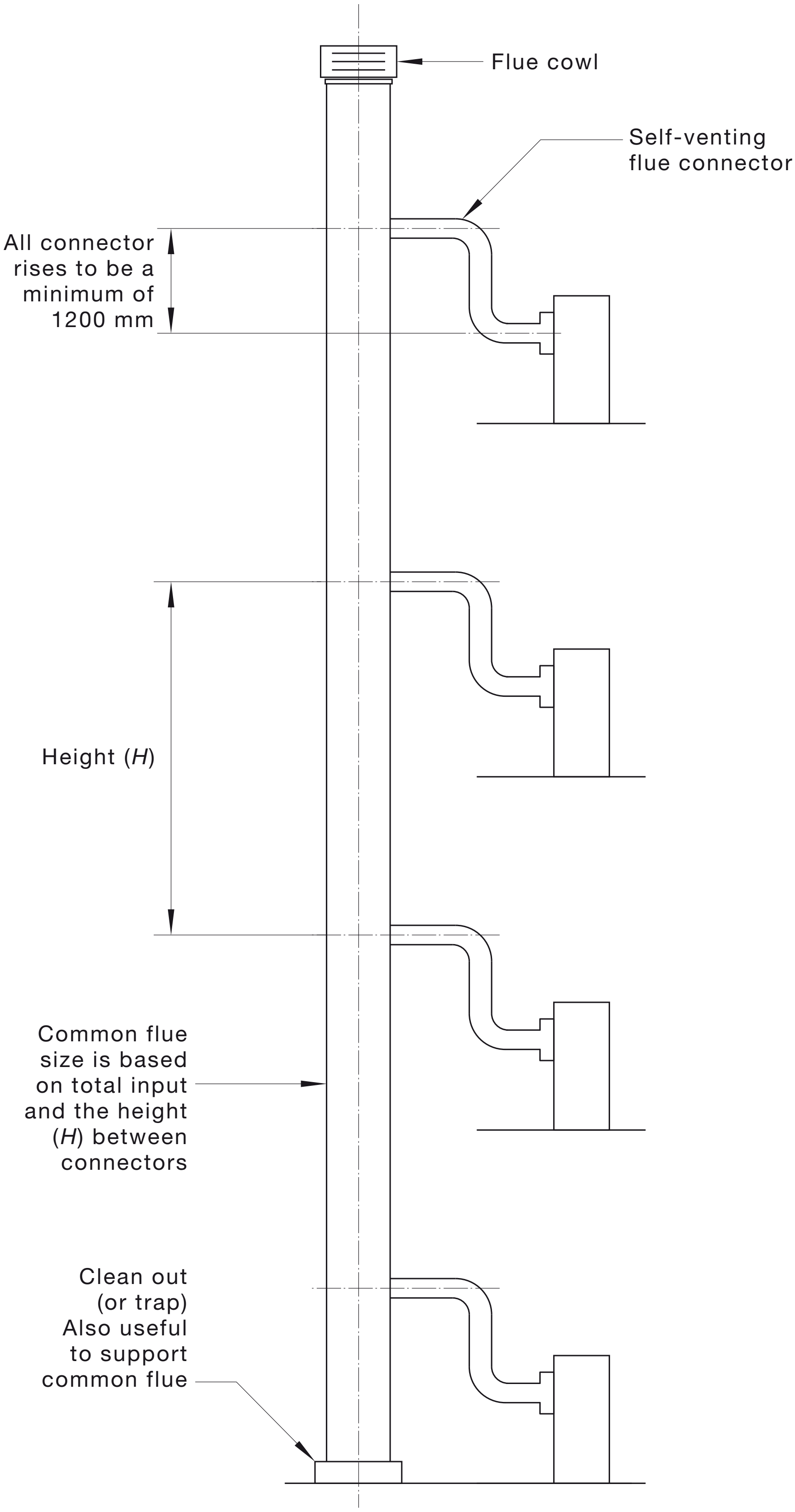


FIGURE H2 COMMON FLUE FOR SEVERAL APPLIANCES INSTALLED AT DIFFERENT LEVELS



NOTE: A self-venting *flue* connector does not depend on the *common flue* for its performance. The minimum connector rise of 1200 mm is designed so that each *flue* performs as an individual *flue*.

FIGURE H3 COMMON FLUE FOR SEVERAL APPLIANCES INSTALLED AT DIFFERENT LEVELS AND USING SELF-VENTING FLUE CONNECTORS

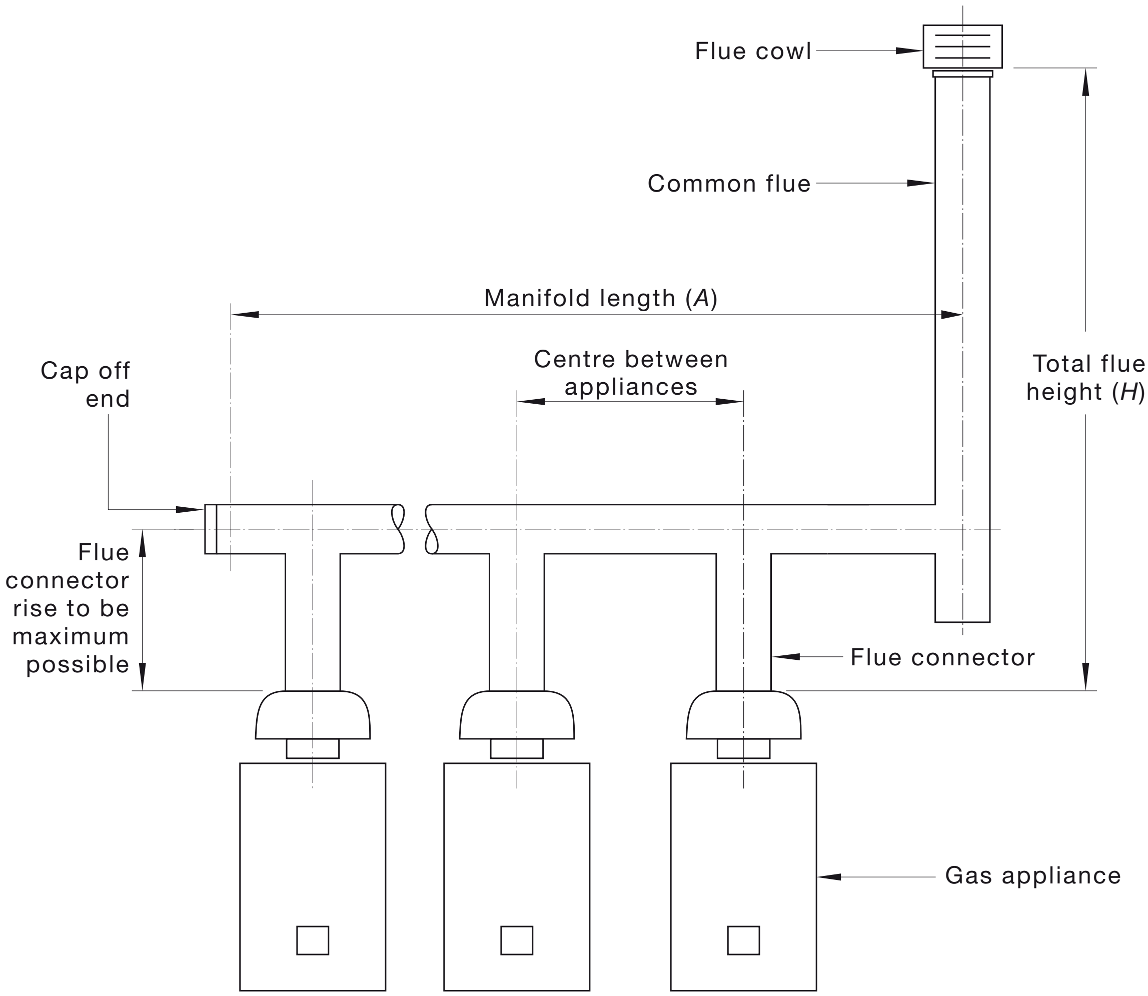
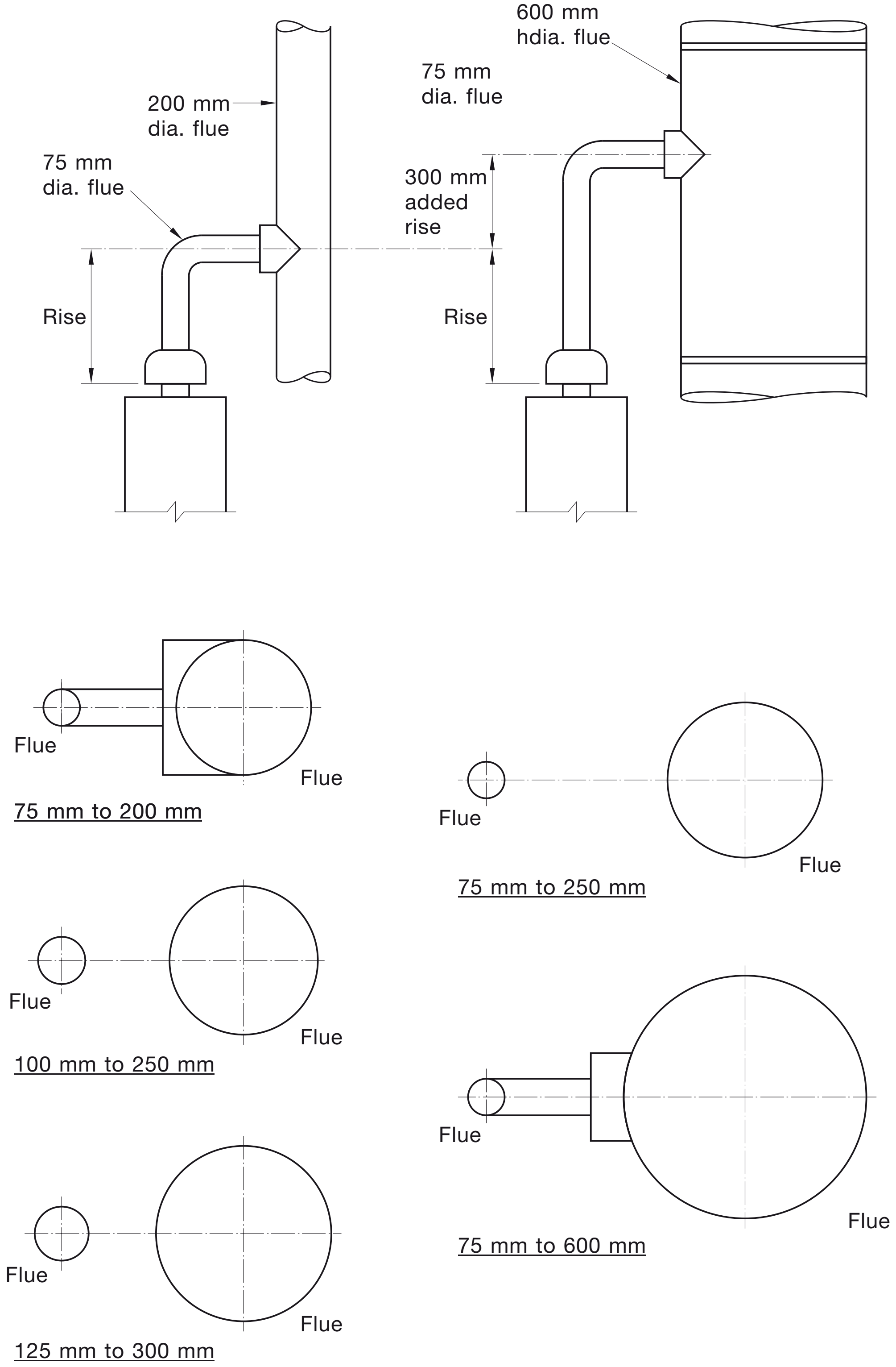


FIGURE H4 COMMON FLUE FOR SEVERAL APPLIANCES INSTALLED AT THE SAME LEVEL



Combination limits for use with Tables H4 and H6

Combination requiring 300 mm added connector rise

FIGURE H5 COMBINING A SMALL FLUE INTO A LARGE FLUE

TABLE H2

INDIVIDUAL APPLIANCE FLUES LOW HEAT LOSS MATERIALS AND ENVIRONMENTS (INDOOR LOCATIONS OR INSULATED FLUES)

Total height of flue (*H*)	Length of lateral (*L*)	Capacity of flue, MJ/h													
		Diameter of flue (*D*), mm													
m	m	75	100	125	150	175	200	250	300	350	400	450	500	550	600
2.0	0.0	49	91	149	216	301	390	601	897	1234	1614	2068	2564	3112	3714
	0.6	38	71	111	166	229	301	480	686	939	1234	1561	1952	2342	2817
	1.5	34	64	106	157	216	288	459	665	918	1213	1551	1920	2332	2796
2.5	0.0	53	99	164	248	338	438	696	1023	1393	1836	2342	2901	3545	4231
	0.6	42	79	127	190	261	340	543	786	1076	1414	1794	2226	2701	3218
	1.5	40	74	121	181	252	329	531	772	1066	1403	1778	2205	2685	3210
3.0	0.0	56	106	175	269	364	475	760	1118	1530	2031	2585	3218	3914	4695
	0.6	44	85	136	206	288	375	591	897	1192	1561	1994	2469	2996	3576
	1.5	42	81	131	197	279	364	578	879	1173	1541	1974	2443	2971	3556
4.5	0.0	61	118	197	301	411	554	886	1308	1815	2395	3060	3819	4653	5592
	0.6	51	98	158	237	333	437	712	1039	1424	1867	2384	2954	3598	4304
	1.5	47	94	154	231	323	422	696	1029	1396	1844	2358	2930	3571	4280
	3.0	44	87	147	220	307	399	670	1013	1359	1805	2314	2889	3526	4239
6.0	0.0	64	126	213	324	454	607	981	1424	2005	2659	3429	4283	5254	6330
	0.6	54	106	175	263	365	496	797	1161	1604	2110	2711	3376	4125	4959
	1.5	51	101	169	254	356	482	779	1142	1578	2085	2683	3348	4093	4919
	3.0	46	94	158	241	339	467	749	1102	1540	2047	2638	3302	4041	4853
	4.5	41	89	151	230	329	450	728	1076	1504	2018	2605	3261	4010	4844
9.0	0.0	68	135	232	354	501	686	1118	1635	2289	3081	3977	5011	6172	7448
	0.6	59	118	195	295	416	564	913	1382	1899	2511	3218	4020	4906	5908
	1.5	55	114	190	288	406	553	898	1360	1873	2479	3186	3991	4876	5857
	3.0	51	106	180	275	391	536	875	1323	1828	2427	3133	3945	4826	5772
	4.5	—	100	172	263	377	517	850	1287	1785	2374	3081	3897	4776	5686
	6.0	—	95	162	250	362	499	827	1250	1741	2321	3028	3851	4726	5602
12	0.0	70	139	241	372	528	723	1203	1825	2532	3408	4410	5560	6858	8292
	0.6	62	124	209	314	443	611	1013	1498	2110	2806	3608	4537	5549	6668
	1.5	57	120	203	306	435	599	1005	1478	2079	2767	3569	4492	5502	6623
	3.0	54	114	194	296	422	581	965	1457	2031	2703	3505	4418	5427	6549
	4.5	50	108	184	286	410	562	936	1414	1875	2639	3401	4346	5351	6477
	6.0	—	101	176	275	398	544	907	1382	1931	2595	3376	4273	5275	6404

(*continued*)

TABLE H2 (*continued*)

Total height of flue (*H*)	Length of lateral (*L*)	Capacity of flue, MJ/h													
		Diameter of flue (*D*), mm													
m	m	75	100	125	150	175	200	250	300	350	400	450	500	550	600
18	0.0	—	143	249	394	564	770	1319	2026	2849	3851	5001	6330	7786	9495
	0.6	—	132	225	348	496	686	1118	1693	2374	3186	4136	5233	6467	7803
	1.5	—	126	217	342	487	674	1104	1674	2351	3159	4104	5203	6422	7762
	3.0	—	120	207	331	474	656	1078	1643	2313	3113	4051	5154	6346	7680
	4.5	—	115	196	321	460	638	1054	1612	2276	3068	3998	5105	6292	7611
	6.0	—	—	186	310	446	621	1030	1581	2238	3033	3946	5056	6195	7536
	7.6	—	—	175	300	433	603	1005	1550	2200	2977	3893	5005	6120	7640
24	0.0	—	—	252	405	580	797	1361	2131	3038	4115	5381	6805	8440	10286
	0.6	—	—	229	369	522	721	1208	1836	2595	3503	4547	5750	7111	8651
	1.5	—	—	217	363	514	711	1194	1817	2571	3474	4514	5712	7071	8605
	3.0	—	—	206	352	501	695	1171	1785	2533	3427	4459	5650	7006	8529
	6.0	—	—	—	331	476	664	1125	1723	2455	3333	4352	5524	6875	8376
	4.5	—	—	—	342	488	679	1148	1757	2494	3379	4406	5587	6941	8452
	7.6	—	—	—	321	464	648	1102	1691	2416	3285	4298	5462	6810	8300
30	0.0	—	—	—	422	591	812	1382	2163	3112	4273	5592	7069	9073	10867
	0.6	—	—	—	396	538	739	1234	1920	2690	3693	4853	6119	7596	9284
	1.5	—	—	—	382	531	730	1223	1902	2670	3666	4816	6085	7556	9238
	3.0	—	—	—	368	519	716	1204	1873	2638	3622	4756	6030	7991	9161
	4.5	—	—	—	354	507	703	1186	1842	2604	3578	4696	5976	7424	9084
	6.0	—	—	—	—	496	689	1167	1812	2571	3534	4635	5921	7359	9007
	7.6	—	—	—	—	484	675	1148	1783	2538	3490	4574	5866	7292	8930
	9.1	—	—	—	—	473	661	1129	1753	2506	3446	4515	5806	7227	8853

TABLE H3

INDIVIDUAL APPLIANCE FLUES HIGH HEAT LOSS MATERIALS AND ENVIRONMENTS (OUTDOOR LOCATIONS WITH NON-INSULATED FLUES)

Total height of flue (H)	Length of lateral (L)	Capacity of flue, MJ/h													
		Diameter of flue (D), mm													
m	m	75	100	125	150	175	200	250	300	350	400	450	500	550	600
2.0	0.0	41	74	122	179	245	329	528	791	—	—	—	—	—	—
	0.6	33	58	99	149	205	274	438	654	—	—	—	—	—	—
	1.5	30	54	93	135	187	255	411	633	—	—	—	—	—	—
2.5	0.0	44	80	133	195	266	359	572	860	1224	1604	—	—	—	—
	0.6	34	64	108	162	222	300	476	717	1023	1340	—	—	—	—
	1.5	31	59	100	149	205	279	454	684	995	1308	—	—	—	—
3.0	0.0	47	89	146	213	294	392	639	962	1393	1846	2279	3102	—	—
	0.6	37	71	117	177	246	328	563	802	1161	1540	2005	2585	—	—
	1.5	34	64	110	161	227	305	506	764	1129	1505	1965	2541	—	—
4.5	0.0	52	96	159	235	329	445	722	1097	1530	2099	2722	3418	4241	5180
	0.6	41	76	129	196	274	369	601	913	1277	1751	2268	2849	3534	4326
	1.5	37	71	116	179	253	343	570	870	1242	1712	2236	2801	3479	4271
	3.0	32	61	109	167	235	325	542	839	1182	1646	2152	2722	3387	4178
6.0	0.0	56	107	172	266	361	496	812	1255	1772	2416	3165	3988	4937	6066
	0.6	44	84	143	222	302	414	676	1044	1477	2015	2638	3323	4115	5064
	1.5	40	78	130	203	279	384	644	997	1438	1973	2587	3264	4051	4998
	3.0	34	69	121	188	260	364	602	960	1372	1899	2500	3165	3946	4885
	4.5	—	58	110	172	241	344	580	918	1319	1825	2416	3075	3890	4779
9.0	0.0	59	114	193	291	405	558	926	1445	2026	2775	3608	4558	5697	7227
	0.6	46	89	156	243	338	665	770	1203	1688	2310	3007	3798	4748	6014
	1.5	—	82	145	222	312	433	732	1139	1646	2260	2948	3735	4677	5934
	3.0	—	72	132	207	289	409	692	1108	1572	2173	2849	3629	4558	5803
	4.5	—	—	119	187	272	386	659	1055	1509	2094	2754	3518	4442	5676
	6.0	—	—	109	172	253	363	629	1013	1445	2015	2659	3408	4326	5549
15	0.0	—	127	222	327	467	622	1034	1635	2321	3165	4115	5275	6583	8229
	0.6	—	100	180	274	390	519	865	1361	1931	2638	3429	4399	5486	6858
	1.5	—	—	168	247	361	500	823	1298	1880	2578	3362	4333	5407	6763
	3.0	—	—	154	233	335	481	770	1255	1794	2479	3249	4220	5275	6604
	4.5	—	—	—	211	308	429	744	1192	1725	2384	3139	4093	5138	6467
	6.0	—	—	—	195	291	405	707	1139	1656	2289	3028	3967	5001	6330
24	0.0	—	—	—	—	—	—	—	—	2659	3587	4695	5855	7332	9115
	0.6	—	—	—	—	—	—	—	—	2216	2986	3904	4959	6119	7638
	1.5	—	—	—	—	—	—	—	—	2156	2919	3776	4879	6024	7524
	3.0	—	—	—	—	—	—	—	—	2057	2806	3703	4748	5866	7332
	4.5	—	—	—	—	—	—	—	—	1978	2701	3576	4600	5718	7174
	6.0	—	—	—	—	—	—	—	—	1899	2595	3450	4452	5570	7016

TABLE H4

MAXIMUM FLUE CONNECTOR PIPE CARRYING CAPACITY LOW HEAT LOSS MATERIALS AND ENVIRONMENTS

Least total height (*H*) m	Connector rise (*L*) m	Capacity of flue, MJ/h Diameter of flue (*D*), mm 75	100	125	150	175	200	250	300
1.5	0.3	26	46	74	107	145	190	295	426
	0.6	32	56	88	127	171	225	351	506
	0.9	35	63	98	142	193	253	396	570
1.8	0.3	27	49	76	110	150	195	305	439
	0.6	33	58	91	131	177	232	364	523
	0.9	37	65	101	147	199	262	407	587
2.4	0.3	28	51	80	115	156	205	320	463
	0.6	34	60	95	136	185	243	378	544
	0.9	38	68	107	153	209	272	424	612
3.0	0.3	30	53	82	119	162	211	331	477
	0.6	35	62	98	141	192	251	392	565
	0.9	39	71	110	158	216	283	440	633
4.5	0.3	32	56	88	127	172	226	351	506
	0.6	37	66	104	150	204	267	416	599
	0.9	42	75	117	169	230	302	468	675
6	0.3	33	59	92	132	180	236	366	528
	0.6	39	70	110	157	213	280	437	629
	0.9	44	78	122	177	241	317	492	709
9	0.3	35	62	98	141	192	251	392	565
	0.6	41	74	116	167	228	298	463	667
	0.9	46	83	131	188	255	334	521	751
12	0.3	37	65	102	148	200	262	410	591
	0.6	43	77	121	175	237	311	486	702
	0.9	49	88	136	197	267	349	549	789
18	0.3	39	70	110	158	215	281	440	633
	0.6	46	83	130	188	255	333	521	751
	0.9	53	94	146	211	287	375	586	844

TABLE H5

MAXIMUM COMMON FLUE CARRYING CAPACITY LOW HEAT LOSS MATERIALS AND ENVIRONMENTS

Least total height (*H*) m	Common flue type (L or V)	Capacity of flue, MJ/h										
		Diameter of flue (*D*), mm										
		100	125	150	175	200	250	300	350	400	450	500
1.5	L	51	80	115	157	206	327	480	665	876	1118	1403
	V	63	100	145	196	255	404	578	793	1036	1308	1614
1.8	L	55	87	123	169	222	343	494	747	976	1234	1524
	V	69	109	155	211	274	433	620	860	1124	1419	1751
2.4	L	61	96	137	188	243	385	549	837	1092	1382	1709
	V	77	120	172	235	306	491	688	962	1255	1593	1962
3.0	L	66	103	150	204	264	417	599	913	1192	1509	1862
	V	83	131	188	255	332	522	751	1050	1372	1735	2142
4.5	L	77	120	173	236	306	485	692	1063	1387	1757	2173
	V	96	152	217	295	385	596	870	1222	1593	2015	2490
6.0	L	85	134	192	264	343	538	768	1188	1551	1962	2427
	V	108	169	242	327	427	675	966	1361	1783	2258	2785
9	L	99	155	223	306	396	622	890	1400	1830	2310	2859
	V	124	195	281	380	496	781	1081	1609	2099	2659	3281
12	L	111	173	249	338	443	696	997	1574	2057	2606	3218
	V	138	214	311	427	554	865	1245	1809	2363	2986	3693
18	L	—	188	273	371	485	760	1161	1846	2405	3049	3766
	V	—	236	342	464	607	950	1456	2121	2764	3505	4326
24	L	—	—	290	395	515	807	1300	2057	2690	3408	4199
	V	—	—	363	494	644	1008	1625	2374	3091	3914	4842
30	L	—	—	—	404	528	823	1408	2258	2943	3724	4600
	V	—	—	—	505	659	1029	1762	2585	3376	4273	5275

NOTES:

1 TYPE L: Applies to *common flues* having a manifold at the base or an offset in the *common flue*.

2 TYPE V: Applies when all connectors are individually attached directly to a straight vertical *common flue.*

TABLE H6

MAXIMUM FLUE CONNECTOR PIPE CARRYING CAPACITY HIGH HEAT LOSS MATERIALS AND ENVIRONMENTS

Least total height (*H*)	Connector rise (*L*)	Capacity of flue, MJ/h					
		Diameter of flue (*D*), mm					
m	m	75	100	125	150	175	200
1.8 to 2.4	0.3	22	42	72	108	154	216
	0.6	30	56	91	131	188	248
	0.9	36	64	103	155	215	290
4.5	0.3	24	46	81	123	189	253
	0.6	32	59	97	141	205	280
	0.9	37	68	108	164	228	314
9.0 and over	0.3	26	52	89	136	200	285
	0.6	33	61	102	153	223	311
	0.9	38	72	113	173	245	339

TABLE H7

MAXIMUM COMMON FLUE CARRYING CAPACITY HIGH HEAT LOSS MATERIALS AND ENVIRONMENTS

Least total height (*H*)	Capacity of common flue, MJ/h						
	Diameter of common flue (*D*), mm						
m	100	125	150	175	200	250	300
1.8	51	82	117	164	216	338	—
2.4	58	94	135	185	247	385	533
3.0	62	100	143	200	264	417	591
4.5	75	121	177	241	322	506	728
6.0	84	136	196	274	359	580	833
9.0	—	155	227	317	422	686	992
15.0	—	—	—	380	517	855	1255

TABLE H8

EQUIVALENT SIZES FOR ROUND AND RECTANGULAR FLUES

Round flue diameter mm	Rectangular flue size mm								
100	100 × 100								
125	125 × 100	100 ×125	—	—	75 × 200				
150	200 × 100	150 × 125	125 × 150	100 × 175	100 × 200				
175	275 × 100	200 × 125	175 × 150	150 × 175	125 × 200				
200	375 × 100	275 × 125	225 × 150	225 × 175	175 × 200	150 × 225			
225	500 × 100	375 × 125	300 × 150	250 × 175	225 × 200	200 × 225			
250		475 × 125	375 × 150	300 × 175	275 × 200	250 × 225	200 × 250		
300			500 × 150	425 × 175	350 × 200	350 × 225	300 × 250	250 × 300	
350				600 × 175	500 × 200	475 × 225	450 × 250	350 × 300	300 × 350
400					700 × 200	600 × 225	575 × 250	450 × 300	400 × 350
450						850 × 225	725 × 250	575 × 300	500 × 350
500							975 × 250	750 × 300	625 × 350

NOTE: Sizes outside those shown are not normally used.

H2 POWER FLUE DESIGN

NOTES:

1 A *flue* using a fan to remove or assist in removing *combustion products* from an *appliance* is known as a '*power flue*'.

2 For *appliances* with *atmospheric burners*, see Paragraph H1.

H2.1 Power flue applications

A *power flue* may be used for one or more *appliances* where any of the following conditions apply:

(a) It will be very difficult or very expensive to extend the *flue* of an *appliance* above roof level.

(b) Spillage is occurring at the *appliance* due to insufficient *flue* draught. This may be due to unfavourable *flue* configuration or inadequate size.

(c) It is desirable to reduce the concentration of the *flue gases* to a maximum of 1% carbon dioxide (CO_2) when they are to be discharged at a low level, i.e., up to 4 m from ground level.

H2.2 Design requirements

H2.2.1 *Air supply*

H2.2.1.1 *General*

Air supply to the *appliance* shall be in accordance with the requirements of Clause 6.4.

H2.2.1.2 *Provision for plant room air*

Air for diluting the *combustion products* may be taken from either the *plant room* or from outside directly into the *flue* before the fan (see Figure H6). Provision shall be made for supplying a quantity of dilution air equal to the flow through the *power flue* fan.

H2.2.1.3 *Flue design requirements*

NOTES:

1 It is recommended that the 'equal friction design method' should be used when calculating air flow and *pressure* loss. A velocity of 3 m/s is recommended.

2 See Figure H7 for the use of a common *flue* to power *flue appliance*s at different levels.

H2.2.2 *Requirement for a damper*

For multiple *appliance* installations, where the *appliances* are 2.5 m or more apart and where *flue* sizing is based on the 'equal friction' design method, a pivoted fixed-blade damper or blast gate shall be incorporated in the branch to every *appliance* in order to achieve correct air flow for the *flue* system.

H2.2.3 *Sizing of the fan*

In order to select a suitable fan, it is necessary to determine the volume and temperature of the *flue gases*. Before this can be done the percentage of CO_2 in the *flue gases* shall be decided.

If discharge is at low level, 1% CO_2 may be used in the design formula. For other situations, values between 4% and 8% may be used. These values will give *flue gas* temperatures of 140°C and 220°C respectively.

For *appliances* with modulating *burners*, the carbon dioxide concentration in the *flue* shall be considered when the *appliance* is operating at normal rate, i.e., 8% CO_2 in the combustion chamber.

The quantity of *flue gases* to be handled by the fan may be determined by the following simplified formula, which is sufficiently accurate for most *fuel gases* currently distributed. A suitable fan may then be selected.

$$Q = \frac{T}{R}$$

where

Q = volume of *flue gases*, litres per second.

T = total *gas consumption* of *appliances* connected to *flue* megajoules per hour.

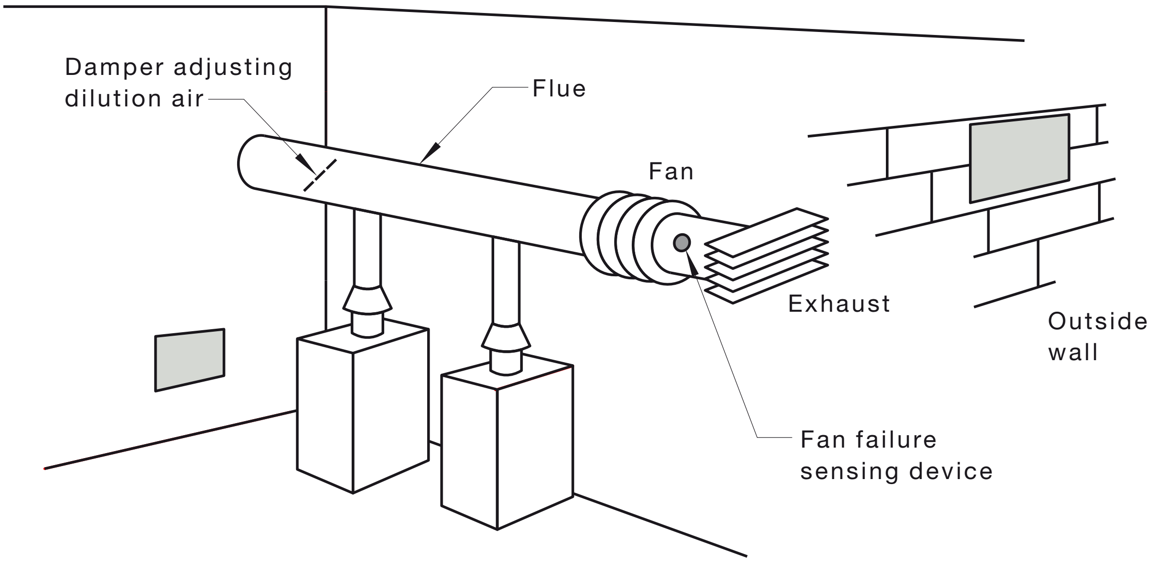
R = desired % CO_2 concentration by volume in the *flue gases* at the discharge point

Table H9 indicates the relationship between % CO_2, the volume of *flue gases* per MJ/h of *gas consumption* and the amount of *excess air* in the *flue gases*.

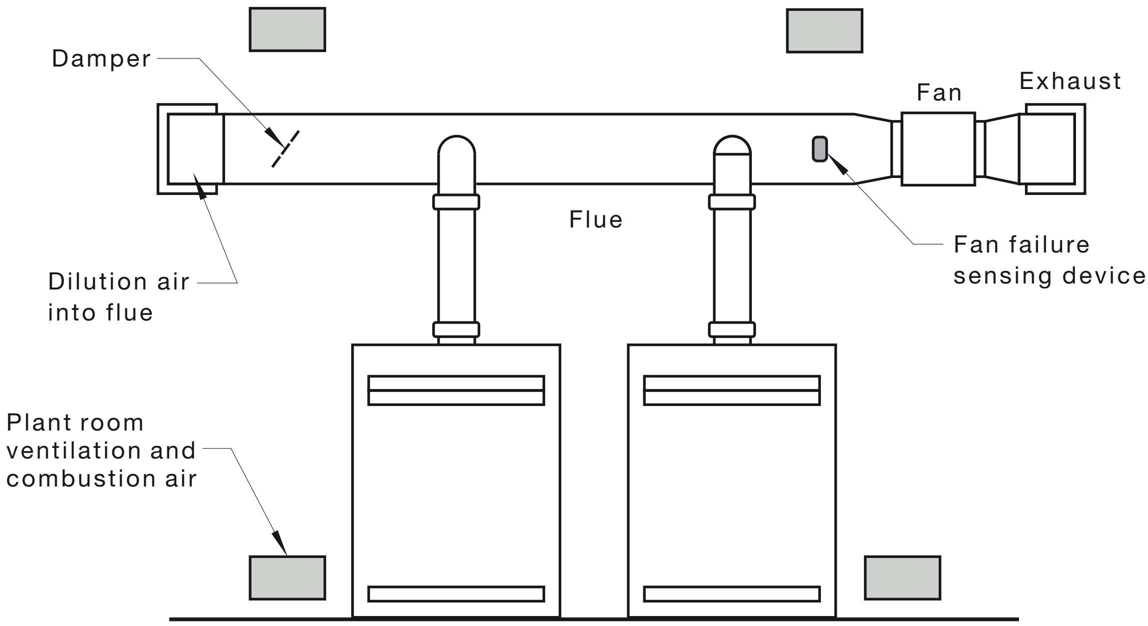
TABLE H9

FLUE GASES—RELATIONSHIP BETWEEN % CO_2, VOLUME FLOW RATE AND % EXCESS AIR

CO_2 %	Volume flow rate L/s/MJ/h	Excess air %
10	0.10	33
9	0.11	50
8	0.13	67
7	0.14	90
6.7	0.15	100
6	0.17	120
5	0.20	170
4.4	0.23	200
4	0.25	230
3.3	0.30	300
3	0.33	400
2.2	0.45	500
2	0.50	570
1.7	0.60	700
1.2	0.80	1000
1.0	1.00	1200
0.8	1.20	1500
0.6	1.60	2000
0.5	2.00	2600



(a) Installation using two outside walls



NOTE: *Appliance*s have inbuilt *draught diverters*.

(b) Installation using one outside wall

FIGURE H6 POWER FLUE—HORIZONTAL DISCHARGE

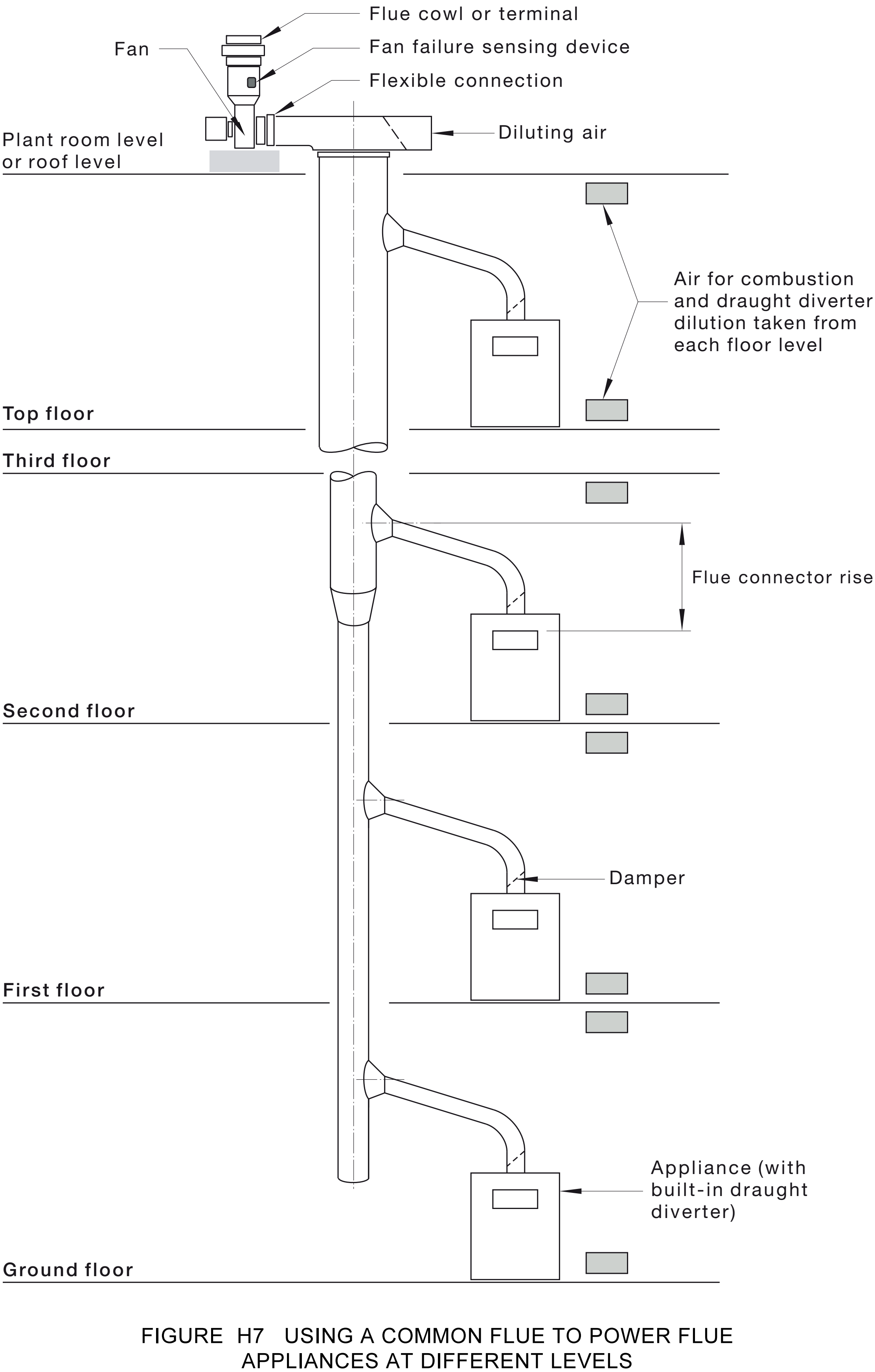


FIGURE H7 USING A COMMON FLUE TO POWER FLUE APPLIANCES AT DIFFERENT LEVELS

H2.2.4 *Fan requirements*

When selecting a fan for the *power flue*, allowance shall be made for wind *pressures* at the *flue terminal*. A barometric damper is usually installed in these situations to provide a means of balancing the draught.

The fan shall be rated for continuous operation giving consideration to the maximum design *flue* temperature. A fan located outside shall have a weatherproof motor.

A fan with an indirect drive shall be fitted with a removable steel guard designed and installed so as not to interfere with the pulleys when the motor is moved to take up belt slack. Bearings and shafts shall be protected from the weather by a durable and removable cover.

NOTES:

1 The fan should preferably be of the backward curved blade type having a non-overloading power characteristic.

2 The fan is to be located in the *common flue* as near as practicable to the *flue terminal*. Factors such as power and control wiring may determine its actual location.

H2.2.5 *Fan failure sensing devices*

A sensing device shall be installed in the *flue* to ensure that, in the event of flow failure, the *safety shut-off valve* will close. *Appliances* with permanent pilots may shut down the main *burner gas* only and need not have manual reset. Other *appliances* shall go to *lockout* when there is a flow failure.

NOTES:

1 Flow failure can be caused by fan failure, power supply failure, blocked *flue*, or any other cause by which the flow falls to a value at which there would be an unacceptable deterioration of performance (poor combustion, overheating, or spilling of *combustion products*).

2 Types of sensing devices which may be considered are:

(a) Vane or sail switch, which may be fitted on either side of the fan and which has position proving.

(b) *Pressure* differential detector, with both of its *pressure* detecting points either upstream or downstream of the fan and with position proving.

(c) Temperature detector, with a sensor, which is positioned close to the relief opening of the *draught diverter*. In normal operation the detector is kept cool by the air flowing from within the room into the *flue*. Should spillage occur, the sensor is heated by the escaping *flue gases* and causes the *gas* valve to close.

A possible disadvantage of sail switches and *pressure* differential detectors in *open flue* systems is that wind gusts can cause rapid on/off cycling of the *gas* valve. This can be overcome by *fitting* a delayed switching device in the circuit.

H2.2.6 *Noise and vibration reduction requirements*

Where an *appliance* with a *power flue* is to be installed in a housing or *plant room*, the construction and the possible effects of high noise levels in neighbouring rooms are to be taken into account. Methods of minimizing noise levels are detailed in the following Notes.

NOTES:

1 Often *flue* wall resonance, grille noise and *burner* noise may necessitate acoustic treatment being carried out after the installation has been completed.

2 *Flue* edging should be smooth and care should be taken that there are no burrs, sharp edges inside or outside, and loose parts in the *flue* system. The *flue* should be sturdily constructed and supported to prevent vibration and drumming.

3 The fan should preferably be of the slow running type and the maximum *flue gas* velocity should be kept within the region of 3 m/s.

4 Flexible connections between fan and *flue* are desirable, and fans should be separately supported on suitable resilient type mountings.

5 Resilient material between a bracket and a wall also assists to reduce noise to a great extent. The material should not be affected by weather or sunlight.

6 A suitable sound absorbent material may be used to insulate a *flue*, which is intended to be boxed in for aesthetic reasons.

7 Where fan noise, air rush noise and self-generated noise produced by components of the *flue* are excessive, attenuating devices (sound traps) should be fitted, either directly above the *draught diverter* (wall furnace type space heaters in particular), or in the *flue* downstream and/or upstream of the fan.

H2.2.7 *Commissioning the power flue*

The correct CO_2 concentration shall be established by adjustment of dampers and checked by *flue gas* analysis. A check that the controls are operating in the manner specified shall be carried out. This check shall include a simulation of fan failure.

APPENDIX I

APPLIANCES IN OUTDOOR AREAS

(Informative)

I1 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.

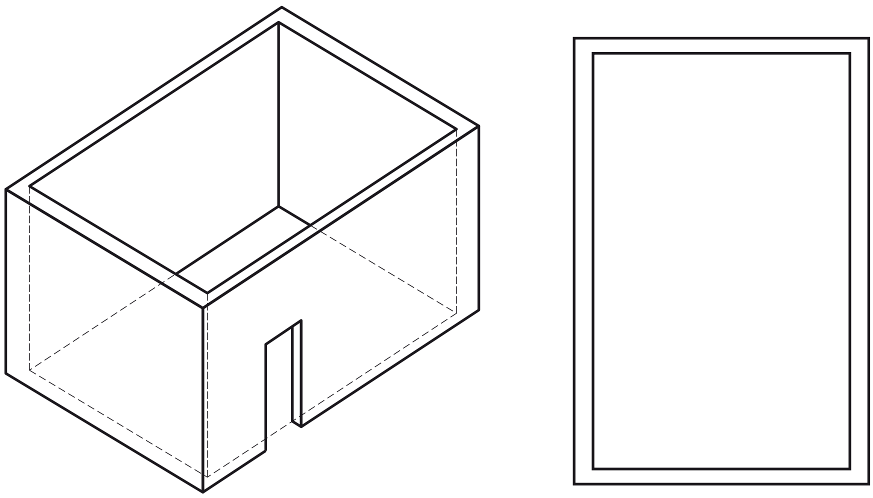


FIGURE I1 EXAMPLE OF AN ENCLOSURE WITH WALLS ON ALL SIDES, BUT AT LEAST ONE PERMANENT OPENING AT GROUND LEVEL AND NO OVERHEAD COVER

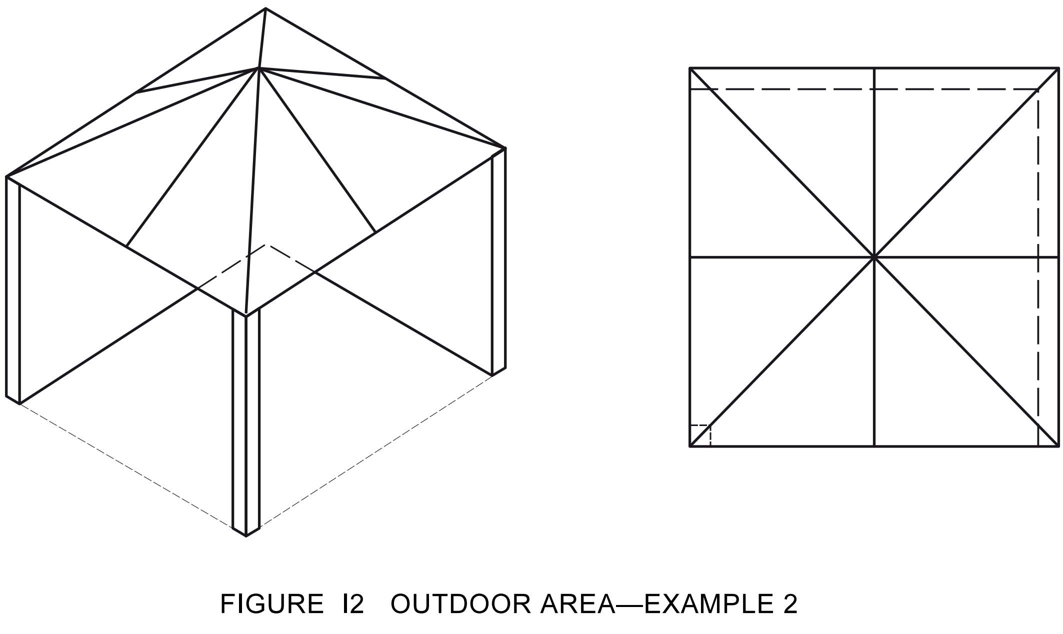


FIGURE I2 OUTDOOR AREA—EXAMPLE 2

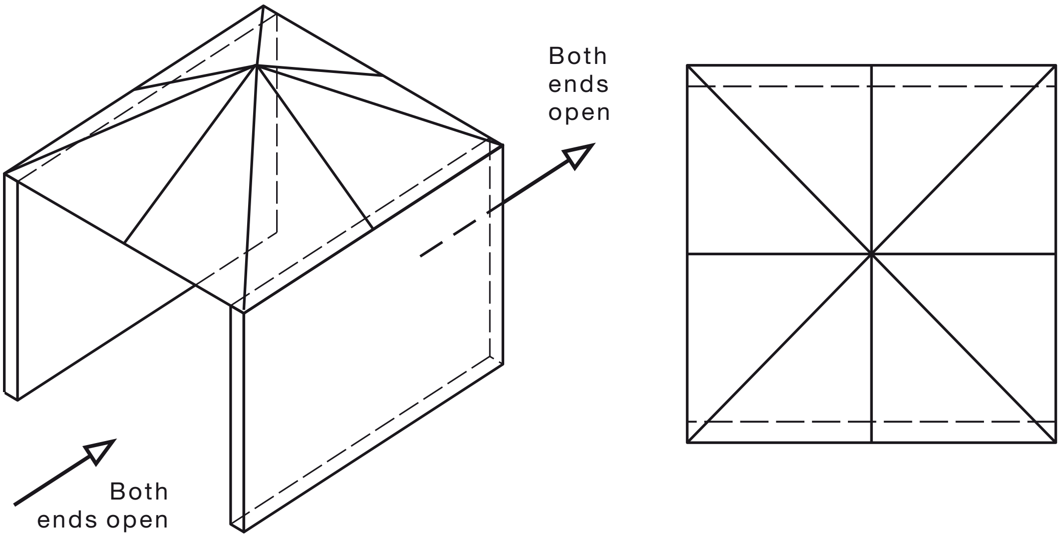


FIGURE I3 OUTDOOR AREA—EXAMPLE 3

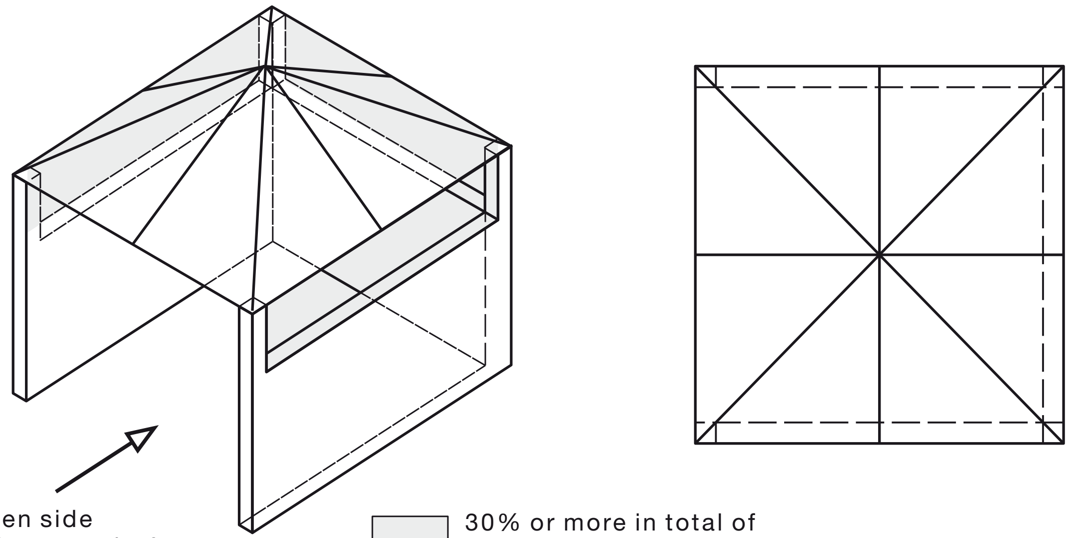


FIGURE I4 OUTDOOR AREA—EXAMPLE 4

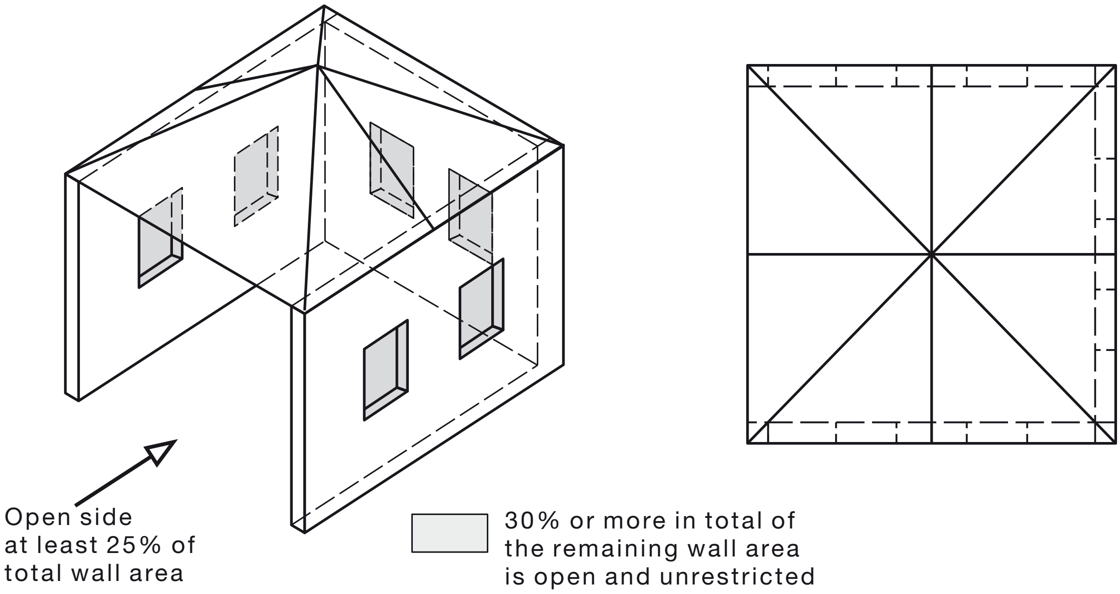


FIGURE I5 OUTDOOR AREA—EXAMPLE 5

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I2 'Text deleted'

APPENDIX J

LP GAS CYLINDER LOCATIONS

(Informative)

J1 GENERAL

This Appendix contains guidance for the location of *LP Gas cylinders*. For further information and other installations, refer to AS/NZS 1596 .

J2 CYLINDER REQUIREMENTS

In Australia, requirements for *cylinders* for use in an *LP Gas installation* are specified in AS 2030.1.

In New Zealand, *cylinders* for use in *LP Gas installation*s are required to be stamped with a LAB number and a current test date in accordance with the requirements of the Hazardous Substances and New Organisms (HSNO) Act 1996.

J3 LOCATION OF CYLINDERS

J3.1 General

Cylinders and associated equipment should not be installed *indoors* unless specifically permitted by AS/NZS 1596 and in such instances should be carried out with all controls specified in AS/NZS 1596 and this Standard relevant to the *appliance*s concerned.

J3.2 Prohibited locations

Any *cylinder* and its associated equipment should not be installed in any of the following locations:

(a) Within a building, except where permitted by AS/NZS 1596.

(b) Under a stairway.

(c) In a location with restricted access, where inspection, refilling or exchange of the *cylinder* is restricted, obscured or hazardous to the operator.

(d) Where nearby constructions, fences, walls or *vapour barriers* could prevent cross-ventilation.

(e) Under a building, except where permitted by Paragraph J3.5.

(f) Where the *cylinder*, or an incident involving the *cylinder* and its contents, could obstruct egress from a building.

(g) Buried in the ground, unless the *cylinder* and *gas* installation have been specifically designed for such a location.

Any *cylinder* and its associated equipment should not be installed where damage is likely to occur, unless adequate protection is provided.

J3.3 Cylinders on a verandah

Where *cylinder*s are located on a verandah, the following recommendations apply:

(a) The location should be nominally at ground level.

(b) The verandah should be open on all three sides.

(c) The hazardous area around the *cylinders* should be free of fixed *ignition sources*, as illustrated in Figure J1.

(d) The *cylinders* should not be subject to physical damage, heat or vibration.

(e) A maximum of 90 kg should be kept on a verandah complying with this Paragraph.

The location of such *cylinders* is shown in Figure J1.

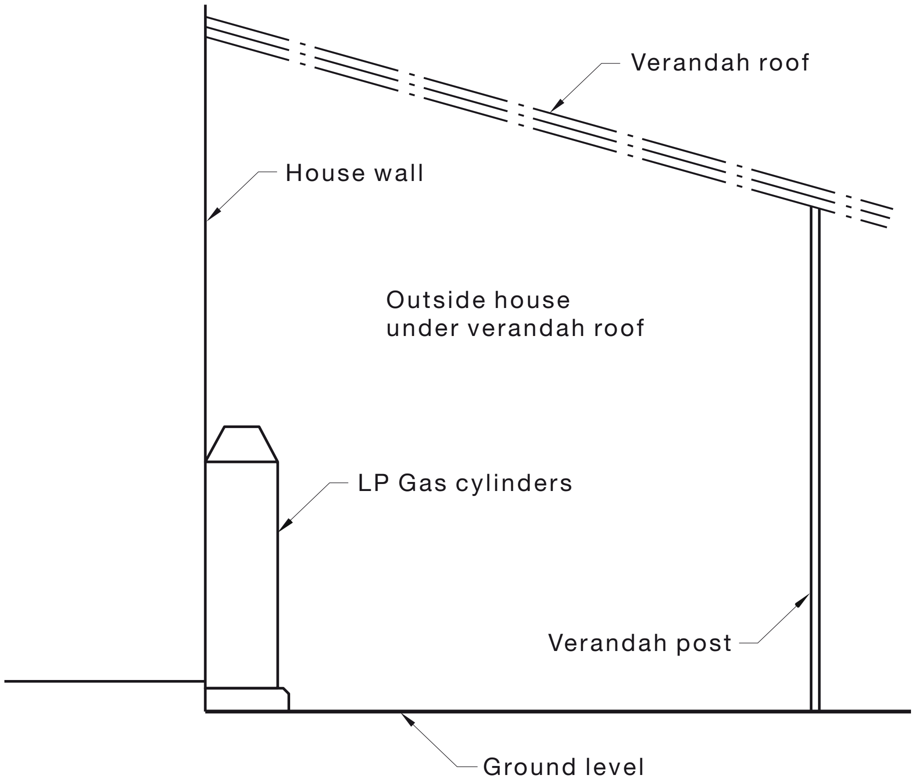


FIGURE J1 LOCATION OF CYLINDER ON A VERANDAH

J3.4 Cylinders in an enclosure or recess

Where a *cylinder* is to be installed in an *enclosure* or recess, the *enclosure* or recess should be designed to—

(a) house *cylinders* and their associated equipment only;

(b) allow free unimpeded discharge from each *cylinder* safety valve;

(c) ensure that water will not accumulate on the base; and

(d) ensure the *cylinder* and its associated equipment are clear of the surrounding soil.

Enclosures of sheet metal or similar impervious construction should have ventilation openings at the top and bottom with each opening providing a *free area* of at least 20 000 mm^2 for every *cylinder* enclosed.

J3.5 Cylinders under buildings

Where a *cylinder* is located under a building supported by piers, the following recommendations apply:

(a) There should be a vertical clearance of at least 800 mm between the top of the neck ring of the *cylinder* and the underside of any overhanging part of the building.

(b) No part of the *cylinder* should be more than 800 mm within the perimeter of the building's walls (see Figure J2, side view).

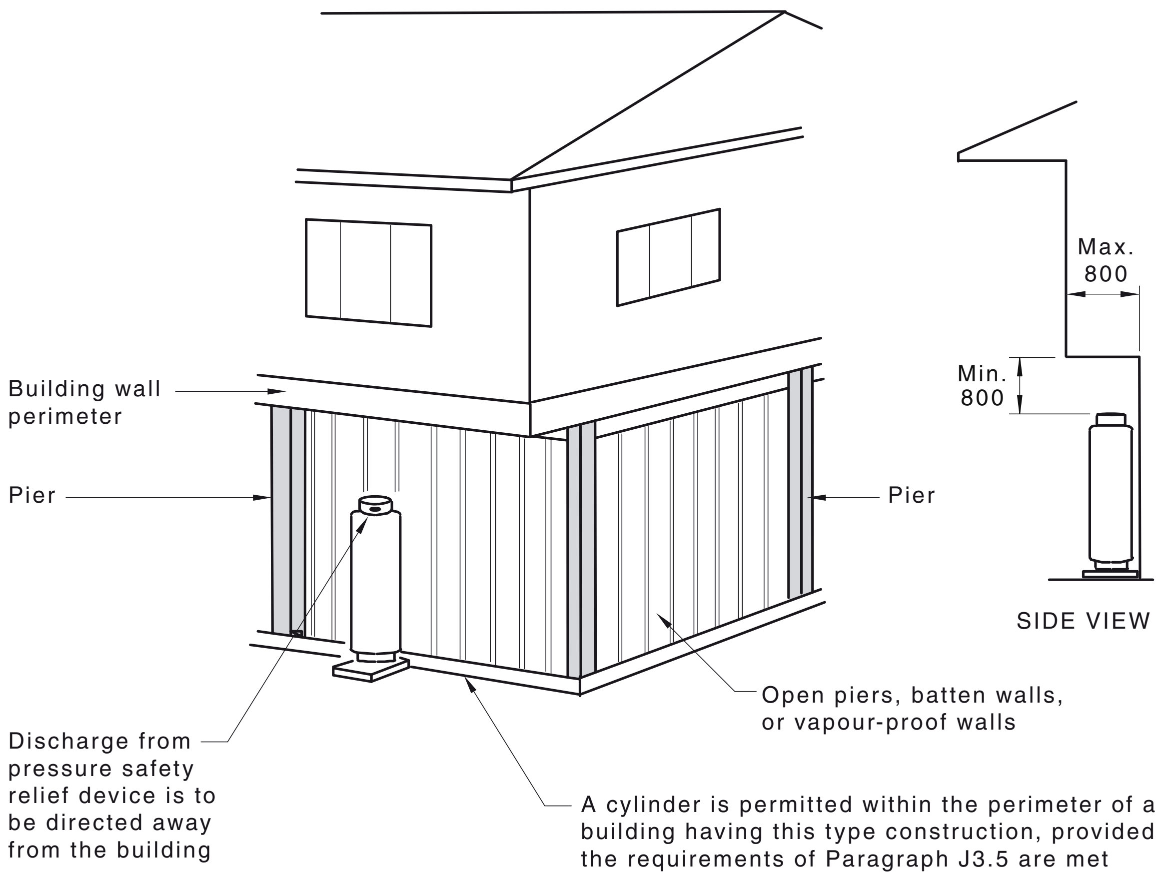
(c) The area between the piers should be—

(i) open on at least three sides; or

(ii) enclosed by a construction through which cross-ventilation can occur (e.g., slats or battens) on at least three sides; or

(iii) a combination of Items (i) and (ii) above.

A2



DIMENSIONS IN MILLIMETRES

FIGURE J2 LOCATION OF CYLINDER UNDER A BUILDING

J3.6 Cylinders in public locations

Where a *cylinder* exceeding 12 L capacity is permanently installed for public use in a location having unrestricted public access, the following recommendations should apply:

(a) Either—

(i) the *cylinder* and any associated regulator should be enclosed in a lockable cage or cabinet ventilated at the top and bottom; or

(ii) the *cylinder* valves and regulator should be guarded by a covering metal hood and the *cylinder* protected against accidental dislodgment.

(b) The connecting piping should be arranged so that it is not vulnerable to tampering or accidental impact.

Any lockable *enclosure* as described in Items (a)(i) and (a)(ii) should be kept locked when not in use.

These requirements do not apply to *cylinders* on *caravans* or mobile homes, or to *cylinders* attached to any cabins for hire or domestic dwelling associated with the site.

J4 INSTALLATION

J4.1 Installing cylinders

NOTE: Authorities in most areas permit only specifically licensed persons to make, repair, alter, or open connections in any installation for *LP Gas cylinders*, except for their actual connection or disconnection.

Cylinders should be installed in accordance with the following recommendations:

(a) *Cylinders* should be installed on a firm, level, non-combustible base, and not resting on soil. The floor or base should be constructed so that water cannot accumulate within any *enclosure* or recess.

(b) *Cylinders* should not be stacked on top of each other.

(c) Any *cylinder* that is liable to accidental dislodgment should be prevented from falling.

NOTE: This includes a *cylinder* located in an area likely to be subject to flooding or seismic activity.

(d) In New Zealand, any *cylinder* larger than 25 L should be restrained against seismic activity.

(e) Except for domestic installations, where there are manoeuvring vehicles, *cylinder*s should be afforded suitable protection, e.g., by the use of bollards, or a fully contained, free-moving frame which encapsulates all *cylinder* components.

NOTE: A frame may be used where the *cylinder* is not connected to external pipework.

(f) *Cylinders* should not be installed below ground level unless there is sufficient ventilation to prevent the accumulation of any leaking *gas*.

(g) A *cylinder* should be installed so that the *pressure*-relief valve is in contact with the vapour space and, *where practicable*, any discharge from this valve is directed away from any adjacent *cylinders* or combustible structures.

(h) A *cylinder* intended to be exchanged or removable should be connected to a fixed piping system complying with Paragraph J6.

(i) Vapour-service *cylinders* should be installed so that the point of *LP Gas* withdrawal is in contact with the vapour space.

(j) Where two or more *exchange cylinders* are connected for use, a means should be provided to permit the *cylinders* to be isolated from the *gas* supply, to allow the *cylinders* to be disconnected. This should be achieved by either of the following:

    (i) A manual or automatic changeover valve should be installed immediately upstream of the regulator serving the system.

    NOTE: Such a valve may be an integral part of an *automatic changeover regulator*.

    (ii) *Isolation valves* should be installed on the manifold, to allow each *cylinder* to be individually disconnected from the manifold without depressurizing the manifold.

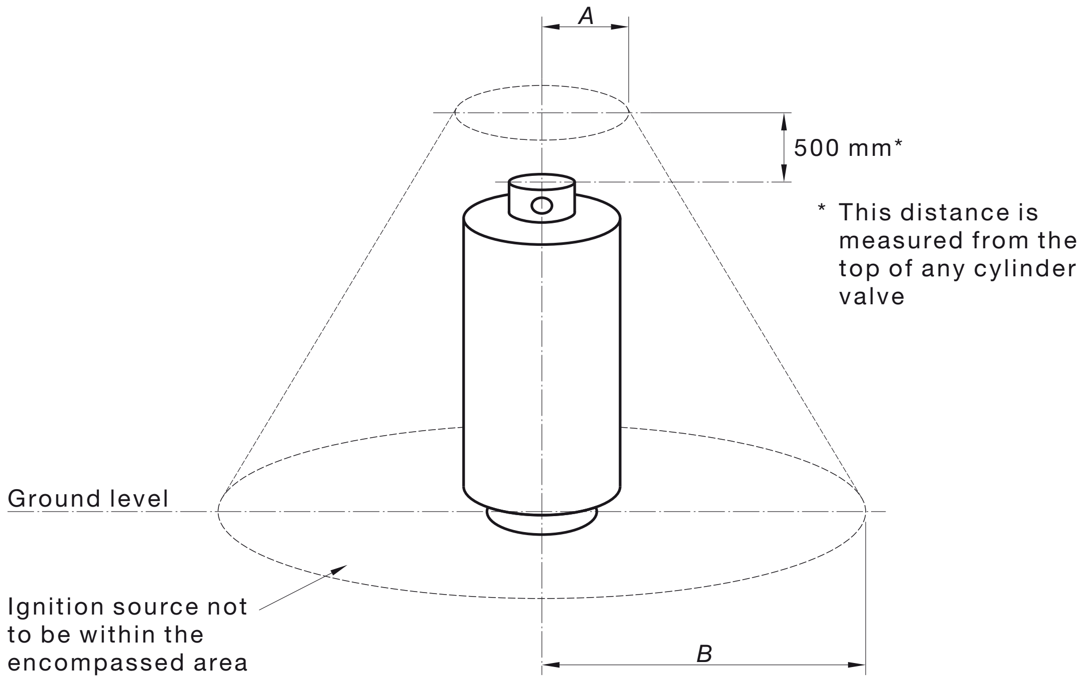
A2

J4.2 'Text deleted'

J5 CLEARANCES AROUND CYLINDERS

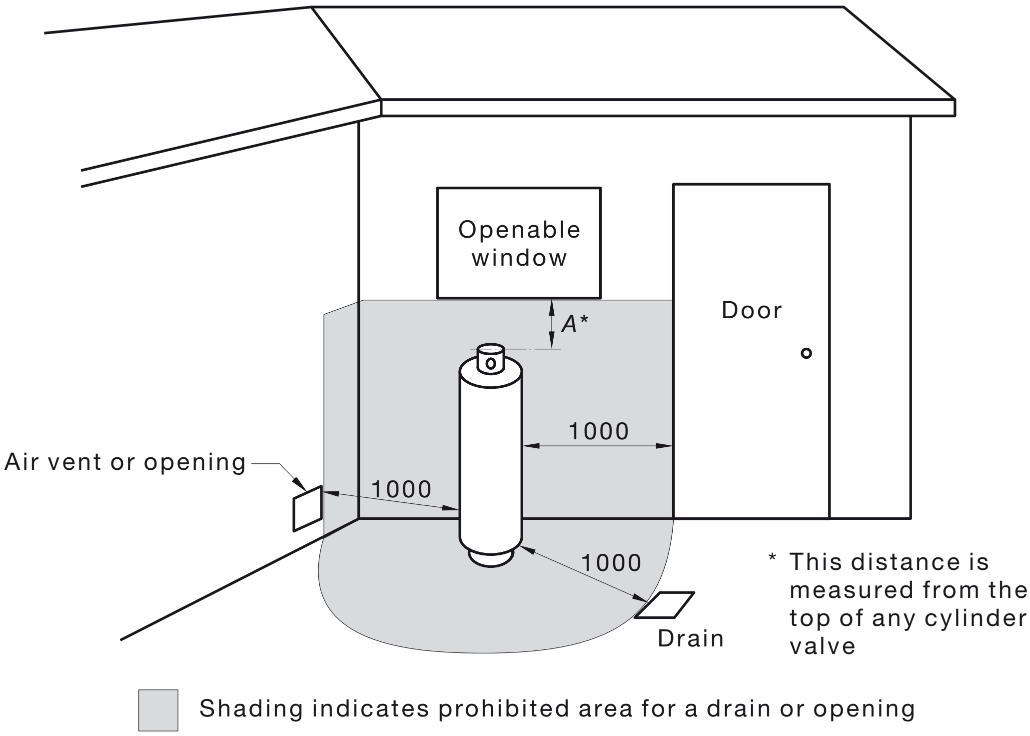
Cylinders should be installed with clearances complying with Figure J3 and Figure J4 and at least one (1) metre from readily ignitable material.

In New Zealand, the separation distances illustrated in Figure J4 are only applicable to installations having a storage capacity up to 100 kg of *LP Gas*. Above 100 kg storage capacity, the requirements are contained in the Hazardous Substances (Dangerous Goods and Scheduled Toxic Substances) Transfer Notice.



Radius	Exchange cylinder mm	In-situ fill cylinder mm
A	500	1500
B	1500	3500

FIGURE J3 MINIMUM CLEARANCE TO IGNITION SOURCES



Distance	Exchange cylinder mm	In-situ fill cylinder mm
A	150	500

DIMENSIONS IN MILLIMETRES

FIGURE J4 MINIMUM CLEARANCE TO A DRAIN OR OPENINGS INTO A BUILDING

J6 CYLINDER REGULATORS

A *cylinder regulator* should be *certified* to AS 4621 or UL 144.

Cylinder regulators should be located outside buildings, except where an *indoor* location is permitted by AS/NZS 1596.

For *cylinders* up to 400 L the regulators should be—

(a) rigidly fixed to an adequate support independent of the *cylinder* and—

 (i) mounted with the diaphragm vertical and the vent pointing vertically downwards; and

 (ii) *wherever practicable*, be located above the *cylinder* valves. (See Figure J5)

A2 (b) connected to the *cylinder* by pipework in accordance with Paragraph J9; and

(c) protected from the entry and accumulation of water (e.g., sprinkler water, rain water etc.) and other foreign matter.

For *cylinders* exceeding 400 L that are fitted with lockable domes, the regulator should be connected directly (or as close as *fittings* will practicably allow) to the *cylinder* valve outlet.

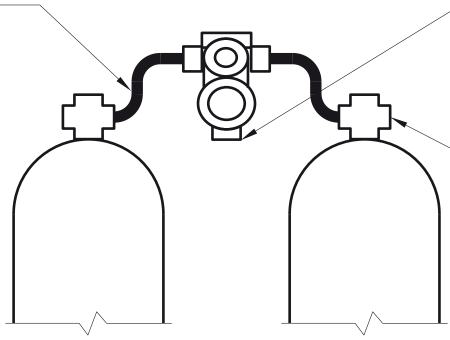


FIGURE J5 LOCATION OF CYLINDER REGULATOR

J7 LP GAS CYLINDER CAPACITY

Table J1 provides approximate capacities of *LP Gas cylinders*.

TABLE J1

APPROXIMATE CAPACITIES OF CYLINDERS FOR LP GAS

Nominal mass of LP Gas in cylinder kg	Approximate volume (water capacity) of cylinder L
3	7
4.5	11
5	13
9	22
10	26
13.5	32
15	36
18	44
45	108
90	200
190	454
210	499

J8 VAPORIZATION CAPACITY FOR CYLINDERS AND TANKS

The vaporization capacity of any *LP Gas* container is dependant on the amount of heat that can be transferred from the external environment through the storage vessel wall into the liquid, This heat can be supplied from either artificial or natural sources. The most common is natural vaporization, i.e., heat from the sun (radiant) and wind (conduction).

The surface area of a vessel which is bathed with liquid is called the 'wetted surface'. The greater the wetted surface, the greater the vaporization capacity of any storage vessel.

A number of assumptions have been made in calculating the vaporization capacity—

(a) the *LP Gas* is propane;

(b) the vessel is 30% full;

(c) relative humidity is 70%; and

(d) the vessel is under continuous load.

Tables J2 and J3 show nominal vaporization capacity (in MJ/h) at various temperatures. As a general guide, 4°C represents typical winter conditions and 16°C represents typical summer conditions.

TABLE J2
VAPORIZATION CAPACITY OF GAS CYLINDER

Vessel size kg	Vaporization capacity, MJ/h				
	−1°C	4°C	10°C	16°C	22°C
45	118	141	164	188	211
90	155	185	216	246	277
190	265	318	372	424	477

Cylinder capacity:

45 kg — 1.115 m height × 0.374 m diameter

90 kg — 1.100 m height × 0.485 m diameter

190 kg — 1.207 m height × 0.776 m diameter

TABLE J3
VAPORIZATION CAPACITY OF GAS TANK

Vessel size kL	Vaporization capacity, MJ/h				
	−1°C	4°C	10°C	16°C	22°C
2.75	1010	1212	1414	1616	1818
4.2	1362	1635	1907	2180	2452
7.5	2300	2760	3220	3680	4140

Tank capacity :

2.75 kL — 3.330 m long × 1.065 m diameter

4.2 kL — 3.920 m long × 1.220 m diameter

7.5 kL — 6.620 m long × 1.220 m diameter

J9 MATERIAL BETWEEN LP GAS CYLINDER VALVE AND INLET TO FIRST REGULATOR

Materials for *piping* between the LP *Gas cylinder* valve and the inlet to the first regulator should meet the criteria in Table J4.

A2

TABLE J4

MATERIALS FOR PIPING SYSTEMS BETWEEN CYLINDER VALVE AND INLET TO FIRST REGULATOR

Pipe	Fittings
Annealed copper tube complying with AS 1572 having an alloy designation of 122 in accordance with AS 2738 with a minimum wall thickness of 1.22 mm and a *nominal size* of 6 mm or 9 mm in industrial and commercial applications.	Copper alloy flared compression fitting complying with AS 3688 Copper or copper alloy capillary fitting complying with AS 3688 See Note 3
A flexible pigtail complying with AS/NZS 1869 with an *excess flow valve* immediately upstream of the *hose assembly*; and— • having a maximum length of 600 mm; • having a *nominal size* of 6 mm or 9 mm in industrial or commercial applications; and • for a non-metallic lined flexible pigtail having a maximum life of six years from the date of manufacture.	*POL fitting* and tail piece

NOTES:

1 The piping should be as short as practicable and not more than 1 m in length.

2 An *excess flow valve* may be an integral part of the *POL fitting*.

3 For joining methods and materials, see Table 4.1.

APPENDIX K

GAS IN HIGH-RISE BUILDINGS

(Informative)

K1 INTRODUCTION

This Appendix provides guidance for those associated with the design and installation of *gas* systems in *high-rise buildings.* However, it is not a comprehensive design guide. As these installations are complex in nature and need to resolve issues not normally encountered in low-rise *gas* installations, their design and installation should only be undertaken by persons who can demonstrate competency in this type of work.

Use of heavier-than-air *gases*, e.g., *LP Gas*, in *high-rise buildings* will require special consideration in terms of ventilation.

The information provided is supplementary to Clause 5.7 and the requirements of this Standard or any other relevant standard. It is critical that consideration be given to the *gas* installation requirements as early as practicable in the design and construction of the building.

Ensuring a safe *gas* installation in a multi*storey* building is significantly more complex than for single *storey* residential installations. They generally consist of larger more complex systems that are installed in areas with smaller amounts of adventitious ventilation and more opportunities for escaping *gas* to pool. As a rule occupants of multi*storey* buildings should not be exposed to a risk greater than that for a single level residence. At the design stage of a *gas* system in a *high-rise building* the risks need to be assessed and measures implemented to eliminate or moderate the risks to the lowest level reasonably possible.

K2 GAS SUPPLY

Arranging for a *gas* supply is by application to an energy retailer or distributor. The meter location/meter room or *LP Gas* storage details are decided in consultation with the applicant and the local *gas* supply company. The applicant should provide adequate details of expected *gas loads* and *pressure* requirements. Contact the *Technical Regulator* for further details and for installation acceptance procedures.

NOTE: The use of *LP Gas* in *high-rise buildings* is not recommended.

K3 CONSUMER PIPING

Pipe materials complying with the requirements of Clause 4.2 can be used in *high-rise buildings*, except where specifically prohibited.

All joints should be welded if the *riser* is constructed from steel or brazed if constructed from copper with the exception of valves which may be screwed or flanged.

K4 PIPE RISER SHAFTS

Riser shafts should be vented to a safe location, external to the building. These will probably need to be fire rated to the requirements of the applicable building code or its equivalent and should be referred to the Building Surveyor.

The use of unventilated *riser* shafts is not recommended and if used needs to be validated by a risk assessment.

If regulators with over-*pressure* relief are to be installed in a *riser* shaft, there should be a vent pipe that discharges to outside the building in a safe location.

If a regulator without over-*pressure* relief is installed, a vent pipe may be required. Refer to Clause 5.11.1.2. The volume of the *riser* needs to be calculated to determine if it is acceptable to vent into the shaft or if a *vent line* is required. When a regulator is installed without a vent pipe the *riser* design should take into account the need to dilute to a safe level any *gas* that may escape from the regulator(s)

K5 CONSUMER PIPE LOCATION

Clause 5.3.1 provides for prohibited location of *consumer piping*. Some corridors and passageways are defined as 'required exits' or 'fire exit ways'. The relevant building codes do not permit *gas* piping in a required exit. If there is doubt about whether a location is to be a required exit, written clarification from the relevant authority should be obtained.

K6 COMPONENTS TO BE ACCESSIBLE

A number of components installed in a high-rise installation need to be *accessible* for servicing or for inspection, including *pressure* regulators, limited flexibility connections, *isolation valves*; and pipe anchors and spring clips.

K7 PIPE SUPPORT SYSTEMS

K7.1 Components to be considered

To allow for the movement of piping within a *high-rise building* the design should consider the four different components highlighted in Figures K1 and K2.

K7.2 Pipe anchor

Generally one anchor is provided (provision for anchor failure should be made) to support the pipe, and it should be a friction fit. The anchor should not be brazed to the pipe unless the *riser* has been reinforced, because heating anneals the pipe and the pipe could collapse at this point. Before selecting the location of the anchor, the direction of the expansion needs to be considered. If the anchor is located in the centre of the pipe *riser*, the expansion travel is halved, but allowance for movement is required at both ends. Except where a loop or offset is fitted to absorb movement, there should only be one anchor. If more than one anchor was fitted, without a loop being installed between the anchor points the pipe could buckle due to excessive compressive loading or be subject to tensile forces that could result in permanent deformation of the pipe as the temperature changes.

K7.3 Pipe riser clamp

Pipe *riser* clamps should be installed at regular intervals (as a general rule approximately every seven *storeys* from the anchor, or evenly spaced out, and located at the top and bottom of the *riser*). The purpose of the *riser* clamp is to reduce the load imposed on the pipe through its own weight and can be a friction fit around the pipe. A spring at each side of the clamp is adjustable to take the weight of the pipe off the anchor while still allowing the pipe to travel. The springs are selected taking into consideration the weight of the pipe being supported, and the length of travel. The required spring tension may change as the distance from the anchor increases.

K7.4 Pipe guides

Pipe guides are to be installed at spacings as required by Clause 5.8.2. Guides hold the pipe in position and in line, allowing the pipe clip to move in its bracket as the pipe moves.

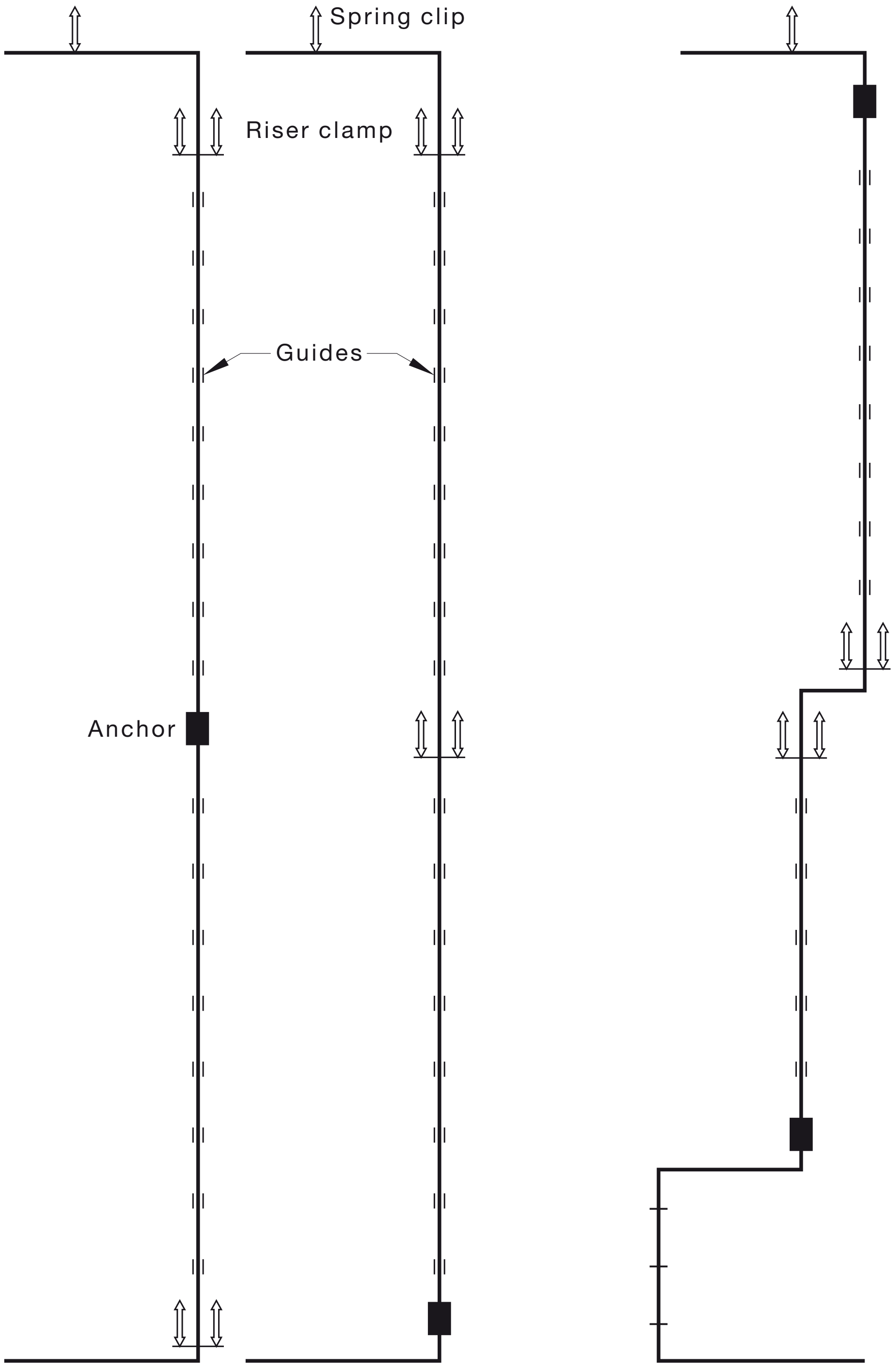


FIGURE K1 BUILDINGS NOT EXCEEDING 30 STOREYS

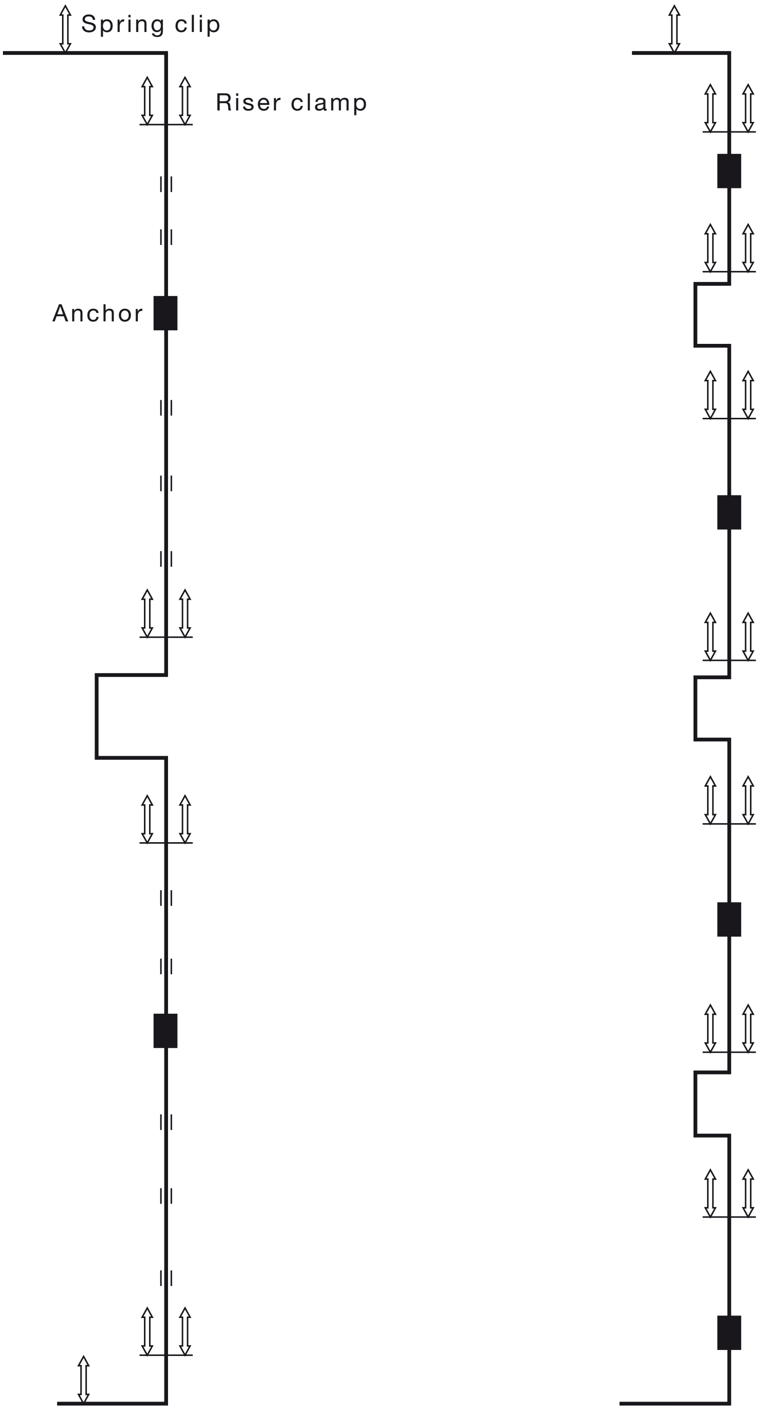


FIGURE K2 BUILDINGS OVER 30 STOREYS

K7.5 Spring clip

Spring clips are installed on horizontal sections of the pipe (usually out of the *riser*) to allow for the vertical movement while still being supported. They comprise a bolted clip supported by a single spring adjusted to take the weight of the pipe. The number of spring clips required along a horizontal run will depend on whether pipe has bends or is a straight run. The spacing of the clips is as per Clause 5.8.2.

K8 EXPANSION AND CONTRACTION OF CONSUMER PIPING AND BUILDINGS

K8.1 Thermal expansion

NOTE: Materials expand or shrink when subjected to changing temperatures; this is known as thermal expansion. The design needs to address the changes in pipe length that can occur as a result of thermal expansion.

K8.1.1 *Selecting a design temperature differential*

The design temperature differential should be selected to represent the maximum temperature change that the piping system will experience during its lifetime.

Consideration should be given to the temperatures that the piping will be subjected to through operational and ambient effects, both daily and seasonal. It should start from the time the system is locked into place, usually during construction when it may be exposed to the weather right through to normal operation of the system. If the pipe is installed external to the building then allowances should be made for solar exposure and shading from adjacent structures.

K8.1.2 *Calculating the thermal expansion*

The thermal co-efficient of expansion for copper is 0.000 017 7 per degree Celsius differential temperature. Therefore the thermal expansion for a 70 m copper pipe rise through 30°C would be—

Thermal expansion = 70000 × 30 × 0.0000177 = 37.2 mm.

K8.2 Building shrinkage

The effect building shrinkage has on *consumer piping* should be considered in all *high-rise building consumer piping* designs. Buildings can shrink significantly for up to ten years after the initial drying out period. This shrinkage should be allowed for in calculations as it will apply loads to piping systems not designed to cope with support structure shrinkage or disappearing clearances to structural members. The civil design/construction engineer should supply information regarding the expected amount of building shrinkage. For example, buildings of 40-*storeys* are expected to shrink between 150 mm and 200 mm over such a period. Even on 10-*storey* buildings shrinkage should be considered as it may result in significant pipe stresses.

K8.3 Design for expansion/contraction

The amount a pipe system will expand or contract over its life can be estimated using the above factors. The system should be designed to ensure that it is flexible enough to ensure that it never reaches a condition where it will yield and possibly fail.

Figures K1 and K2 show some design systems that are used to ensure that the system is flexible and will not fail due to expansion and/or contraction and building shrinkage. Flexibility of the system is increased by incorporating offsets or loops in the design.

Where a system fails to have enough flexibility, loops or offsets should be installed in the *riser*. The number of loops or offsets will depend on the available space in the *riser* shaft, and the amount of travel in the pipe. The amount of travel in the pipe will be controlled by the number of loops/offsets that can be installed, the more loops/offsets installed, the less travel that each loop/offset will be required to deal with. This in turn allows for smaller loops/offsets. (Travel is divided by number of loops.)

An anchor is installed between each loop to support the pipe; the expansion between the two anchors is taken up by the loop. A pipe *riser* clamp is installed as close as possible to each side of the loop, then spaced at approximately every seven levels or evenly spaced as required. Requirements for the installation of guides are set out in Clause 5.8.2.

The design of loops/offsets needs to ensure that the pipe system is not placed into yield by linear and/or torsional deflexions. Such designs should only be undertaken by persons competent in the field.

K9 BRANCHES (OFF TAKES)

Where a branch is required to be connected to the *riser* at a point remote from an anchor point, allowance should be made for expansion of the pipe to prevent a fixed branch being broken off as the pipe moves.

Shear and bending loads should be assessed at all off takes due to the action of shrinkage, expansion and contraction to ensure that the system is never subjected to loads where it will be in yield.

Loads can be accommodated by ensuring correct design to allow for bending of the off take to cope with pipe movement without yielding, or the installation of limited flexibility connectors, *certified* to AS 4631.

K10 VALVES

K10.1 General

The positioning of the valves in *high-rise buildings* has to be considered. Clause 5.3.8 requires pipes in unventilated concealed locations to have *permanent joints*. Valves invariably have mechanical joints, and should therefore be installed only in vented spaces. If valves are installed in a ceiling, then the ceiling should be vented to atmosphere at both ends to a safe location (see Clause 5.3.12(b)). The vent should not terminate into any prohibited location (see Clause 5.3.1) or into a 'required exit'. Valves are usually installed in the *riser* shaft for ease of access and ventilation. Ventilation can be obtained through the *riser* to roof level and atmosphere.

K10.2 Pipe riser isolation valves

A manual *isolation valve* is required for a *riser*. Where more than one *riser* is installed, a manual *isolation valve is* required at the base of each *riser*. The valve is to be fitted as close as possible to the *riser* but be *accessible*. A *pressure test point* is recommended to be installed downstream of each valve.

K10.3 Off take isolation valves

A manual *isolation valve* is required at each off take (branch) from a *riser*. This *isolation valve* should as close to the main *riser* as possible but be *accessible*. A *pressure test point* is recommended to be installed downstream of each valve.

A regulator, if required, depending on the *operating pressure* of the *consumer piping* may also be installed at this point. All these components should be installed in the *riser* shaft and as they comprise mechanical joints the *riser* should be adequately ventilated.

K10.4 Apartment isolation valves

It is good practice that each apartment or tenancy can be isolated by a valve located in an *accessible* and identified location. If the *gas* supply is interrupted, valves can be turned off until access is available for re-supply. A *pressure test point* is recommended to be installed downstream of each valve.

Unlike the roof space of a house, where *gas* can escape to atmosphere if a leak occurs, unvented ceilings of foyers, kitchens, food courts, corridor ceilings, etc, could form a very large area to hold any leaking *gas*.

K11 PLAN OF PIPE

A durable, permanent plan of the *gas* installation is to be fixed in every *high-rise building*, in a visible location, such as the *gas meter* room.

K12 BOOSTERS

Requirements for installation of boosters (also referenced to as *gas pressure*-raising devices) and the sequence of components are given in Clause 5.12. Boosters are not permitted within a meter room, unless authorized by the *gas* distribution company. Any take-off between the meter and booster should be protected against low *pressure*.

APPENDIX L

EXTRACTS FROM BUILDING CODES OF AUSTRALIA AND NEW ZEALAND

(Informative)

This Appendix contains an extract from the National Construction Code Series, Volume One, Building Code of Australian 2013, and the New Zealand Building Code—First Schedule of Building Regulations 1992.

NOTES:

1 In Australia, the *Technical Regulator* may have a different interpretation of what is part of a building to the Building Codes, e.g., carparks, car ports, garages and portable buildings.

2 The Building Codes are periodically updated and changes may have occurred since the publication of this Standard.

NATIONAL CONSTRUCTION CODE SERIES, VOLUME ONE

BUILDING CODE OF AUSTRALIA 2013

PART A3 CLASSIFICATION OF BUILDINGS AND STRUCTURES

Principles of classification (A3.1)

The classification of a building or part of a building is determined by the purpose for which it is designed, constructed or adapted to be used.

Classifications (A3.2)

Buildings are classified as follows:

Class 1: one or more buildings which in association constitute—

(a) Class 1a—a single dwelling being—

(i) a detached house; or

(ii) one of a group of two or more attached dwellings, each being a building, separated by a fire-resisting wall. Including a row house, terrace house, town house or villa unit; or

(b) Class 1b—a boarding house, guest house, hostel or the like—

(i) a boarding house, guest house, hostel or the like—

(A) with a total area of all floors not exceeding 300 m^2 measured over the enclosing walls of the Class 1b; and

(B) in which not more than 12 persons would ordinarily be resident; or

(ii) 4 or more single dwellings located on one allotment and used for short-term holiday accommodation,

which are not located above or below another dwelling or another Class of building other than a *private garage*.

Class 2: a building containing 2 or more sole-occupancy units each being a separate dwelling.

Class 3: a residential building, other than a building of Class 1 or 2, which is a common place of long term or transient living for a number of unrelated persons, including—

(a) a boarding-house, guest house, hostel, lodging-house or backpackers accommodation; or

(b) a residential part of a hotel or motel; or

(c) a residential part of a school; or

(d) accommodation for the aged, children or people with disabilities; or

(e) a residential part of a health-care building which accommodates members of staff; or

(f) a residential part of a detention centre.

Class 4: a dwelling in a building that is Class 5, 6, 7, 8 or 9 if it is the only dwelling in the building.

Class 5: an office building used for professional or commercial purposes, excluding buildings of Class 6, 7, 8 or 9.

Class 6: a shop or other building for the sale of goods by retail or the supply of services direct to the public, including—

(a) an eating room, café, restaurant, milk or soft-drink bar; or

(b) a dining room, bar area that is not an *assembly building*, shop or kiosk part of a hotel or motel; or

(c) a hairdresser's or barber's shop, public laundry or undertaker's establishment; or

(d) market or sale room, showroom, or service station.

Class 7: a building which is—

(a) Class 7a—a carpark; or

(b) Class 7b—for storage, or display of goods or produce for sale by wholesale.

Class 8: a laboratory, or a building in which a handicraft or process for the production, assembling, altering, repairing, packing, finishing, or cleaning of goods or produce is carried on for trade, sale or gain.

Class 9: a building of a public nature—

(a) Class 9a—a health-care building, including those parts of the building set aside as a laboratory; or

(b) Class 9b—an assembly building, including a trade workshop, laboratory or the like in a primary or secondary school, but excluding any other parts of the building that are of another Class; or

(c) Class 9c—an aged care building.

Class 10: a non-habitable building or structure—

(a) Class 10a—a non-habitable building being a private garage, carport, shed or the like; or

(b) Class 10b—a structure being a fence, mast, antenna, retaining or free-standing wall, swimming pool, or the like.

(c) Class 10c—a *private bushfire shelter*.

Multiple classification (A3.3)

Each part of a building must be classified separately, and—

(a)

(i) where parts have different purposes – if not more than 10% of the floor area of a *storey*, being the minor use, is used for a purpose which is a different classification, the classification applying to the major use may apply to the whole *storey*; and

(ii) the provisions of (i) do not apply when the minor use is a laboratory or Class 2, 3 or 4 part; and

(b) Classes 1a, 1b, 7a, 7b, 9a, 9b, 9c, 10a, 10b and 10c are separate classifications; and

(c) a reference to—

(i) Class 1—is to Class 1a and 1b; and

(ii) Class 7—is to Class 7a and 7b; and

(iii) Class 9—is to Class 9a, 9b and 9c; and

(iv) Class 10—is to Class 10a, 10b and 10c; and

(d) A *plant room*, machinery room, lift motor room, boiler room or the like must have the same classification as the part of the building in which it is situated.

Parts with more than one classification (A3.4)

(a) Notwithstanding A3.3, a building or part of a building may have more than one classification applying to the whole building or to the whole of that part of the building.

(b) If a building or part of a building has more than one classification applying to the whole building or part in accordance with (a), that building or part must comply with the relevant provisions of the BCA for each classification.

NEW ZEALAND BUILDING CODE

First Schedule to Building Regulations 1992

FIRST SCHEDULE

Clause A1 CLASSIFIED USES

1.0 EXPLANATION

1.0.1 For the purposes of this building code *buildings* are classified according to type, under seven categories.

1.0.2 A *building* with a given classified use may have one or more *intended uses* as defined in the Act.

2.0 HOUSING

2.0.1 Applies to *buildings* or use where there is self-care and service (internal management). There are three types:

2.0.2 Detached Dwellings

Applies to a *buildings* or use where a group of people live as a single household or family.

Examples: a holiday cottage, boarding house accommodating fewer than 6 people, dwelling or hut.

2.0.3 Multi-unit Dwelling

Applies to a *building* or use which contains more than one separate household or family.

Examples: an attached dwelling, flat or multi-unit apartment.

2.0.4 Group Dwelling

Applies to a *building* or use where groups of people live as one large extended family. Examples: within a commune or marae.

3.0 COMMUNAL RESIDENTIAL

3.0.1 Applies to *buildings* or use where assistance or care is extended to the *principal users*. There are two types.

3.0.2 Community Service

Applies to a residential *building* or use where limited assistance or care is extended to the *principal users*. Examples: a boarding house, hall of residence, holiday cabin, hostel, hotel, motel, nurses' home, retirement village, time-share accommodation, a work camp, or camping ground.

3.0.4 Community Care

Applies to a residential *building* or use where a large degree of assistance or care is extended to the *principal users*. There are two types:

(a) **Unrestrained**; where the *principal users* are free to come and go. Examples: a hospital, an old people's home or a health camp.

(b) **Restrained**; where the *principal users* are legally or physically constrained in their movements. Examples: a borstal or drug rehabilitation centre, an old people's home where substantial care is extended, a prison or hospital.

4.0 COMMUNAL NON-RESIDENTIAL

4.0.1 Applies to a *building* or use being a meeting place for people where care and service is provided by people other than the *principal users*.

There are two types:

4.0.2 Assembly Service

Applies to a *building* or use where limited care and service is provided. Examples: a church, cinema, clubroom, hall, museum, public swimming pool, stadium, theatre, or whare runanga (the assembly house).

4.0.3 Assembly Care

Applies to *building* or use where a large degree of care and service is provided. Examples: an early childhood centre, college, day care institution, centre for handicapped persons, kindergarten, school or university.

5.0 COMMERCIAL

5.0.1 Applies to a *building* or use in which any natural resources, goods, services or money are either developed, sold, exchanged or stored.

Examples: an amusement park, auction room, bank, car-park, catering facility, coffee bar, computer centre, fire station, funeral parlour, hairdresser, library, office (commercial or government), police station, post office, public laundry, radio station, restaurant, service station, shop, showroom, storage facility, television station or transport terminal.

6.0 INDUSTRIAL

6.0.1 Applies to a *building* or use where people use material and physical effort to:

(a) extract or convert natural resources,

(b) produce goods or energy from natural or converted resources,

(c) repair goods, or

(d) store goods (ensuing from the industrial process).

Examples: an agricultural building, agricultural processing facility, aircraft hanger, factory, power station, sewage treatment works, warehouse or utility.

7.0 OUTBUILDINGS

7.0.1 Applies to a *building* or use which may be included within each classified use but are not intended for human habitation, and are accessory to the principal use of associated buildings. Examples: a carport, farm building, garage, greenhouse, machinery room, private swimming pool, public toilet, or shed.

8.0 ANCILLARY

8.0.1 Applies to a *building* or use not for human habitation and which may be exempted from some amenity provisions, but which are required to comply with structural and safety-related aspects of the building code.

Examples: a bridge, derrick, fence, free standing *outdoor* fireplace, jetty, mast, path, platform, pylon, retaining wall, *tank*, tunnel or dam.

(Visit www.dbh.govt.nz for the latest edition of New Zealand Building Regulations)

APPENDIX M

CONSUMER BILLING METER INSTALLATIONS

(Informative)

M1 FOR NEW ZEALAND

M1.1 General

The following guidelines apply for locating a *gas measurement system* (*GMS*) with a meter having a capacity up to 25 m^3 per hour (actual) (G16).

(a) The GMS should be located to provide for the shortest, most direct route of *gas* service pipe (i.e., on front of a house or on side within 3.0 m of front).

(b) Where the property is on a corner lot, the GMS should be positioned on the side of the property that fronts the street address for that property.

(c) Where it is not possible to maintain the specified clearance, consideration should be given to installing the GMS at the consumer's boundary or other location and the meter outlet piped to the building.

(d) Where the GMS is installed in a recessed meter box the box should be sealed completely from wall cavities and consumer's *premises*.

(e) The meter should be installed so that the base of the meter is above finished ground level.

(f) The service valve should be a maximum height of 300 mm from finished ground level.

M1.2 Exclusion areas and hazardous zones

M1.2.1 *General*

The exclusion areas and hazardous zones around the GMS have been determined from the applicable *gas* related and hazardous area codes, and include suitable margins to cover typical variations and layouts.

The determinations assume that the maximum inlet *pressure* to the service regulator does not exceed 1000 kPa and that the vent discharges vertically downwards.

M1.2.2 *Electrical equipment*

For the purposes of this Standard all fixed sources of ignition and/or building openings should be excluded from a Zone 1 or Zone 2 area (see Figure M1).

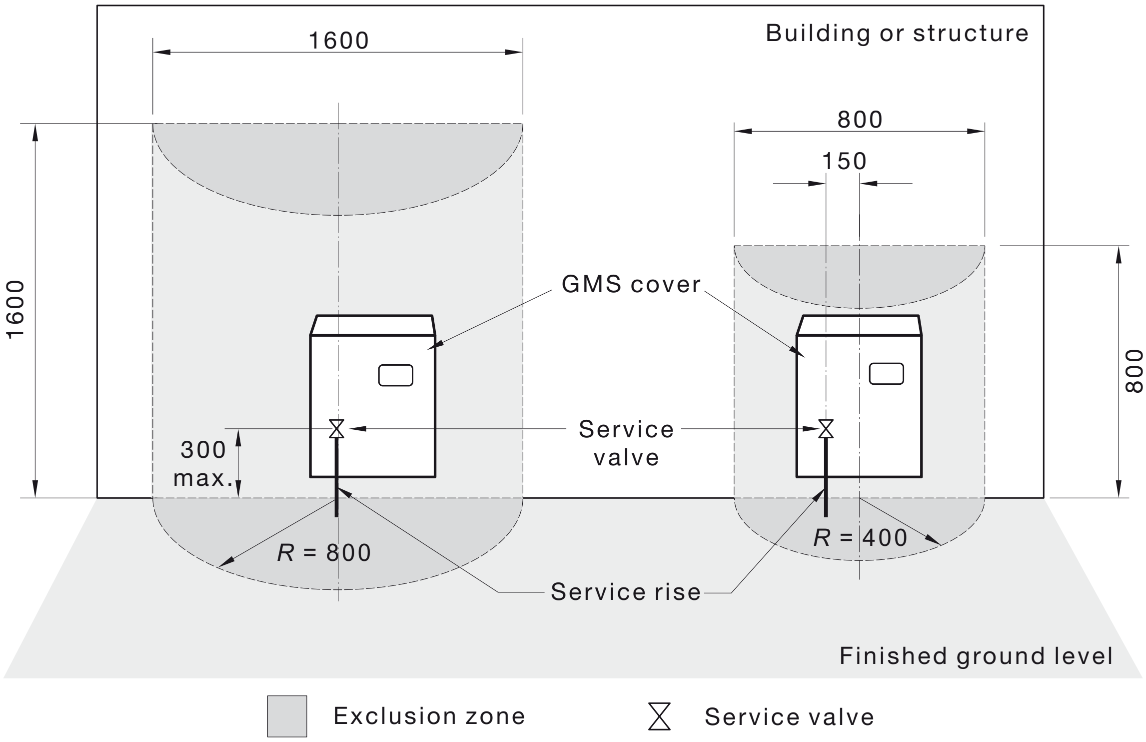
Where the service valve cannot be installed to this requirement then all vertical measurements should be adjusted accordingly.

The clearances specified should be increased if the *GMS* layout or position is likely to create any additional hazard.

For a *LP Gas GMS* with a venting regulator relief valve a drain or pit should be excluded from an area of at least 1.5 m radius measured from the service *riser* centre-line.

For a *LP Gas GMS* with an automatic shut-off regulator device a drain or pit should be excluded from an area of at least 0.4 m radius measured from the service *riser* centre-line.

NOTE: The service *riser* has been used as the point of reference as it is clearly identifiable and unlikely to be moved.



NOTES:

1 Exclusion zone starts at ground level. For venting regulators, the exclusion zone is centred on the service *riser*. For OPSO or non-venting regulators, the exclusion zone is centred 150 mm to the right-hand side of the service *riser*, when viewed looking towards the structure.

2 The service valve shall be installed between 150 mm and 300 mm maximum above finished ground level.

DIMENSIONS IN MILLIMETRES

FIGURE M1 EXCLUSION ZONE FOR GAS REGULATORS

M1.2.3 *Natural gas*

In addition to Paragraph M1.1, the following should apply for *natural gas* GMS installations:

(a) For a *natural gas* GMS with a venting regulator relief valve—

(i) the interior of the GMS *enclosure* should be classified as Zone 1; and

(ii) an area of at least 0.8 m horizontally from the service *riser* centre-line and at least 1.5 m vertically from finished ground level should be classified as Zone 2.

(b) For a *natural gas* GMS with an automatic shut-off device regulator—

(i) the interior of the GMS *enclosure* should be classified as Zone 1; and

(ii) an area of at least 0.4 m horizontally from the service *riser* centre-line; and at least 0.8 m vertically from finished ground level should be classified as Zone 2.

M1.2.4 *LP Gas*

In addition to Paragraph M1.1, the following should apply for *LP Gas* GMS installations:

(a) For a *LP Gas* GMS with a venting regulator relief valve—

(i) the interior of the GMS *enclosure* should be classified as Zone 1;

(ii) an area of at least 0.8 m horizontally from the service *riser* centre-line, and at least 1.5 m vertically from finished ground level should be classified as Zone 2; and

(iii) a drain or pit should be excluded from an area of at least 1.5 m radius measured from the service *riser* centre-line.

(b) For a *LP Gas* GMS with an automatic shut-off regulator device—

(i) the interior of the GMS *enclosure* should be classified as Zone 1;

(ii) an area of at least 0.4 m horizontally from the service *riser* centre-line, and at least 0.8 m vertically from finished ground level should be classified as Zone 2; and

(iii) a drain or pit should be excluded from an area of at least 0.4 m radius measured from the service *riser* centre-line.

M2 FOR AUSTRALIA

M2.1 Meter location

The location and the method of installation of a *consumer billing meter* are determined by the *network operator*. Ventilation of the meter location should be in accordance with Clause 5.13 as appropriate. Contact should be made with the *network operator* to determine the meter location and relevant installation requirements before any work commences.

NOTE: For *sub-meters*, refer to Clause 5.11.6.

M2.2 Multiple meters

Where multiple meters are installed, each meter needs to be clearly marked to indicate the portion of the *premises* that is supplied.

NOTE: *Consumer piping* should also be appropriately marked prior to meter installation.

M2.3 Subsequent work

The *network operator*'s requirements are to be maintained when subsequent work which involves access to the *consumer billing meter* is carried out. Ensure the following are provided on completion of such work:

(a) Security.

(b) Ventilation.

(c) Corrosion protection.

(d) Access for reading and maintenance.

APPENDIX N

SPECIAL REQUIREMENTS IN AUSTRALIAN JURISDICTIONS

(Normative)

N1 INTRODUCTION

This Appendix contains information on State and Territory-specific requirements set out by the *Technical Regulators*, requirements related to some aspects of this Standard. This is not an exhaustive list. The requirements may be subject to change.

N2 TECHNICAL REGULATORS

The *Technical Regulators* referred to in this Appendix are as follows:

(a) Office of the *Technical Regulator*, South Australia.

(b) Energy Safe Victoria.

(c) Energy Safety Division of the Department of Commerce, Western Australia.

N3 DETAILS OF SPECIAL LOCAL REQUIREMENTS

N3.1 Quick-connect devices

N3.1.1 *Energy Safety Division of the Department of Commerce, Western Australia*

The following additional requirement applies:

Where a *quick-connect device* socket is installed *indoors*, for the future connection of a flueless space heater, the room is required to have two permanent ventilation openings direct to outside. The openings are required to be provided at high and low levels, with a minimum vertical separation of 1.5 m. Each opening is required to have an aggregated minimum *free area* of 25 000 mm^2.

N3.1.2 *Energy Safe Victoria*

A person is not to install or locate for use a connection device (quick connect, bayonet connection) in any of the following locations:

(a) A hospital.

(b) A community health centre, day procedure centre, residential care service or supported residential service within the meaning of the Health Services Act 1988.

(c) A school, TAFE institute or university within the meaning of the Education and Training Reform Act 2006 (excluding a workshop or assembly hall).

(d) A children’s service within the meaning of the Children’s Services Act 1996.

N3.2 Restriction on installation of a flueless space heater

N3.2.1 *Office of the Technical Regulator, South Australia*

The following additional requirements apply:

In residential *premises*, the maximum *gas consumption* is required to not normally exceed
A2 18 MJ/h and the *appliance* is required to be *certified* to the requirements of AS 4553 or AS/NZS 5263.1.3.

An *appliance* exceeding 18 MJ/h is required to not be installed without additional adequate safety features, or characteristics, that are capable of being demonstrated by the *appliance* manufacturer or supplier.

Two permanent ventilation openings is required to be provided directly to outside, one at a high level and one at a low level, each having a minimum *free area* of 1 000 mm^2 per MJ/h.

Where a quick connect device socket is installed for the future connection of a flueless heater and the capacity is unknown, the room is required to have two ventilation openings installed, one at high level and one at low level. Each opening is required to have a minimum *free area* of 25 000 mm^2.

N3.2.2 *Energy Safety Division of the Department of Commerce, Western Australia*

The following additional restrictions apply:

Where a flueless space heater is installed *indoors*, the room is required to have two permanent ventilation openings direct to outside. The openings are required to be provided at high and low levels, with a minimum vertical separation of 1.5 m. Each opening is required to have an aggregated minimum *free area* of 25 000 mm^2.

N3.3 Restriction on installation of an instantaneous hot water unit within a roof space—Office of the Technical Regulator, South Australia

The following additional restriction applies:

An instantaneous *water heater* is required not to be installed in a roof space unless approved by the *Technical Regulator*.

N3.4 Replacement of flueless space heaters—Energy Safe Victoria

A person cannot install any flueless space heater as a new installation in residential *premises* (including a *caravan* or boat).

A person is required not to install or locate for use a connection device (quick connect, bayonet connection) for a flueless space heater in residential *premises* including a *caravan* or boat.

However a person is permitted to replace an existing flueless space heater with a new flueless space heater if the new flueless heater meets the following requirements:

(a) The heater being replaced operated on *LP Gas*; and

(b) The new heater operates on *LP Gas*; and

(c) The emission of oxides of nitrogen from the new heater does not exceed 2.5 ng/J; and

(d) The carbon monoxide/carbon dioxide ratio of the new heater does not exceed 0.002.

A2

N3.5 Piping in the ground beneath a building—Office of the Technical Regulator, South Australia

The following additional requirement applies:

Consumer piping installed in the ground beneath a building shall not operate at pressures above 7 kPa unless acceptable to the Technical Regulator.

APPENDIX O

GUIDELINES FOR GAS APPLIANCE COMMISSIONING

(Informative)

O1 GENERAL

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

(a) Operate all *appliances* in the installation while performing the *pressure* check.

(b) Remove or loosen screw in *burner* test point, connect a manometer and light the *gas appliance*. (Electronic *gas appliance*s require a digital manometer, as water gauge manometers are not accurate or sensitive enough).

(c) 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).

(d) Check *burner gas pressure*, against rating plate. (Remember that some *gas appliance*s have both a cold and hot *pressure*).

(e) Adjust *burner gas pressure* to specifications. (Remember some *gas appliance*s have both a low and high-*pressure* setting.)

(f) Lock off the *gas appliance* regulator.

(g) Remove the manometer and replace the test screw, test for leaks.

(h) Turn *gas appliance* off and on, and up and down (if modulating type) several times, to ensure correct operation and smooth ignition.

(i) Observe operation of safety and operating devices (such as fan proving, ODS and tilt switch if mobile or portable type).

(j) Test that spillage of *combustion products* is not occurring.

(k) Check for the *flow* of *condensate* from the drain of a *condensing appliance*.

(l) Replace panels or covers.

(m) Instruct householder in correct operation and regular maintenance requirements.

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

O2 STOVES, COOKERS AND HOT PLATES

In addition to the procedures in Paragraph O1, for stoves, cookers and hot plates—

(a) check ventilation to the *gas appliance* (especially if inbuilt);

(b) check distances from the *burners* to *combustible surface*s comply with Figure 6.3;

(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.

O3 INSTANTANEOUS WATER HEATERS

In addition to the procedures in Paragraph O1, for instantaneous *water heaters* without electronic controls—

(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.

O4 STORAGE WATER HEATERS

In addition to the procedures in Paragraph O1, for storage *water heaters* —

(a) check operation of the water valves;

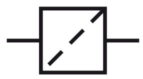
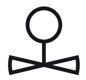
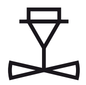
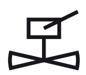
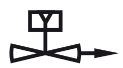
(b) with the *burner* turned off, check that the temperature-*pressure* relief valve or *pressure* relief valve is not dripping, or the open vent is not overflowing; and

(c) check operation of the thermostat.

APPENDIX P

SYMBOLS USED IN GAS CONTROL SYSTEM DIAGRAMS

(Informative)

1		Manual *gas* valve	
2		Filter	
3		*Pressure* point	
4		*Pressure* regulator	
5		*Pressure* regulator with *over-pressure protection*	
6		*Over-pressure protection* slam shut valve	
7		Slow-opening fast-closing value	
8		Slow-opening fast-closing two stage valve	
9		Fast-opening fast-closing valve	Automatic *safety shut-off valves* (items 7 to 11)
10		Fast-opening fast-closing two stage valve	
11		Manual reset valve	
12		*Vent valve*	
13		Closed position indicator (CPI) switch on valve	
14		Proof of closure switch on valve (e.g., mechanical over-travel)	
15		Low *gas pressure* detector	
16		High *gas pressure* detector	
17		Flow rate control valve	
18		Flow limiting valve	

19		*Burner*
20		3-way valve
21		*Non-return valve*

APPENDIX Q

GAS INSTALLATION CHECKLIST

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

(*continued*)

GAS INSTALLATION CHECKLIST (*continued*)

Item	C	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 surface*s			
Temperature safety			

(*continued*)

GAS INSTALLATION CHECKLIST (*continued*)

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

(*continued*)

GAS INSTALLATION CHECKLIST (*continued*)

Item	C	NA	Notes
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			

C = Compliant

NA = Not Applicable

Name	Signature	Reg. No.

APPENDIX R

SPILLAGE TESTS FOR FLUED APPLIANCES

(Normative)

A2

R1 GENERAL

The tests in this Appendix are performed as part of Appliance Commissioning as per Clause 6.11.4.

This Appendix contains—

(a) a procedure for checking whether mechanical extraction ventilation draws air through flue systems or chimneys or not. If yes, this will most likely result in combustion product spillage from appliances during their operation and will require the provision of additional fixed relief ventilation to that which may be required in Clauses 6.4.4 or 6.4.5;

(b) a procedure for checking whether the operation of appliances and flue systems or chimneys is satisfactory; and

(c) a method for determining the additional fixed ventilation area required to counteract the effect of mechanical extract ventilation.

Before these procedures are applied a visual inspection shall be undertaken to confirm that the appliance and flue or chimney are clean and unobstructed and installed correctly.

NOTES:

1 In this Appendix, mechanical extract ventilation means ventilation provided for a purpose other than providing ventilation for the operation of gas appliances.

2 Mechanical extract ventilation such as extraction fans (for example, kitchen range hoods and exhaust fans in toilets and bathrooms) can cause products of combustion to be drawn back down the flue and into the building due to the negative pressure (suction) they generate. This applies particularly to modern buildings which are more airtight than older buildings and allow less adventitious ventilation.

3 This Appendix does not apply to room sealed appliances.

4 The effect of mechanical extract ventilation can be detected with a suitable smoke producing device (for example, a smoke match or incense stick) and the effect of combustion product spillage can be checked with suitable combustion product detection equipment.

During testing consider the welfare of the persons conducting the testing and the occupants of the building.

R2 TESTING THE EFFECT OF MECHANICAL EXTRACTION VENTILATION AND DETERMINATION OF ADDITIONAL VENTILATION AREA WITH APPLIANCES NOT OPERATING

R2.1 Test conditions

The following test conditions apply:

(a) The effect of mechanical extract ventilation is tested on all flued appliances in a space.

(b) Spaces are tested one at a time.

(c) All flued appliances in the space being tested are not in operation.

(d) The suction effect on the flue system(s) or chimney(s) of flued appliances in the space being tested due to operation of extraction fans is the greatest.

A2

NOTE: In most circumstances the suction effect is greatest when—

1 all external windows and doors of the dwelling are closed;

2 all extraction fans are turned on;

3 all internal doors that allow a flow path of air between the space being tested and the extraction fans are opened; and

4 all internal doors that allow a flow path of air between the spaces not being tested and the extraction fans are closed.

(e) Ensure permanent ventilation is provided in each space where required in accordance with Clauses 6.4.4 or 6.4.5.

R2.2 Test procedure

Ensure Test conditions are in accordance with Paragraph R2.1. The steps in this procedure are also documented in flow chart form for additional clarity. Refer to Figure R1.

Step 1: Close external windows and doors. Open or close internal doors to achieve the greatest suction effect on the flue system(s) or chimney(s) of the appliances in the space being tested.

Step 2: Activate all extraction fans to achieve the greatest suction effect.

Step 3: Position a suitable smoke producing device (for example, a smoke match or incense stick) at the appliance draught diverter, or adjacent to appliance openings for the intake of combustion air.

NOTE: If in doubt refer to the manufacturer's installation instructions or contact the manufacturer.

Step 4: Generate smoke and observe whether smoke is being drawn away from the appliance towards the source(s) of the suction.

Step 5: Repeat Steps 3 and 4 for each appliance in the space being tested. If there is no smoke being drawn away from any of the appliances the testing in this section is completed and proceed to Paragraph R3. Otherwise proceed to Step 6.

Step 6: If smoke is being drawn away from any of the appliances in Step 5, the mechanical extract ventilation is causing suction of air through the appliance(s) from the flue system or chimney which will result in combustion product spillage during appliance operation. To provide an alternative path for this air flow, open a window in the space where the appliances are located until the smoke is no longer drawn away from any of the appliances in that space. Mark the position of the opened window. Keep the window opened in this position. Proceed to Paragraph R3.

NOTE: If the space where the appliances are located does not have an external window, open a window in the space closest to the space being tested.

R3 TESTING APPLIANCE AND FLUE OPERATION

R3.1 Test conditions

Ensure testing according to Paragraph R2 is carried out before commencing the testing in this Paragraph (R3).

The following test conditions apply:

(a) All appliances in a space are operated one at a time.

(b) Spaces are tested one at a time.

(c) Any windows opened in Paragraph R2 remain open.

(d) The suction effect on the space being tested due to operation of extraction fans is the greatest.

A2 NOTE: In most circumstances the suction effect on the space being tested is greatest when—

5 all external windows of the dwelling are closed, except for any windows opened in Paragraph R2.

6 all external doors of the dwelling are closed;

7 all extraction fans are turned on;

8 all internal doors that allow a flow path of air between the space being tested and the extraction fans are opened; and

9 all internal doors that allow a flow path of air between the spaces not being tested and the extraction fans are closed.

NOTE: The above test conditions should result in extraction fan operation causing suction of air through the opened window in the space and having no effect on appliance operation. The test results should therefore reflect the operating condition of the appliances and their flue systems or chimneys.

R3.2 Test procedure

The steps in this procedure are also documented in flow chart form for additional clarity. Refer to Figure R2.

Step 1: Close all external windows, except for any windows opened in Paragraph R2. Close all external doors. Open or close internal doors to achieve the greatest suction effect on the space being tested.

Step 2: Activate all extraction fans to achieve the greatest suction effect.

Step 3: Operate each appliance, one at a time, at the highest setting for 10 min from cold for Type 1 decorative gas flame effect fires installed in a chimney and for 5 min from cold for all other appliances. During this period ensure that the appliance is operating at its nominal burner pressure.

NOTES:

1 The operation times are taken from the combustion tests in Australian gas appliance standards.

2 A Type 1 decorative gas flame effect fire consists of an assembly or kit that comprises a burner, simulated fuel effect logs or coals, grate and decorative surround and that is designed to be installed in a fireplace of indeterminate specifications and in which the chimney is intended to convey flue products to outside air.

3 Where a space heater is installed in a chimney without a *chimney liner* and spillage still occurs in testing after 5 min of operation, the appliance may be operated a further 5 min to see if the chimney draw establishes and spillage ceases.

Step 4: After the required time, check for combustion product spillage from each appliance.

NOTE: Spillage can usually be detected from the appliance draught diverter and warm air outlet. If in doubt refer to the manufacturer's installation instructions or contact the manufacturer.

If no spillage was observed from any of the appliances, the appliances and flue systems are operating satisfactorily and ventilation provisions are adequate. If no window was opened in Paragraph R2 all work relating to this Appendix is now completed. If a window was opened in Paragraph R2 then proceed to Paragraph R4.

A2

Step 5: If spillage was observed from one or more appliances in Step 4, establish the cause as follows:

(a) Switch off the affected appliance(s).

(b) Switch off all extraction fans.

(c) Restart the affected appliance:

(i) If spillage ceases the window in Paragraph R2.2 was not opened far enough. Switch on extraction fans and then open the window further until spillage from the affected appliance(s) ceases. Mark the new position of the opened window. Keep the window opened in this position. Proceed to Paragraph R4.

(ii) If spillage does not cease, check for faults with the affected appliance(s) and flue system(s). If faults are found, rectify and repeat Steps 1 to 4. If spillage is still observed isolate the affected appliance(s) and contact the appliance manufacturer.

R4 LOCATION AND INSTALLATION FOR ADDITIONAL AND PERMANENT VENTILATION OPENINGS

The following location and installation conditions apply:

(a) The free area required for any additional and permanent ventilation openings to prevent spillage from appliances during the operation of extraction fans is to be calculated from the degree of window opening in Paragraphs R2 and R3.

(b) Ventilation openings shall be located in the space(s) where the appliance(s) are installed.

(c) Ventilation openings shall be located so that building occupants are not subjected to discomfort from cold draughts or noise.

NOTE: Discomfort from cold draughts may be avoided by supplying air directly to appliances, for instance—

10 locating ventilation openings close to appliances (e.g. in the floor);

11 drawing air from intermediate spaces such as hallways; or

12 ensuring good mixing of incoming cold air by placing external ventilation openings close to ceilings.

(d) The minimum dimension of any free ventilation opening shall be 6 mm to minimize linting.

(e) Repeat test procedure R2.2 to confirm whether or not the additional fixed ventilation installed avoids suction of air through any flue systems or chimneys.

A2

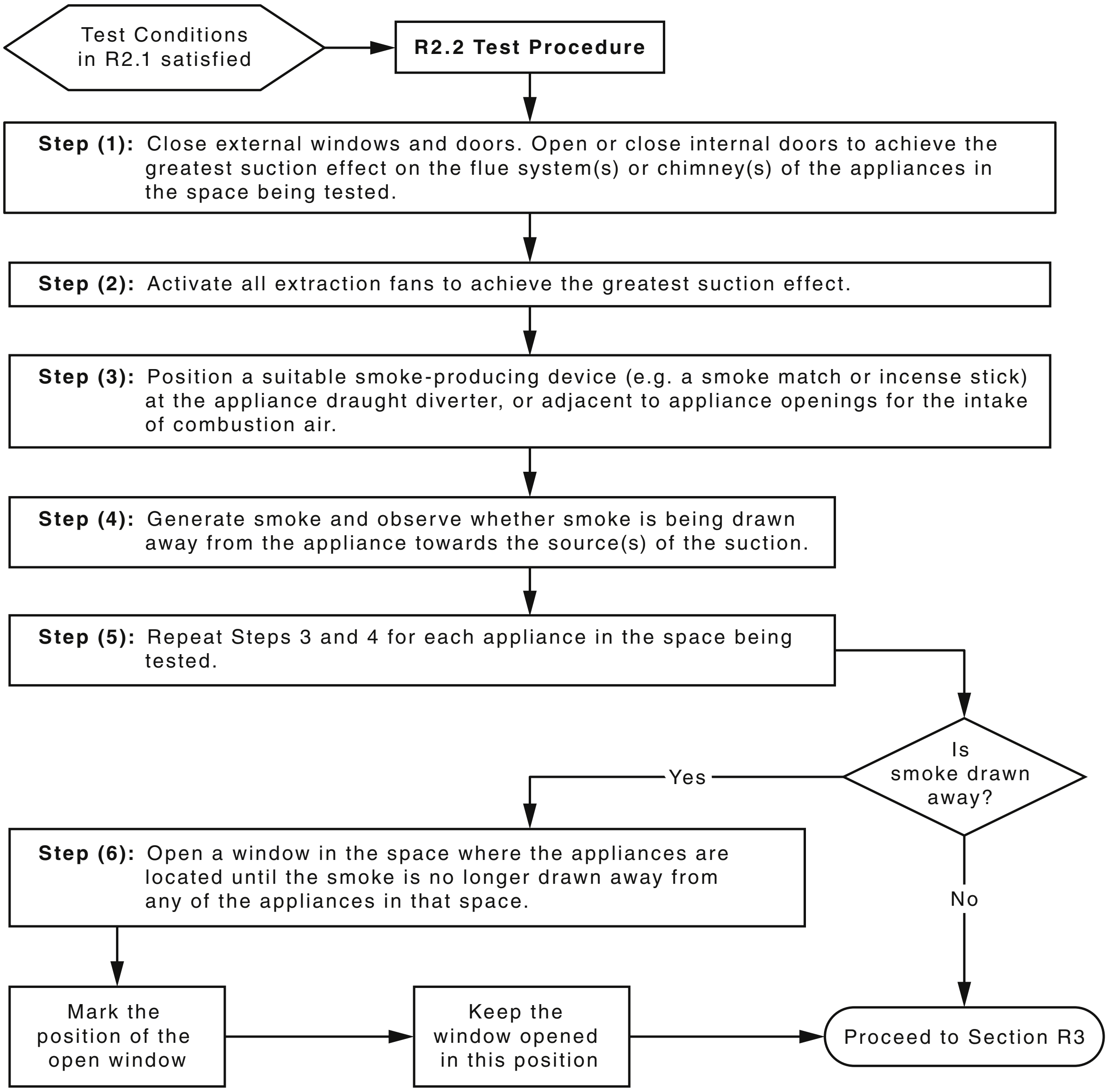


FIGURE R1 TESTING THE EFFECT OF MECHANICAL EXTRACTION VENTILATION AND DETERMINATION OF ADDITIONAL VENTILATION AREA WITH APPLIANCES NOT OPERATING

A2

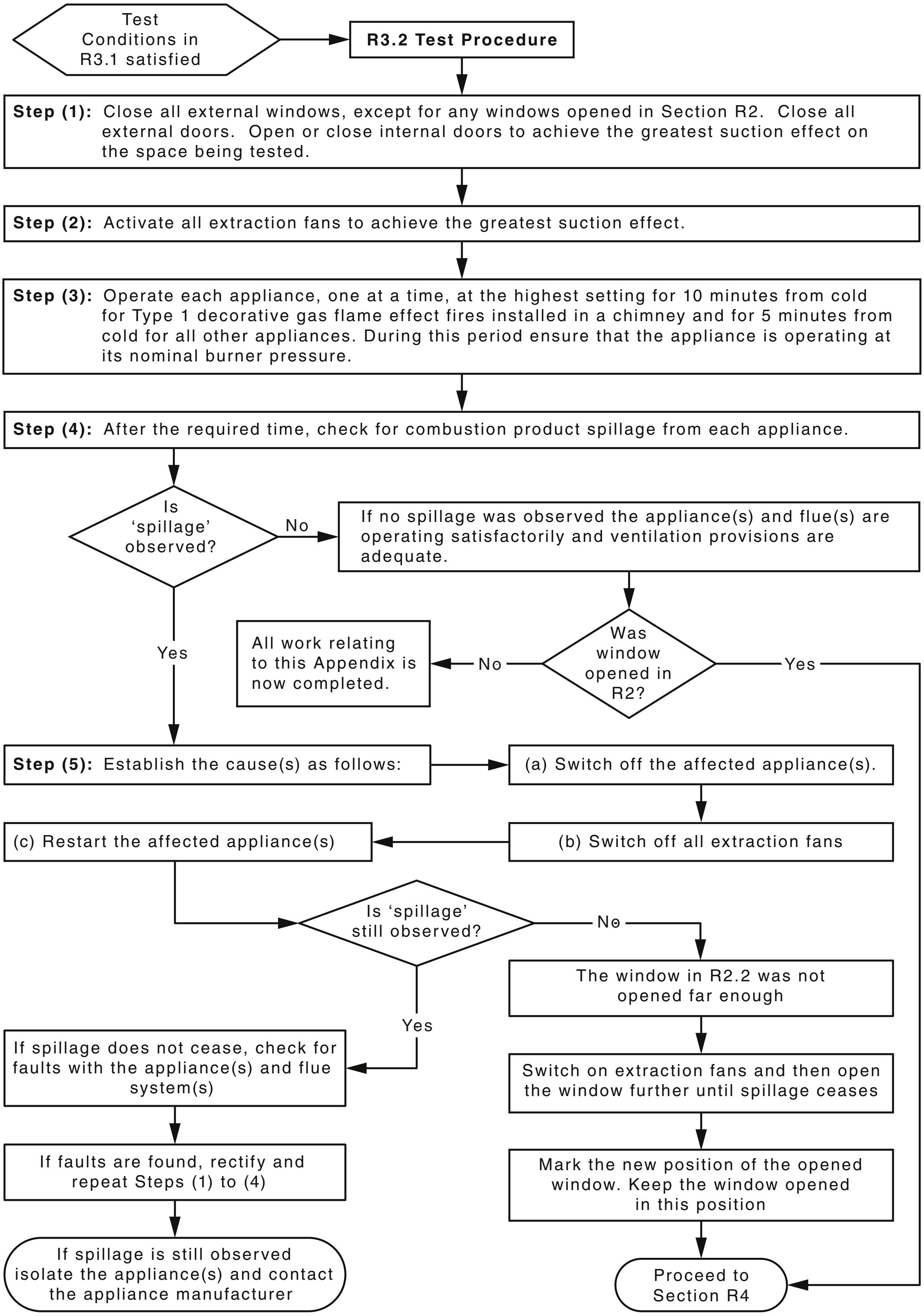


FIGURE R2 TESTING APPLIANCE AND FLUE OPERATION

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1668 The use of ventilation and airconditioning in buildings
1668.2 Part 2: Mechanical ventilation in buildings

2030 Gas cylinders
2030.1 Part 1: General requirements

2067 Substations and high voltage installations exceeding 1 kV a.c.

3959 Construction of buildings in bushfire-prone areas

4621 Regulators for use with liquefied petroleum—Vapour phase

AS/NZS
1668 The use of ventilation and air conditioning in buildings
1668.1 Part 1: Fire and smoke control in multi-compartment buildings

5601 Gas installations
5601.2 Part 2: LP Gas installations in caravans and boats for non-propulsive purposes

3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)

NZS
3604 Timber Framed Buildings

Other
BCA Building Code of Australia

A2 Gas (Safety and Measurement) Regulations 2010

Hazardous Substances (Dangerous Goods and Scheduled Toxic Substances) Transfer Notice

IFGC—International Fuel Gas Code

New Zealand Building Code

UL 144 LP Gas regulators

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Appliance installation (cont'd)

Appliance location

Bathroom

Venting (cont'd)

AMENDMENT CONTROL SHEET

AS/NZS 5601.1:2013

Amendment No. 1 (2015)

REVISED TEXT

SUMMARY: This Amendment applies to the Clauses 2.4.11 and 5.11.5.9 and Figure 5.3 and Table 4.1

Published on 27 August 2015.

Amendment No. 2 (2016)

REVISED TEXT

SUMMARY: This Amendment applies to Clauses 1.3, 1.8.11A (new), 1.8.40.3A (new), 1.8.103A (new), 2.6.8, 5.2.8, 5.2.10, 5.2.13, 5.3.11, 5.4.6, 5.9.1, 6.2.3, 6.4.4.1.1 6.4.4.1.2, 6.4.4.4, 6.6.5 (new), 6.7.3, 6.7.9, 6.8.6, 6.9.1, 6.9.2, 6.9.4, 6.9.5, 6.10.1.2, 6.10.1.7, 6.10.1.14 (new), 6.10.1.15 (new), 6.10.2.2, 6.10.2.5 (new), 6.10.6.1, 6.10.19 (new) and 6.11, Tables 4.1, 6.1, 6.2, 6.4, 6.9, 6.10, F5.1, F13A (new), and J4, Figures 6.2 (in part), 6.2(a) (new) and J2 and Appendices C, F, I, J, N (new) and R.

Published on 11 May 2016.

NOTES

NOTES

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